The Role of Trait Emotional Intelligence in Adaptation and Achievement during the Transition to University

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Certificate of Original Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Co-Authorship and Research Output

The manuscripts presented below, which have been derived from the doctoral thesis, are the work of Harsha N. Perera in collaboration with his graduate supervisors and colleagues at USQ. In all cases, Perera was responsible for identifying the research issues, developing the research questions and concomitant hypotheses, study design, analysis of data, interpretation of results, and the drafting of manuscripts. The extent of co-authorship in all cases was the provision of valuable editorial feedback, advice on research strategies and data collection assistance. The research output from this doctoral research follows:

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Abstract

This dissertation reports on research into the role of trait emotional intelligence (TEI) in adaptation and achievement during a stressful educational transition. Hitherto, higher TEI has been linked to better adaptation and achievement across several educational contexts, including stressful educational events. However, the pathways by which TEI is associated with adaptation and achievement have received limited systematic investigation. As such, understanding of the mechanisms underlying the associations of TEI with adaptation and achievement is limited.

The present research addresses these gaps in the psychoeducational literature. Specifically, conceptual models are proposed linking TEI, social support, engagement coping, adaptation, and achievement during the typically stressful transition to university. The model specifications draw on multiple accounts of emotion, regulation and adjustment, including TEI theory, social-functional and broaden-and-build accounts of emotion, stress-buffering models of social support, expectancy-value and psychobiological models of motivation and emotion, and a novel formulation of university adjustment. Although these theoretical accounts variously emphasize different variables as focal constructs, when taken together, they provide a comprehensive picture of the possible mechanisms linking TEI with adaptation and achievement. In this regard, the research also redresses the problem of vaguely specified theoretical links currently hampering progress in the field.

In light of the findings of inconsistent TEI-achievement relations in the existing literature, the first study of the present research reports on a preliminary meta-analysis conducted to assess the validity of TEI for predicting achievement. Seventy-four effect sizes were drawn from 48 independent samples with a cumulative sample size of 10,292. A meta-analysis with random-effects weights yielded a modest-to-moderate, favorable validity coefficient for TEI (r = .20, 95% CI = .16–.24). The finding of a non-trivial validity coefficient not only extends prior research by clarifying the TEI-achievement relation but also serves to reinforce the present model specifications directly and indirectly linking TEI with educational achievement.

In the second study, the proposed conceptual models were tested in a sequential design with a sample of incoming undergraduate students (N = 458). In structural equation analyses, TEI was found to be a direct, prospective predictor of higher perceived support, the greater

use of engagement coping strategies and better mid-semester psychosocial adjustment. Furthermore, mediation analysis revealed that TEI was indirectly associated with academic and psychosocial adaptation via engagement coping and social support, respectively. TEI was also found to be indirectly associated with first-semester achievement via engagement coping and academic adaptation linked serially in a three-path mediated sequence. Notably, these direct and indirect relations were robust when controlling for the known confounding influences of neuroticism and extraversion. The empirically supported mediating processes extend the meta-analytic review and previous literature by elucidating the pathways through which TEI promotes better adaptation and achievement during a stressful educational event.

Taken together, the studies constituting the present research have provided new perspectives and a great deal of data on the role of TEI in adaptation and achievement during the university transition. The data hold implications for current understanding and extant theory bearing on TEI by not only obtaining evidence for a TEI-achievement total effect but also illuminating the mechanisms linking TEI, adaptation and achievement in an integrative framework. The data obtained also have implications for university practitioners, administrators and counselors who operate in student selection and screening contexts by identifying portals for systematic intervention on the basis of deleterious affective personality processes. On a more general level, the data hold methodological implications for researchers investigating mediation hypotheses and conducting research in a broad mean and covariance structure framework. In addition to discussing these implications for theory, practice and methodology, limitations of the studies and directions for future research are considered.

Chapter One
Introduction

For some students, adjusting to the novelty of the university environment as part of the university transition can be overwhelming. The failure to adjust to university has been implicated in both academic failure and attrition (Credé & Niehorster, 2012). During this emotionally turbulent time, managing academic and social stressors, such as increased academic demands (Arthur & Hiebert, 1996) and forming new friendships (Shaver, Furman, & Buhrmester, 1985), are crucial to optimal adaptation and achievement (Gerdes & Mallinckrodt, 1994; Perera & McIlveen, 2014). Given the emotional intensity of this typically stressful life event (Feldman & Newcomb, 1994), one set of factors that may be particularly important in navigating these academic and social challenges is emotional dispositions, with which the present research is centrally concerned.

The role of emotions in adaptation and achievement has been widely studied in the psychological literature. The research has consistently demonstrated that emotions play an important part in individuals' social relationships (Shiota, Campos, & Keltner, 2004), health (S. Cohen & Pressman, 2006; Salovey, Rothman, Detweiler, & Steward, 2000) and performance attainment (Pekrun, Elliot, & Maier, 2009; Valiente, Swanson, & Eisenberg, 2012). Integral to this body of work is the now well-established perspective that emotions serve adaptive social and motivational functions (Izard, 1993; Keltner & Gross, 1999; Keltner & Haidt, 1999, 2001; Shiota et al., 2004). From this functional standpoint, emotions prioritize and regulate ongoing behavior in ways that enhance the individual's adaptation to the demands of the environment (Keltner & Gross, 1999). If this functional position is indeed correct, it follows that those affective dispositions, which reflect tendencies toward the perception, expression, and management of emotions as well as related regulatory dispositions (e.g., self-control), may confer important adaptational advantages to individuals in the navigation of academic and social environments.

The notion that individuals vary in their levels of these affective dispositions is the central postulate underlying the construct of TEI (Perera & DiGiacomo, 2013; Petrides, 2011). TEI refers to a collection of relatively enduring affective personality traits reflecting typical patterns of feelings, thoughts and behaviors related to the perception, regulation, management and expression of emotion-related information as well as positive emotionality, self-control, self-motivation, and optimistic dispositions (Freudenthaler, Neubauer, Gabler, Scherl, &

Rindermann, 2008; Mikolajczak, Luminet, Leroy, & Roy, 2007; Perera & DiGiacomo, 2013). Over the last fifteen years since the construct was first elaborated in the psychological literature, TEI has been empirically linked to academic achievement (see Perera & DiGiacomo, 2013 for a review) as well as several indices of adaptation, including psychological wellbeing (Martins, Ramalho, & Morin, 2010), relationship satisfaction (Malouff, Schutte, & Thorsteinsson, 2014), prosocial behavior (Mavroveli, Petrides, Sangareau, & Furnham, 2009), social competence (Frederickson, Petrides, & Simmonds, 2012), low loneliness (K. J. Gardner & Qualter, 2010), and life satisfaction (Petrides, Pérez-González, & Furnham, 2007). TEI has also been shown to predict adaptation and achievement in response to several assessed and unassessed stressful events, including academic examinations (Mikolajczak, Luminet, & Menil, 2006), the university transition (Parker, Summerfeldt, Hogan, & Majeski, 2004), emotional labor (Mikolajczak, Menil, & Luminet, 2007), cancer diagnoses and referrals (Smith, Petrides, Green, & Sevdalis, 2012;), and laboratory-induced stressors (Mikolajczak, Petrides, Coumans, & Luminet, 2009; Mikolajczak, Roy, Luminet, Fillee, & de Timary, 2007).

1.1 Unresolved Issues in the TEI Literature

Notwithstanding the accumulating evidence for associations of TEI with these adaptational and achievement outcomes, the processes or mechanisms through which TEI is associated with adaptation and achievement are largely unknown (Kong, Zhao, & You, 2012a; Perera & DiGiacomo, 2013; Zeidner, Matthews, & Roberts, 2012). Hitherto, the vast majority of TEI studies have investigated total effects of TEI on adaptation and achievement outcomes, with little systematic empirical attention directed towards the decomposition of these effects (for exceptions, see Kong & Zhao, 2013; Kong et al., 2012a, 2012b; Koydemir, Şimşek, Schütz, & Tipandjan, 2013). Although the empirical demonstration of theoretically-plausible total effects is important to the initial development of the nomological net of TEI like any novel construct (Petrides, 2011), establishing total effects does little to illuminate the pathways through which TEI is related to adaptational and achievement outcomes (Zeidner et al., 2012). As such, relative to the knowledge of empirical total effects of TEI on adaptation and achievement, far less is known about the mechanisms underlying these relationships.

The lack of progress in understanding the processes through which TEI is linked with adaptation and achievement can be attributed to at least two unique limitations in the TEI field. First, the absence of specific explanatory accounts of these relationships complicates

theorizations about the mechanisms that may intervene in these links. Existing theoretical accounts of TEI, such as TEI theory (Petrides, 2011; Petrides & Furnham, 2001) and the Bar-On (1997, 2000, 2006) emotional-social intelligence (ESI) formulation, do not offer transparent explanations for associations of TEI with adaptation and achievement (Perera & DiGiacomo, 2013). Instead, these theories only function as descriptive frameworks for the economical ordering of the affective facets of personality believed to constitute the construct. In this regard, though predictive links exist (see Petrides, 2011 for a review), there is little in the way of explanatory accounts of these relationships that appeal to causal mechanisms. Second, findings of inconsistent TEI-achievement relationships, which have been interpreted in the TEI literature as evidence for the absence of any total effect (Mavroveli & Sánchez-Ruiz, 2011), may have resulted in the premature termination of programs of research designed to illuminate the pathways linking TEI and achievement. Aside from the erroneous view that inconsistency in results is indicative of null effects (Perera & DiGiacomo, 2013), the presence of null effects in the population does not preclude the emergence of significant direct and mediated pathways (Rucker, Preacher, Tormala, & Petty, 2011). In response to this lack of progress in understanding the pathways from TEI to adaptation and achievement, there have been increasing calls to attend to the specific direct and indirect mechanisms linking TEI with these constructs (Kong et al., 2012a, 2012b; Perera & DiGiacomo, 2013; Zeidner et al., 2012).

1.2 Overview of the Present Research

The aim of the present research is to address these identified gaps in the TEI literature by examining the underlying processes through which TEI is associated with adaptation and achievement. Specifically, the present research specifies and tests target and alternative conceptual models linking TEI, social support, engagement coping, adaptation and achievement in the context of a stressful educational event, namely the university transition. Figure 1.1 shows the basic structure of the proposed models to be investigated. The target model is one in which higher TEI is proposed to prospectively predict achievement both directly and indirectly via (a) perceived social support and engagement coping and (b) academic and psychosocial adaptation linked serially in a temporal chain of events unfolding across the transition. The alternative models represent conceptual variants of this target specification reflecting full mediation of the TEI-adaptation-and-achievement relationships. The processes implied by these conceptual models are roughly akin to, and informed by,

those outlined in models of personality and affect proposed by G. Matthews, Zeidner and Roberts (2006) and Zeidner et al. (2012) among others (see e.g., Aspinwall & Taylor, 1992; Brissette, Scheier, & Carver, 2002; Kong et al., 2012a, 2012b). According to these models, individuals' dispositions influence their social network development and the coping strategies they use to manage the academic and social demands of their environments. These social networks and coping strategies, in turn, influence their adaptation to the environment and perhaps ultimately their achievement.

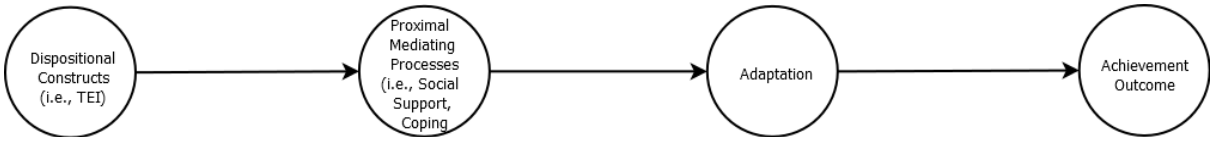

Figure 1.1. Basic structure of the models to be examined.

In the absence of an integrative explanatory account of the ways in which TEI should be related to the constructs included in the conceptual models, the present research draws on a number of theoretical accounts of emotion, regulation and adaptation to inform the conceptual model specifications. These include the well-established social-functional (Keltner & Haidt, 1999, 2001; Shiota et al., 2004) and broaden-and-build (Fredrickson, 1998, 2001) accounts of emotions, the stress-buffering account of social support (S. Cohen & Willis, 1985), psychobiological (Derryberry & Reed, 2008; Derryberry, Reed, & Pilkenton-Taylor, 2003) and complementary expectancy-value (Carver & Scheier, 1998) models of regulation, cognitive discrepancy and social needs models of social functioning (Marangoni & Ickes, 1989; Perlman & Peplau, 1982), and a novel formulation of university adaptation (Astin, 1999; Lent, 2004; Tinto, 1993). Although some of these theories have seldom been linked with TEI, and differentially emphasize various constructs in their accounts of human functioning, aligning the TEI construct with these richer accounts of emotion, regulation and adaptation allows for the development of a comprehensive picture of the ways in which TEI in implicated in adjusting to stressful life events and achievement. Indeed, the present target and alternative model specifications are developed in response to calls for greater theoretical integration concerning the ways in which distal dispositional constructs and situational mediating processes operate together to influence adaptation to stressful life events (Brissette et al., 2002; G. Matthews, Zeidner et al., 2006; Zeidner et al., 2012). These models are tested in a multiwave design with a sample of incoming Australian undergraduates.

Whilst the emphasis of the present research is on the specification and testing of the conceptual models linking TEI, adaptation and achievement, an important first step in this process is determining the validity of TEI for predicting achievement. In light of the inconsistent results in the empirical literature (Mavroveli & Sánchez-Ruiz, 2011), a preliminary meta-analysis is conducted to clarify the TEI-achievement link. Although the absence of a total effect does not entirely preclude the possibility of significant direct and indirect pathways (Rucker et al., 2011), without evidence of suppressor effects, the lack of a zero-order association is typically indicative of the absence of a causal relationship and may be taken, prima facie, as evidence for the implausibility of the present model specifications linking TEI and achievement (Lyubomirsky, King, & Diener, 2005). Furthermore, central to this meta-analytic review is the investigation of the moderating role of the university transition, the focal context of the present research, on any summary effect. Thus, findings obtained from this meta-analytic review are germane to the present research to the extent that they may clarify the TEI-achievement relationship and thereby reinforce the present model specifications.

In addition to these central research issues, the present research addresses several supplementary issues bearing on (a) the TEI-achievement relation and (b) the conceptualization of university adjustment that have not been given sufficient attention in prior research. These include the moderating effects of gender, age, academic level, and TEI operationalization instrument on the summary effect of TEI on achievement in the meta-analysis. Moreover, the present research posits a reformulation of university adaptation in line with existing accounts of institutional integration (Tinto, 1993), involvement (Astin, 1999) and well-being (Lent, 2004), and tests this novel formulation using confirmatory factor analytic (CFA) methods.

1.2.1 An Ecologically Meaningful Context

Does TEI have effects on adaptation and achievement in a substantively meaningful life context? In the present research, the context of investigation is the transition into university. Adjusting to the transition has long been recognized as an emotionally intense and stressful life event (Gerdes & Mallinckrodt, 1994). During this period of emotional turbulence, incoming undergraduates must confront a number of novel academic and social challenges (Petruzzello & Motl, 2006). Typical sources of stress include greater academic demands (Arthur & Hiebert, 1996), a lower level of academic structure (Credé & Niehorster, 2012),

increased time pressure (Park & Adler, 2003), developing and maintaining new relationships (Shaver et al., 1985), and novel social opportunities (Petruzzello & Motl, 2006; Ross, Niebling, & Heckert, 1999). The failure to manage these stressors and adjust to university has been shown to predict lower achievement outcomes and withdrawal (Credé & Niehorster, 2012; Gerdes & Mallinckrodt, 1994). The initial transitional period upon entry to university, encompassing the first semester, is widely regarded as the most emotionally taxing of the university tenure (Brooks & DuBois, 1995; Compas, Wagner, Slavin, & Vannatta, 1986; Gall, Evans, & Bellerose, 2000). It is this initial transitional period that is the focal context of the present research, when emotional dispositions are expected to have particularly pronounced and important consequences for adaptation and achievement (Petrides, 2011; Petrides, Frederickson, & Furnham, 2004).

Hitherto, little research has been conducted on the role of TEI in adaptation and achievement during the university transition (Kerr, Johnson, Gans, & Krumrine, 2004; Parker, Austin, Hogan, Wood, & Bond, 2005; Parker, Hogan, Eastabrook, Oke, & Wood, 2006; Parker, Summerfeldt et al., 2004). This is surprising because a core postulate of TEI theory is that the effects of TEI on adaptation and achievement are expected to assume prominence under conditions of high affective arousal (Petrides, 2011; Petrides et al., 2004), such as adjusting to university. Even fewer studies have attempted to investigate the mechanisms underlying the associations of TEI with adaptation and achievement during the transition (Austin, Evans, Goldwater, & Potter, 2005). A limited process-based understanding of the role of TEI in adaptation and achievement may impede university practitioners', administrators' and counselors' implementation of structured interventions designed to mitigate or diminish deleterious processes (e.g., ineffective coping) linked to affective personality dysfunction that may hamper university adjustment and performance attainment (Perera & DiGiacomo, 2013). The detection of potential points of intervention in a temporal process of unfolding events beginning with TEI may be especially important in this context because emotional dispositions themselves, like other personality traits, may not be amenable to short-term modification.

1.2.2 Anticipated Contributions of the Present Research

The foreseen yields of the present research are manifold as follows:

- the research aligns the TEI construct with rich and well-developed accounts of emotion and regulation to provide a comprehensive picture of the ways in which TEI is linked with adaptation and achievement;
- the research is the first to draw together TEI, perceived social support, engagement coping, adaptation and achievement in unifying conceptual models;
- the research provides timely meta-analytic data on the TEI-achievement relationship, which has been a particularly thorny issue in the TEI literature;
- the research is the first to conceptually and empirically decompose the total effect of TEI on achievement into specific direct and indirect relationships;
- the research provides timely replicative data on the associations of TEI with perceived social support, engagement coping and psychosocial adjustment and extends the TEI literature by examining a novel indirect pathway from TEI to psychosocial adjustment via engagement coping;
- the research extends the existing TEI-adaptation research by investigating, for the first time, the direct and indirect roles of TEI in academic adaptation to university;
- the processes implied by the target and alternative models specifications are assessed in the context of a sequential design, following incoming undergraduates across the first semester, which yields data on these processes that have, until now, typically been generated using cross-sectional designs; and,
- the research advances an integrative, theoretically-based conceptualization of university adjustment that is not only testable but also links the generated adjustment constructs to rich conceptual accounts of institutional integration, involvement and well-being.

1.3 Dissertation Outline

Following this introductory exposition, Chapter Two provides a brief overview of the historical roots of emotional intelligence (EI) and the ability EI/ TEI distinction and outlines the two major theoretical frameworks that subsume the TEI construct. An argument is made for the definition of TEI in the present research from the perspective of TEI theory. Chapter Two also examines evidence for a fundamental tenet of TEI theory, namely that TEI is located in personality factor space. Finally, Chapter Two highlights an important limitation of TEI theory for understanding the role of TEI in adaptation and achievement and argues for drawing on existing accounts of emotion, regulation and adaptation to redress this limitation.

Chapter Three provides an integrative conceptualization of university adjustment for the present research. This formulation of adaptation is developed on the basis of the limitations of existing frameworks and concomitant definitions of adjustment in the university transition literature. The novel account integrates existing theories of institutional integration, involvement and psychological well-being to propose a comprehensive definition and content domain of adjustment, including academic, social and psychological dimensions, that guides the measurement of the adaptation constructs in the present research. This account also posits a multidimensional, hierarchical representation of adjustment that is not only used as the structure of adjustment in the present conceptual models but also subject to separate empirical scrutiny.

Chapter Four specifies the target conceptual model linking TEI, perceived social support, engagement coping, adaptation and achievement across the university transition. In addition, the fourth chapter specifies three theoretically-plausible alternative parametric structures to facilitate the comparative testing of competing conceptual processes. The target and alternative model specifications draw on multiple theoretical accounts of emotion, regulation and adaptation to generate a comprehensive picture of the ways in which TEI is associated with these proximal and distal mediators and achievement outcome. Chapter Four also outlines potential factors that could obfuscate the relationships of TEI with the social support, engagement coping and the adjustment constructs, laying the foundation for their statistical control in the tests of the conceptual models. In addition, chapter four presents a case for the conduct of a preliminary meta-analytic review of the TEI-achievement relationship on the basis of inconsistent findings in prior research. A quantitative synthesis may serve to clarify the validity of TEI for predicting achievement and, in turn, reinforce the model specifications directly and indirectly linking TEI and achievement. Finally, the chapter provides an overview of the research issues and specific predictions generated from the theoretical considerations and reviewed evidence.

Chapter Five reports the methods and results of the preliminary meta-analytic review of the relationship between TEI and academic achievement. In addition to reporting the summary relation of TEI with achievement, the chapter reports on several focal and subsidiary tests of third variable moderating influences, including university transition status, age, academic level, gender, and TEI measure, on the summary effect. The chapter then provides a brief discussion of (a) the meta-analytic findings with respect to extant theory and

(b) the limitations of the review. Chapter Five concludes with a summary of the findings and implications for the present target and alternative model specifications.

Chapter Six reports the methods and results of a preliminary Monte Carlo experiment conducted to evaluate the *N* requirements for the target model specification in the present research. In the course of reporting the experimental methods and results, the chapter outlines an integrative framework for the conduct of *N* planning based on simulation methods. Finally, Chapter Six provides a discussion of the simulation results from the perspective of the integrative framework proposed and implications for the present tests of the conceptual models, and it concludes with a summary of the Monte Carlo findings.

Chapter Seven reports the methods and results of the empirical tests of the target and alternative parametric structures linking TEI, perceived social support, engagement coping, adaptation and achievement with which the present research is centrally concerned. In this chapter, results for conditioned (i.e., including covariates) and unconditioned model analyses are reported separately to determine whether any relationships change substantially once the covariate effects are controlled. The chapter also reports the results of a post-hoc Monte Carlo experiment designed to evaluate the propriety of the final unconditioned empirical solution, biases in the parameters estimates and standard errors, and statistical power for the tests of the estimated parameters. Furthermore, Chapter Seven reports results of an empirical test of the multidimensional, hierarchical structure of university adaptation in line with the novel formulation of adjustment proposed in Chapter Three. Finally, Chapter Seven provides a discussion of (a) the results obtained from the tests of the conceptual models with respect to theory bearing on TEI and (b) the limitations of the study, which serves to qualify the findings and guide the appropriate interpretation of results.

The final chapter of the dissertation presents a general discussion of the evidence obtained from the meta-analytic, simulation and longitudinal studies in terms of implications for theory, methodology and practice. The chapter concludes with a summary of the studies' findings and a list of novel contributions to the educational and psychological literatures.

Chapter Two
TEI Conceptualized

The current chapter provides an overview of the theoretical background on TEI, including the distal and proximal roots of TEI, the distinction between ability EI and TEI and the dominant trait-based conceptual models subsuming the focal construct. The chapter then advances an argument for the definition of TEI from the perspective of TEI theory for the present research. This chapter also examines evidence for a fundamental definitional tenet of TEI theory, namely that TEI is located in personality factor space, which is a crucial precursor to proposing theoretical links from TEI to adaptation and achievement in the current model specifications. The chapter closes with a consideration of the limitations of TEI theory as an explanatory framework for understanding the ways in which TEI is related to adaptation and achievement and argues for adopting existing accounts of emotion, regulation and adaption to provide a richer account of the ways in which TEI is implicated in these substantive criteria.

2.1 Historical Roots

EI is a multidimensional meta-construct with fundamental theoretical underpinnings that can be traced to several distal and proximal sources (see Petrides, 2011; Pérez, Petrides, & Furnham, 2005 for reviews). The distal roots of EI lie in Darwin's (1872/1998) initial account of the adaptive function of emotional expressions. According to Darwin, emotional expressions evolved in the human species as a mechanism for preparing the organism to respond adaptively to environmental cues and communicate important social information. A second distal source of EI is E. L. Thorndike's (1920) concept of social intelligence, which refers to the ability to understand and manage social partners (R. L. Thorndike & Stein, 1937). More proximal roots of EI can be traced to the concept of alexithymia, which denotes affective personality dysfunction characterized by difficulties in identifying, expressing and experiencing emotions (Parker, Taylor, & Bagby, 2001), and H. Gardner's (1983) account of multiple intelligences (viz., the concepts of intrapersonal and interpersonal intelligence). From the multiple intelligences perspective (H. Gardner, 1999), intrapersonal intelligence refers to the ability to understand oneself and to use this knowledge to function adaptively in the environment whereas interpersonal intelligence refers to the ability to understand the behavior, thoughts and feelings of others.

Drawing on these theoretical accounts, the concept of EI was elaborated in the 1990s in an effort to systematize the study of emotion-related constructs under a single, unifying framework (Bar-On, 1997; Goleman, 1995; Salovey & Mayer, 1990). The first coherent theoretical model of EI and corresponding conceptual definition were advanced by Salovey and Mayer (1990). They defined EI as a set of interrelated cognitive-emotional abilities and proposed an initial three-branch hierarchical model of EI focusing on the appraisal and expression, regulation and utilization of emotions (Salovey & Mayer, 1990; see also Mayer & Salovey, 1997). This initial theoretical account, and a sprinkling of concomitant empirical studies (e.g., Mayer, Di Paolo, & Salovey, 1990) were followed by Goleman's (1995) seminal book *Emotional Intelligence*, which popularized the construct in the folk business and psychology literatures. The extraordinary influence of Goleman's book on these pseudo-scientific literatures was largely due to its claims that EI, conceptualized as a conglomerate of emotion-related abilities and dispositions, was as powerful, and oftentimes more powerful, than general intelligence in the prediction of important life outcomes (e.g., work performance; Goleman, 1995). In the scientific study of EI, Goleman's work may have done more harm than good as it spurred the development of a number of EI models, including the Bar-On (1997) model of ESI, Cooper and Sawaf's (1997) model of executive EQ and Weisinger's (1998) model of EI, with terminal conceptual and measurement frailties (Pérez et al., 2005).

One major frailty concerns the measurement of the nascent construct. Following the proliferation of EI models, efforts to operationalize the construct were made with haste. At least 20 instruments designed to appraise EI appeared in the psychological literature between 1995 and 2005, such as the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) (Mayer, Salovey, & Caruso, 2002), the Trait Meta-Mood Scale (Salovey, Mayer, Goldman, Turvey, & Palfai, 1995), the Emotional Quotient Inventory (EQ-i) (Bar-On, 1997), the Schutte Emotional Intelligence Scale (SEIS) (Schutte et al., 1998), the Swinburne University Emotional Intelligence Test (SUEIT) (Palmer & Stough, 2002), and the Wong and Law Emotional Intelligence Scales (WLEIS) (Wong & Law, 2002; see Pérez et al., 2005 for a review). For many of these measures, however, the process of instrument development failed to account for the core psychometric distinction between typical and maximum performance measurement (Petrides, 2011; Perez et al., 2005). This resulted in a great deal of conceptual confusion with the development of a number of self-report instruments purporting to measure some veridical intelligence and the interpretation of data obtained from these typical-

performance measurements in terms of abilities or competences (Petrides, 2011; Petrides & Furnham, 2001). However, self-report instruments may not yield valid assessments of abilities, intelligences or competences (Furnham & Rawles, 1999; Paulhus, Lysy, & Yik, 1998; Petrides, 2009). In an attempt to bring order to the field, Petrides and Furnham (2001) proposed a conceptual distinction between ability EI and TEI on the basis of the distinction between maximum and typical performance measurement.

2.2 The Ability EI and TEI Distinction

There are currently two major theoretical perspectives on EI emerging from Petrides and Furnham's (2001) conceptual bifurcation of EI based on divergent approaches to psychometric measurement: ability EI and TEI. The ability EI perspective conceptualizes EI as a constellation of cognitive-emotional abilities located in frameworks of human intelligence (Petrides, 2011). This ability-based approach concerns the actual cognitive processing of emotional information as measured through maximal performance tests (Mayer, Salovey & Caruso, 2008), in which participants rate the emotional content of various stimuli (e.g., faces) and solve problems involving emotional understanding and reasoning (MacCann & Roberts, 2008; Mayer et al., 2002). Notwithstanding the wide use of ability models of EI in the psychological literature, several limitations of these models have been noted. The most prominent among these is that the inherent subjectivity of emotional experience precludes the maximal-performance assessment of EI with respect to objective criteria (Brody, 2004; Petrides, 2010; Petrides, Pita, & Kokkinaki, 2007). In this regard, EI cannot be a true intelligence because it is not amenable to veridical assessment (Petrides, 2011). Furthermore, even where the issue of veridical assessment can be circumvented by the use of alternative scoring procedures (e.g., expert or consensus based scoring), when "correct" or "incorrect" answers are determined by these procedures, it is not clear whether EI scores reflect true cognitive-emotional abilities or some confounding factor, such as declarative knowledge about emotions, stereotypical judgment or conformity to social norms (Austin, 2010; Freudenthaler, Neubauer, & Haller, 2008; G. Matthews, Emo, Roberts, & Zeidner, 2006; Petrides, 2011).

This ability EI perspective should be distinguished from the TEI approach on the basis of distinct conceptual definitions and methods of assessment. The TEI perspective conceptualizes EI as a collection of affective-motivational dispositions located in existing frameworks of human personality (Petrides, 2011; Petrides & Furnham, 2001). Dissimilar to

the measurement of ability EI via maximal-performance, TEI is appraised via typical-performance measures (e.g., self or peer-report) akin to other personality constructs (Pérez et al., 2005; Petrides, 2011). Although both perspectives on EI draw on overlapping affective content (e.g., emotion perception, expression and regulation), they are conceptually distinct constructs and have distinctive nomological nets (Parker, Keefer, & Wood, 2011): ability models are fundamentally concerned with competences and skills (i.e., intelligence) whereas trait models concern characteristic patterns of thoughts, feelings and behaviors (i.e., personality; Petrides, 2011). The empirical literature supports this distinction with (a) consistently weak associations found between maximal-performance tests and self-report measures of EI (Brackett & Mayer, 2003; Brannick et al., 2009; Warwick & Nettelbeck, 2004; Zeidner, Shani-Zinovich, Matthews, & Roberts, 2005) and (b) the two formulations of EI consistently shown to be differentially related to various life outcomes (Livingstone & Day, 2005; Van Rooy & Viswesvaran, 2004).This distinction between ability EI and TEI has served to disambiguate previous work on EI and has now become commonplace in the psychological literature. The present research is centrally concerned with TEI.

2.3 TEI Models

2.3.1 Bar-On model of Emotional-Social Intelligence

Numerous theoretical models have been proposed to describe the construct of TEI. Among the most prominent in the psychological literature is the Bar-On (1997, 2000) model of ESI, which is operationalized with the EQ-i. The Bar-On ESI model posits a multidimensional, hierarchical structure of TEI in which a general affective-motivational construct, residing at the apex of the TEI hierarchy, consists of inter-related dimensions of general mood, sociability, adaptability, regulation and self-awareness at the first-order level and more specific facets at the base of the hierarchy (see Bar-On, 2006 for a review). These facets reflect a variety of characteristic patterns of thoughts, feelings and behaviors, such as impulse control, positive emotionality, assertiveness, emotional self-awareness and empathy (Bar-On, 2000). According to the Bar-On model, optimal emotional and social intelligence involves effectively understanding and expressing oneself, understanding and relating well with social partners, and successfully navigating daily challenges and pressures (Bar-On, 2006).

Notwithstanding its wide use in the psychological literature, the Bar-On (2000, 2006) model suffers from a number of limitations that call into question its continued use in TEI

research. First, the Bar-On model includes lower-level facets, such as problem-solving, reality-testing, self-actualization and independence, which do not appear to have an affective basis (Petrides, 2009; Petrides & Furnham, 2001). Second, the model omits core affective dispositions, such as emotion perception (in others) that have long been recognized as part of the TEI content domain (Petrides, 2009). The coverage of facets unrelated to affect and a truncated conceptual content domain may obscure *true* relationships of TEI with various substantive criteria. A third limitation concerns the conceptualization and operationalization of TEI from the Bar-On perspective. According to Bar-On (2000, 2006), the ESI model comprises a range of socio-emotional factors, such as emotional abilities, competencies and skills as well as affective-motivational dispositions, that are believed to influence how individuals understand and express themselves, understand and relate to others, and cope with environmental demands. In this model, these factors are proposed to be appraised using a self-report instrument, the EQ-i, or its psychometric offshoots (e.g., EQ-i–short form) (Parker et al., 2011). The typical-performance operationalization of this conceptual model is, however, irreconcilable with the underlying theoretical framework, proposing the existence of diverse cognitive-emotional abilities (Petrides, 2009, 2011; Zeidner et al., 2005). This is because cognitive-emotional abilities, like any cognitive ability, require veridical, maximum-performance measurement to yield valid assessments. This inconsistency has been the source of much confusion in the TEI literature about not only the appropriate interpretation of results derived from typical-performance measurements of apparent skills or competencies but also the place of such results in the broader field of differential psychology (e.g., Devonish & Greenidge, 2010).

Table 2.1

The Content Domain of TEI in Adults from the Perspective of TEI Theory

Facets	Individuals with high scores tend to …
Adaptability	be flexible and willing to adapt to new conditions.
Assertiveness	be forthright and frank.
Emotion expression	fluently communicate their emotions to others.
Emotion management	manage or influence other people's feelings.
Emotion perception	perceive their own and other people's emotions.
Emotion regulation	regulate their emotions, including the short, medium and long-term control of emotional states.
Low impulsiveness	think before acting and delay momentary gratification in the service of pursuing higher goals.
Relationships	form and maintain fulfilling social bonds.
Self-esteem	possess a positive view of themselves.
Self-motivation	be determined, persevering and achievement oriented.
Social awareness	be socially sensitive, adaptable and perceptive.
Stress management	handle pressure calmly and effectively.
Trait empathy	understand other people's points of view.
Trait happiness	experience pleasant emotion states (e.g., cheerfulness).
Trait optimism	possess generalized favorable outcome expectancies.

2.3.2 TEI Theory

A second influential theoretical model of TEI is the Petrides (2001, 2010, 2011; see also Petrides & Furnham, 2001) model, known as TEI theory. TEI theory also posits a multidimensional, hierarchical representation of TEI with a global TEI factor at the apex of the hierarchy, encompassing interrelated sociability, self-control, emotionality and well-being dispositions at the first-order level, and finite affective-motivational dispositions at the base of the hierarchy (Petrides, 2009). However, dissimilar to the Bar-On (2000) model, TEI theory proposes a comprehensive construct content domain. This content domain was derived from a content analysis of earlier models of EI and cognate affective-motivational constructs, such as alexithymia, empathy, optimism and self-motivation (Petrides, 2001). From this perspective, TEI is defined as a collection of relatively enduring affective personality traits (Freudenthaler, Neubauer, & Gabler et al., 2008; Mikolajczack, Luminet et al., 2007). These traits reflect typical patterns of feelings, thoughts and behaviors related to the perception, regulation, management and expression of emotion-related information as well as

dispositional tendencies towards sociability, positive emotionality, self-control, self-motivation, and holding generalized favorable outcome expectancies (Perera & DiGiacomo, 2013). The content domain of TEI from the perspective of TEI theory is shown in Table 2.1 (see Petrides, 2009).

TEI theory aims to organize into a unifying framework all the affect-related aspects of personality, thereby serving an integrative function in the conceptualization of TEI (Mikolajczak, Luminet et al., 2007). There are both theoretical and applied advantages to organizing affective personality dispositions under a common framework. Theoretically, it may be that the variance in some conceptually-germane outcome (e.g., relationship satisfaction) explained by TEI would otherwise require some cumbersome combination of affective-motivational traits from existing personality frameworks to achieve a comparable degree of explanatory power (e.g., high extraversion, high agreeableness, moderate conscientiousness, low neuroticism) (Mikolajczak, Luminet et al., 2007; Petrides, Pita et al., 2007). Practically, assuming that TEI has some true effect on valued adaptational outcomes, the use of a valid TEI measure in a suite of screening tools designed to detect those at-risk of maladjustment due to affective personality dysfunction is likely to be more efficient than administering multiple personality measures (e.g., measures of alexithymia, the Big-Five, dispositional emotion regulation) to obtain a comparable assessment of the affective aspects of personality. On the basis of the advantages of this integrative framework of affective personality provided by TEI theory, and the noted limitations of the Bar-On (2000, 2006) model, the present research conceptualizes TEI in line with TEI theory.

2.3.2.1 The conceptualization of TEI as a personality construct. Since the initial dichotomization of TEI and cognitive-emotional ability on conceptual and methodological grounds at the turn of the 21st century, there have been systematic attempts to obtain evidence for the theoretical position that TEI is a personality construct (Petrides & Furnham, 2001, Petrides, Pita et al., 2007; see Petrides, 2011 for a review). Indeed, a fundamental postulate of TEI theory is that a partially distinct TEI construct is located in existing frameworks of human personality (Petrides, 2011). This postulate and the concomitant body of research seeking to support it are integral to the present research for three reasons. First, theorizing about the associations of TEI, defined as an affective personality construct, with adaptation and achievement hinges, unsurprisingly, on the validity of the postulation that TEI is a personality construct. The absence of evidence for this position would complicate the

generation of theoretical explanations for these links because the conceptual meaning of TEI would be unclear. Second, a dearth of evidence supporting the view that TEI is a personality construct would obscure the interpretation of existing empirical findings bearing on the TEI-adaptation and achievement links that may otherwise inform the present model specifications. Finally, the tenability of the inferences drawn from the present research rest on whether TEI is in fact a personality construct. Given the centrality of the conceptualization of TEI as a personality construct to the present research, evidence for this theoretical position is reviewed.

Empirical support for the postulation that TEI is a personality construct has emerged from two distinct but complementary bodies of research. First, factor location studies have yielded evidence indicating that a partially distinct TEI factor can be located in existing personality taxonomies (Petrides, 2011). Two factor location studies have shown that TEI can be situated in the Eysenckian framework of personality (Petrides & Furnham, 2001; Petrides, Pita et al., 2007). First, Petrides and Furnham (2001) demonstrated that a distinct TEI factor, measured by the EQ-i, emerged alongside the personality dimensions of the Eysenckian model with moderate associations of the TEI factor with extraversion and neuroticism obtained. These factor analytic results suggest that there is sufficient common variance among TEI facets to define a TEI factor that is distinct from, but related to, the broad bandwidth personality dimensions. Although this evidence is consistent with the conceptualization of TEI as a personality construct, it is limited by the measurement of TEI using the Bar-On EQ-i, which provides only restricted coverage of the TEI content domain from the perspective of TEI theory (Petrides, 2009; Petrides & Furnham, 2001).

This limitation has been redressed in a recent study investigating the location of TEI in the Eysenckian factor space using a comprehensive measure of TEI (Petrides, Pita et al., 2007). Petrides, Pita et al. (2007) found that a discernible TEI factor, measured using the Trait Emotional Intelligence Questionnaire (TEIQue) (Petrides, 2009), which is designed to operationalize TEI theory, emerged alongside the Eysenckian superfactors in joint factor analysis. Moderate associations of the extracted TEI factor with the extraversion and neuroticism dimensions were also found. These findings largely replicate the evidence obtained in Petrides and Furnham (2001) suggesting that a TEI factor, which is oblique to existing personality dimensions, can be isolated in Eysenckian factor space.

Notwithstanding this ostensible replication by Petrides, Pita et al. (2007), there is one anomaly between the studies that merits attention. In Petrides and Furnham (2001), all 15 facets of the EQ-i loaded uniformly on the TEI factor whereas only 10 of the 15 facets of the TEIQue were subsumed under the TEI factor in Petrides, Pita et al. Although both studies suggest that a distinct TEI factor can be recovered in Eysenckian factor space, the extent of the distinctiveness of the TEI factors differs between the studies. This incongruity may be a function of the different content domains of the TEI models operationalized by these distinct measures. For instance, the EQ-i provides very restrictive coverage of impulse control, comprising only emotional control. On the contrary, TEI theory, operationalized by the TEIQue, provides an encompassing perspective on low impulsivity, including the control of diverse urges and desires, which is much more closely aligned with Eysenckian neuroticism and extraversion (H.J. Eysenck & Eysenck, 1975; Guilford, 1975). Indeed, in Petrides, Pita et al., the low impulsivity facet of TEI was subsumed under the Eysenckian extraversion and neuroticism factors in joint factor analysis. This partial displacement of TEI facets under the personality superfactors is, however, consistent with TEI theory, which posits that TEI is a distinct, though compound, construct that can be partially determined by a combination of several personality dimensions (Petrides, 2011).

Evidence has also been acquired for the location of TEI in Big-Five factor space. For instance, in a joint factor analysis of the EQ-i and NEO PI-R, Petrides and Furnham (2001) found that a partially distinct TEI factor could be retrieved alongside the five-factor dimensions. Notably, half the EQ-i facets were subsumed by the personality superfactors, and the extracted TEI factor was moderately associated with neuroticism and extraversion (Petrides & Furnham, 2001). These results were largely replicated by Petrides, Pita et al. (2007) using different measures of both TEI and the Five-Factor dimensions. These researchers subjected the TEIQue and TEXAII to joint principal axis factoring, which revealed that a distinct, albeit truncated, TEI factor could be retrieved in the Big-Five factor space with almost half the TEIQue facets shifting under the personality dimensions. Factor intercorrelations of TEI with extraversion and neuroticism were virtually identical to those obtained in Petrides and Furnham (2001). In both studies, a greater number of TEI facets were displaced under the Five-Factor dimensions, relative to the Eysenckian factors, which should not be unexpected given that the Five-Factor framework is a much more comprehensive model of personality. Importantly, the retrieval of partially distinct TEI factors in both studies suggests that the location of TEI in Big-Five factor space is not

sample-and-instrument-specific, raising the possibility that this postulate of TEI theory is a generalizable principle of the TEI literature.

The theoretical postulate that TEI is a personality construct has also received support from recent factor location research investigating the position of TEI in the Abridged Big-Five circumplex (AB5C) model of personality (De Raad, 2005). The AB5C provides a circular representation of personality trait facets as two-dimensional blends of the Big-Five personality factors, which should be distinguished from the simple structure of hierarchical models of personality (Hofstee, 2003; Hofstee, De Raad, & Goldberg, 1992; see also De Raad & Hofstee, 1993; J. A. Johnson & Ostendorf, 1993). In this circumplex taxonomy, most personality traits are represented as blends of two factors, with primary and secondary loadings, suggesting that personality facets occupy territory in the overlapping conceptual space between two factors (Hofstee et al., 1992). In a study of the location of TEI in the AB5C, De Raad (2005) subjected 437 TEI items to multiple expert assignment of their conceptual fit into the AB5C taxonomy. Two-hundred-and-ninety of these TEI items were captured in the AB5C with 80% expert consensus on the assignment of items (De Raad, 2005). This finding is consistent with TEI theory, which holds that TEI comprises affect-related dispositions whose variance is partially represented by existing personality dimensions, lending further support to the conceptualization of TEI as a personality trait (Petrides, 2011).

A second body of literature underpinning the conceptualization of TEI as a personality construct is the behavioral genetic research on TEI. Univariate behavioral genetic studies seek to derive estimates of the proportion of variance in a phenotype due to genetic and environmental effects (Neale, 2009; Plomin & Caspi, 1999). These studies typically use family or twin designs to obtain these heritability and environmentality estimates (Plomin, 1986). The rationale underlying the univariate behavioral genetic examination of TEI with respect to its conceptualization as a personality trait is straightforward: if heritability estimates of TEI variance approximate estimates for established personality dimensions, this constitutes support for the conceptualization of TEI as a personality construct (Vernon, Petrides, Bratko, & Schermer, 2008). In a recent family study of high school students and their parents, Vernon, Petrides et al. (2008, Study 1) obtained an upper-limit heritability estimate of .32 for global TEI from the regression of offspring phenotypes on midparent

scores. This suggests that approximately 30% of the phenotypic variance in TEI is attributable to genetic variance.

This familial aggregation estimate, reflecting the heritable proportion of TEI, approximates upper-limit heritability estimates for established, broad bandwidth personality traits obtained in comparable family studies. For example, Ahern, Johnson, Wilson, McClearn, and Vandenberg (1982) obtained a mean heritability estimate for 54 personality traits of .22, and Scarr, Webber, Weinberg, and Wittig (1981) found upper-limit heritability estimates of .19 and .20 for Eysenckian extraversion and neuroticism, respectively. In the Five-Factor framework, Loehlin (2005) conducted a review of familial resemblance to estimate the average magnitude of genetic influence on the phenotypic variance in the Big-Five traits based on 29 independent samples. The review yielded heritability proportions of the five superfactors ranging from 18% (Conscientiousness) to 34% (Openness) with a mean heritability coefficient of .26. The correspondence between these upper-limit heritability estimates for established personality traits with the estimate for TEI obtained in Vernon, Petrides et al. (2008) supports the conceptualization of TEI as a personality construct.

A notable limitation of family studies, however, is that these designs cannot isolate genetic influences from common environmental factors because parents and their biological offspring living together share not only 50% of transmissible genetic effects but also common environments (Plomin, 1986; Plomin, DeFries, McClearn, & McGuffin, 2008). Thus, familial aggregation estimates do not statistically differentiate the relative influence of genetic effects from shared environmental effects on phenotypic variation and cannot provide an unequivocal estimate of the heritable proportion of a phenotype. This limitation of family studies disallows a comparison of the magnitude of distinct genetic influences on TEI variance with heritability estimates for conceptually-related personality traits, which would constitute stronger evidence in support of the conceptualization of TEI as a personality trait.

Twin studies provide a more powerful methodology, relative to family designs, for estimating the distinct effects of heredity on trait variance (Horn, Plomin, & Rosenman, 1976; Plomin & Caspi, 1999). The logic of twin studies is straightforward: if the concordance rates of a particular personality trait are greater for monozygotic (MZ) twins than for dizygotic (DZ) twins, then distinct genetic effects are likely to be operating. This is because MZ twins share 100% of both their genes and shared environment whereas DZ twins share only roughly 50% of their genes and 100% of their common environment (Plomin & Caspi,

1999; Plomin et al., 2008). Univariate behavioral genetic model-fitting, based on this logic, has shown that the magnitude of genetic contributions to phenotypic variance in global TEI is .42, suggesting that the heritable proportion of TEI is approximately 40% (Vernon, Petrides et al., 2008, Study 2). This approximates the estimates of heritability for broad bandwidth personality traits based on comparable model fitting procedures obtained in six twin studies over the past two decades (see Table 2.2) (Bouchard, 1994; Horsburgh, Schermer, Veselka, & Vernon, 2009; Jang, Livesley, & Vernon, 1996; Loehlin, McCrae, & Costa, 1998; Riemann, Angleitner, & Strelau, 1997; Vernon, Villani, Vickers, & Harris, 2008). The heritability estimate for TEI is also consistent with recent meta-analytic data indicating that the weighted mean heritable proportion of extraversion and neuroticism, based on the synthesis of about 30 independent model fitting values, is 45% and 40%, respectively (A. M. Johnson, Vernon, & Feiler, 2008). Taken together, these results, showing that TEI heritabilities approximate estimates of heritability for established personality traits, provide support for the conceptualization of TEI as a personality construct.

Table 2.2

Heritability Estimates for the Big-Five Personality Dimensions derived from Model-Fitting Analyses

Big-Five Dimension	Bouchard (1994)	Jang et al. (1996)	Riemann et al. (1997)	Loehlin et al. (1998)	Horsburgh et al. (2009)	Vernon et al. (2008)
N	0.50	0.41	0.52	0.58	0.56	0.57
E	0.40	0.53	0.56	0.57	0.43	0.50
C	0.42	0.44	0.53	0.52	0.47	0.58
A	0.32	0.41	0.42	0.51	0.44	0.63
O	0.43	0.61	0.53	0.56	0.65	0.72

Note. N = Neuroticism; E = Extraversion; C = Conscientiousness; A = Agreeableness; O = Openness.

Further empirical support for the conceptualization of TEI as a personality construct has been acquired in multivariate behavioral genetic investigations. These multivariate studies extend univariate behavioral genetic and correlational investigations by examining the extent of genetic and non-genetic overlap underlying the observed phenotypic associations between traits (Neale, 2009; Plomin & Caspi, 1999; Posthuma, 2009). Two recent multivariate behavioral genetic studies have shown that the phenotypic correlations of TEI with existing personality dimensions are due to shared genetic and environmental factors (Vernon, Villani,

Schermer, & Petrides, 2008; Veselka et al., 2010). Vernon, Villani, Schermer et al. (2008) found that all phenotypic correlations between global TEI and the five-factor dimensions were attributable primarily to overlapping genetic influences and secondarily to non-shared environmental influences. The genetic correlations ranged from |.38 | to |.80 |, indicating that approximately 14% to 64% of the genes that are responsible for variation in TEI are also responsible for individual differences in the Big-Five traits (Vernon, Villani, Schermer et al., 2008). Veselka et al. (2010) replicated these results across personality frameworks, showing that all observed phenotypic correlations between TEI and the HEXACO dimensions were accounted for primarily by correlated genetic influences and secondarily by unique environmental factors, with genetic overlap between 15% and 70% for most observed associations. These findings indicate that TEI shares common genetic and environmental substrates with the established personality dimensions, which constitutes further evidence in support of the conceptualization of TEI as a personality construct.

Taken together, the weight of evidence based on factor location and behavioral genetic research suggests that TEI is a personality construct. The factor location results show that TEI is distinct personality construct because its can be isolated in personality factor space; it is a compound construct because it can be partially accounted for by a complex combination of existing personality dimensions; and it lies at the lower stratums of existing hierarchical frameworks because it is oblique, as opposed to orthogonal, to the existing personality superfactors (Petrides, 2011; Petrides & Furnham, 2001; Petrides, Pita et al., 2007). The factor location findings also suggest that TEI can be situated in dimensional circumplex models of personality (De Raad, 2005). Consistent with these factor location studies, the behavioral genetic research shows that (a) the magnitude of the genetic contribution to phenotypic variance in TEI approximates the estimates of heritability for broad bandwidth personality traits (Vernon, Petrides et al., 2008) and (b) the observed phenotypic covariation between TEI and established personality factors is attributable to overlapping genetic and environmental factors (Vernon, Villani, Schermer et al., 2008; Veselka et al., 2010). These factor location and behavioral genetic results provide support for the conceptualization of TEI as a personality construct in line with TEI theory. The findings represent a major conceptual advance in theorizing about TEI and interpreting concomitant research findings to the extent that they clarify the conceptualization of TEI as a dispositional trait and connect the construct to existing dispositional personality trait frameworks (Petrides, 2011).

2.3.2.2 Limitations of TEI theory. Although TEI theory proffers a conceptual definition of TEI and a descriptive framework for the economical ordering of the affective-motivational aspects of personality (Petrides, 2011), it is limited by the lack of transparent explanatory accounts of the associations of TEI with relevant outcomes (Perera & DiGiacomo, 2013). The TEI construct spans several psychological systems, including emotions, cognitions and motives, and variables, such as expectancies and biologically-based traits (e.g., positive emotionality, self-motivation) (Parker et al., 2011). However, this theoretical complexity of TEI as a multifaceted meta-construct has not been adequately reflected in extant theorizing about, and empirical investigations of, its effects on various substantive criteria. Instead, vaguely specified theoretical links and practices of establishing predictive utility preceding the elaboration of theoretical explanations have dominated the field (Perera & DiGiacomo, 2013). For instance, though TEI has been empirically linked to coping efforts (Petrides, Pérez-González et al., 2007; Petrides, Pita et al., 2007), it is theoretically unclear why these constructs should be related. In this case, the extent of theoretical elaboration from the perspective of TEI theory appears to be that TEI is crucial to the development and selection of coping strategies (Petrides, Pérez-González et al., 2007). While this may be true, it is not a sufficient theoretical explanation for understanding TEI-coping links to the extent that it fails to illuminate the specific psychological systems undergirding TEI that may be responsible for the link. Similarly, though a central tenet of TEI theory is that TEI should be only weakly related or orthogonal to achievement (Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011), the theoretical basis for this postulate is unclear and fails to account for the nonhomogeneity of the construct (Perera & DiGiacomo, 2013). The failure to sufficiently elaborate theoretical links of TEI with various life outcomes in line with the theoretical complexity of the construct may not only obfuscate the true nature of the construct but also complicate empirical research efforts.

In the absence of transparent explanatory accounts for the links between TEI and various life outcomes from the TEI theory perspective, adopting the rich literatures on emotion, regulation and adaptation with which TEI is fundamentally concerned may serve to inform the present conceptual model specifications linking TEI with adaptation and achievement. For example, the scientific definition of TEI from the perspective of TEI theory incorporates generalized favorable expectancies for the future (i.e., an optimistic disposition) (Petrides, 2009, 2011). This can be tied to a rich history of expectancy-value theories of regulation, which hold that behavior reflects the pursuit of valued goals, and favorable expectancies for

eventual goal attainment leads to increased engagement and perseverance even in the face of adversity (Carver & Scheier, 1998). TEI also encompasses dispositions, such as positive emotionality, self-motivation and self-control, that may be grounded in biologically-based appetitive and attentional systems of motivation that facilitate approach behavior and the regulation of these approach tendencies in response to environmental reward cues (Connor-Smith & Flachsbart, 2007; Derryberry & Reed, 2008; Rothbart, Derryberry, & Posner, 1994). Although these biological and goal-based models of regulation have been conceptually distinguished in the psychological literature (Carver & Connor-Smith, 2010), they provide complementary views of human functioning that are relevant to understanding the ways in which TEI is associated with adaptation and achievement. Furthermore, dispositional emotion perception and expressivity, which are also part of the content domain of TEI, can be linked to the social-functional account of emotions that attempts to explain how the perception and expression of emotions regulates social interactions in ways that optimize human adaptation to the social and physical environments (Keltner & Kring, 1998; Shiota et al., 2004). Aligning TEI with these rich accounts of emotion, regulation and adaptation allows for the development of a comprehensive picture of the ways in which TEI in implicated in adaptation and achievement during stressful life events and redresses the limitations of TEI theory.

2.4 Summary of TEI

In summary, the present research is concerned with the trait-based perspective on EI, namely TEI theory. From this perspective, TEI is defined as a set of affective-motivational personality traits reflecting characteristic patterns of feelings, thoughts and behaviors related to the perception, expression, regulation and management of emotions as well as sociability, positive emotionality, self-control, self-motivation and optimistic dispositions. These affective traits have been shown to occupy factor space in existing frameworks of human personality and share a common genetic basis with established broad bandwidth personality dimensions (e.g., Big-Five and Giant-Three). These findings support the conceptualization of TEI as a personality construct in line with TEI theory. Although TEI theory provides a coherent conceptual definition of TEI, the lack of transparent explanatory accounts of the ways in which the construct is associated with various substantive criteria complicates the specification of conceptual models linking TEI with adaptation and achievement. In the absence of these explanatory accounts, the present work draws on several existing accounts of emotion, regulation and adaptation, which are fully compatible with TEI from this trait-

based perspective, to inform the model specifications. Prior to specifying these conceptual models, the present research offers a new, integrative conceptualization of university adaptation to guide the present model specifications in light of the shortcomings of the existing dominant framework.

Chapter Three

Towards an Integrated Conceptualization of University Adaptation

Although the past two decades have seen a burgeoning literature on university adjustment (e.g., Aspinwall & Taylor, 1992; Chartrand, 1992; Chemers, Hu, & Garcia, 2001; Friedlander, Reid, Shupak, & Cribbie, 2007; Gerdes & Mallinckrodt, 1994; Halamandaris & Power, 1997, 1999; Leong, Bonz, & Zachar, 1997; Lidy & Kahn, 2006; Mattanah, Hancock, & Brand, 2004; see Credé & Niehorster, 2012 for a review), one issue that has hampered progress in understanding university adjustment is the absence of a unifying, coherent and theoretically-derived conceptualization of adaptation to university (Hurtado, Carter, & Spuler, 1996). The most widely used definition of university adjustment in the psychological literature stems from a descriptive taxonomy of adaptation with little theoretical underpinning (Baker & Siryk, 1984). In this framework, developed by Baker and Siryk (1984), elucidation of the core facets of adjustment preceded any substantial review of the theoretical adjustment literature, and was based the restrictive view of adjustment as only the extent to which students meet various role demands (Baker & Siryk, 1984; M. A. Taylor & Pastor, 2007). This lack of theoretical principles guiding the conceptualization of university adjustment and elucidation of its content domain serves to not only limit its connection to existing accounts of positive institutional functioning but also encumber its measurement.

In an effort to provide a coherent conceptual definition of adjustment to guide the present research and future inquiry, this chapter advances a new, integrative conceptualization of university adaptation based on a synthesis of existing theories of institutional integration, involvement and psychological well-being (Astin, 1999; Lent, 2004; Ryff, 1989; Tinto, 1993). This conceptualization provides a rich definition of university adjustment as reflecting optimal human functioning in academic, social and psychological domains and includes an elaboration of the conceptual content domain and dimensional structure of adjustment. It is expected that such clarification of the content domain of the construct and the advancement of a testable dimensional structure will not only enable the development of reliable and valid measures of university adjustment but also aid the conduct of investigations on psychosocial contributions to university adjustment, such as the present research. Prior to advancing this novel conceptualization, it should be noted that adaptation and adjustment are used interchangeably in the present work to capture the idea of optimal human functioning in social and physical environments in line with recent theorizing (see e.g., Lent, 2004).

3.1 Academic and Social Adaptation

Both Tinto's (1993) construct of integration and Astin's (1999) concept of involvement are central conceptual underpinnings of the proposed conceptualization of adjustment. A core tenet of Tinto's (1975) interactionalist theory of withdrawal is that persistence behavior is a function of the extent of students' fit into the social and academic domains of an institution. Under this model, academic and social integration, involving students' functioning within the academic and social systems of an institution, are specified to influence persistence in a temporal chain of the effects of individual and environmental factors (Tinto, 1975, 1993). Specifically, the theory posits that academic and social integration influence institutional and goal commitments and these mediators are, in turn, expected to influence persistence behavior (Tinto, 1993). There is a good deal of empirical support for this conceptual model of persistence (Cabrera, Castañeda, Nora, & Hengstler, 1992; Napoli &Wortman, 1998; Pascarella & Chapman, 1983; Pascarella & Terenzini, 1980, 1983), especially the constructs of academic and social integration (e.g., Berger & Milem, 1999; Braxton, Milem, & Sullivan, 2000; Cabrera, Nora, & Castañeda, 1993; Milem & Berger, 1997). Although this model centers on the prediction of persistence and not adjustment per se, the social and academic integration constructs reflect students' functioning in academic and social systems, raising the possibility that the core facets of university adjustment may be elucidated in terms of these integration constructs. Importantly, there is substantial theoretical convergence between Tinto's academic and social integration factors and Astin's constructs of academic and social involvement (Berger & Milem, 1999; Milem & Berger, 1997; Pascarella & Terenzini, 1991), which underpins the central role of students' fit and functioning within the academic and social environments of an institution in the present conceptualization of university adjustment.

Astin's (1999) theoretical model of student involvement is also centrally concerned with students' engagement in academic and social systems of an institution. A fundamental postulate of Astin's theory of involvement is that students' learning, personal development and persistence behaviors are contingent on the amount of "physical and psychological energy" directed towards the academic experience and involvement in the social environment (Astin, 1999, p. 519). Astin characterized the involved student as one who invests substantial effort in studying, maintains regular interactions with peers and engages with university activity, including participating in student organizations (Astin, 1999). The typical uninvolved student is, contrariwise, less likely to exert the effort necessary to meet academic

demands, avoids interacting with peers and disengages from campus activities (Astin, 1999). Emerging from this theoretical account is the central role of academic and social involvement in persistence, which corresponds closely to the roles of academic and social integration in withdrawal under Tinto's (1993) theoretical model of student departure (Pascarella & Terenzini, 1991).

Heretofore, Astin's (1999) construct of involvement, comprising academic and social dimensions of functioning, has received some empirical support in the persistence literature. For instance, two studies have shown that clear academic and social involvement factors, with uniformly moderate-to-high factors loadings, emerged via principal axis factoring of behavioral indicators of university engagement, such as "failed to finish coursework on time" (academic involvement) and "participated in an organized activity" (social involvement; Berger & Milem, 1999; Milem & Berger, 1997). These studies also reported that social and academic involvement factors were predictive of perceptions of student-institutional fit in multi-wave models of the effects of student entry characteristics on persistence mediated by behavioral engagement (Berger & Milem, 1999; Milem & Berger, 1997). Although not a direct empirical test of the predictive validity of Astin's involvement constructs, Kuh, Cruce, Shoup, Kinzie, and Gonyea (2008) examined the role of a closely related construct, student engagement, in persistence behaviors. The researchers reported that engaging in educationally purposeful activities and time spent in co-curricular activities, which conceptually resemble academic and social involvement, respectively, exerted effects on persistence, controlling for the concomitant effects of demographic and prior achievement factors (Kuh et al., 2008). The centrality of academic and social functioning in both Tinto (1975, 1993) and Astin's theoretical models suggests that the core elements of the theoretical content domain of university adjustment may be distilled with reference to the dimensional content of academic and social integration and involvement.

The conceptual resemblance between Astin's (1999) involvement and Tinto's (1993) integration constructs raises the possibility that they may be synthesized to generate an integrative conceptual definition of university adjustment viewed as optimal human functioning in academic and social domains. In Astin's theoretical model, involvement in the social domain of an institution, comprising participation in campus activities and interactions with peers, conceptually resembles Tinto's construct of social integration, which encompasses a set of perceived person-social environment interactions, including peer-group

interactions and the development of satisfying interpersonal relations (Astin, 1999; Berger & Milem, 1999; Pascarella & Terenzini, 1980; Tinto, 1993). It would appear, then, that social involvement and perceptions of fulfilling peer relationships are important facets of functioning socially in the university environment from this integrative perspective. Furthermore, one of the most frequently reported socio-emotional adjustment problems across the university transition is loneliness, which reflects the internalization of the lack of integration or involvement in the social system of an environment (Cutrona, 1982; Perlman & Peplau, 1981). The first dimension of university adjustment—social adjustment—may, then, be profitably viewed as positive social functioning characterized by involvement with university activity, perceptions of satisfying peer relationships and the lack of loneliness.

A second dimension of university adjustment—academic adjustment—may be explicated with reference to Tinto (1993) and Astin's (1999) academic integration and involvement constructs, respectively. The synthesis of these constructs is, however, less straightforward because they have been shown to co-vary only modestly-to-moderately in the empirical literature (Berger & Milem, 1999; Milem & Berger, 1997). Explanations for the lack of stronger statistical covariation between these constructs concern the deficient and inconsistent approaches to their measurement. For example, extant operationalizations of academic involvement have provided insufficient coverage of the theoretical construct's content domain, capturing variance in only a limited number of behavioral indicators of academic (non)involvement, such as failing to attend formal classes and complete coursework on time (see e.g., Berger & Milem, 1999; Milem & Berger, 1997). Astin's conceptualization of academic involvement as the investment of psychological and physical energy in the object of academic work is, however, broader than absenteeism and incomplete coursework and should include specific behavioral indicators of engagement with academic activities (e.g., the extent of students' organization and attention to academic work). Indeed, in his original theoretical account of involvement, Astin intended for the construct to encompass specific behavioral aspects of engagement with the object of study (Astin, 1999).

Inconsistencies across the persistence literature in the operationalization of Tinto's (1993) construct of academic integration may have also served to attenuate relations with academic involvement. In his theoretical account of student departure, Tinto posited both structural and normative dimensions of academic integration (Tinto, 1975; see also Braxton, 2003; Braxton & Hirschy, 2005; Braxton, Sullivan, & Johnson, 1997). Structural integration refers to the

extent to which students meet the academic demands of the institution whereas normative academic integration denotes the correspondence between the student's academic development and the normative intellectual environment of the institution (Braxton, 2003; Braxton & Hirschy, 2005; Braxton et al., 1997; Pascarella & Terenzini, 1980; Tinto, 1975). Notwithstanding Tinto's theoretical demarcation of these two distinct dimensions of academic integration, several studies have failed to use instruments that provide complete coverage of the academic integration content domain. For instance, Berger and Milem (1999) operationalized academic integration via self-reported perceptions of intellectual development and faculty concern for student development. Similar operationalizations are reported in Pascarella and Terenzini (1980) and Fox (1986). The measurement of perceptions of academic development and faculty concern for student development, which provides coverage of the normative integration dimension, does not index the extent to which students are engaged in meeting the formal standards or demands of the university environment (i.e., structural integration). The provision of only partial coverage of the academic integration content domain may have served to yield weaker correlations of academic integration with academic involvement than theoretically expected.

The magnitude of statistical associations of academic involvement with academic integration will vary as a function of the conceptualization of academic integration because the theoretical content domains of the structural and normative dimensions are distinct (Tinto, 1975). It is unlikely that academic involvement and normative academic integration will co-vary substantially because involvement encompasses behavioral components of students' engagement with the academic environment whereas normative integration reflects, in part, self-perceptions of faculty concern for student development, which is not entirely related to students' academic functioning in the physical environment per se (Astin, 1999;; Braxton, et al., 1997; Tinto, 1975). On the contrary, academic involvement is likely to correlate strongly with structural integration, which involves meeting the prescribed standards of the academic system (Astin, 1999; Braxton, 2003; Tinto, 1975). The synthesis of academic involvement and structural integration may serve to illuminate the theoretical content domain of academic adjustment, viewed as optimal academic functioning, because both constructs tap the extent of students' engagement with the demands of the academic environment (Astin, 1999; Tinto, 1975).

There are two crucial limitations concerning the measurement of structural academic integration that need to be addressed before a theoretical content domain of academic adjustment can be posited. First, the prevailing operationalization of structural integration as cumulative achievement may be a misleading index of the extent to which students are structurally integrated into the academic system of a university (Braxton, 2003; Cabrera et al., 1992; Cabrera et al., 1993). Although Tinto (1975, 1993) suggests that academic performance (e.g., GPA) is an index of structural integration, meeting the academic standards of an institution typically involves much more than performance attainment and includes requirements such as regular class attendance, preparation for lectures and tutorials, submission of assessments, and submission of non-assessable academic work, which may be better viewed as predictors of performance (Credé, Roch, & Kieszczynka, 2010; Krause, Hartley, James, & McInnis, 2005; Robbins et al., 2004). Second, it is entirely reasonable that students who meet the academic standards of an institution are not all high achievers because of variation in individual difference variables, such as general mental ability. The operationalization of structural integration as academic achievement may, then, conceal the degree of students' actual academic integration, defined as their functioning in the academic system. Indeed, academic performance may be better viewed as an outcome of meeting the demands of the educational environment rather than an indicator of integration per se. In this regard, structural integration may be better viewed as the extent to which students attend to academic tasks.

Academic involvement and structural academic integration may be synthesized to provide for a conceptual basis on which to distil the core elements of academic adjustment to university. Conceptually, there are subtle differences between the content domains of academic involvement and structural integration. For example, academic involvement captures very specific behavioral aspects of students' engagement with study, such as the extent to which they plan or organize academic work (Astin, 1999). Structural integration taps the broader experience of meeting the academic demands of the institution.

Both constructs, however, capture effective academic functioning in the university environment, reflecting the extent to which the individual is engaged in the academic system (Astin, 1999; Braxton, 2003; Tinto, 1975). Academic adjustment to university may, then, be profitably conceptualized as optimal academic functioning, encompassing both organizational and attentional dimensions. Core facets of this adjustment construct include

the extent to which students set, monitor and pursue academic goals, organize and plan academic work to meet institutional standards, structure time to allow for regular and sustained engagement in study activities, and maintain attention on task-relevant information during formal classes and private study (Astin, 1999; Gerdes & Mallinckrodt, 1994; Kim, Newton, Downey, & Benton, 2010; Perera & McIlveen, 2014; Tinto, 1993).

This theoretical content domain of academic adjustment accords with a few existing definitions of academic functioning in the university adjustment literature. First, the conceptualization is consistent with Krause et al's (2005) descriptive construct of academic integration, comprising behavioral and attitudinal aspects of managing the educational demands of the novel university environment, which served as an index of adjustment to academic life in the largest study of the first year experience in Australia. This novel conceptualization of academic adjustment also approximates Baker and Siryk's (1984) descriptive construct of academic adaptation. In Baker and Siryk's model, academic adaptation refers to the degree to which students adapt to the novel educational demands of the university environment (see also Beyers & Goossens, 2002). Primary-level facets of this construct include application to academic work and exertion of academic effort with a resolve to meeting academic demands (Baker & Siryk, 1984; Gerdes & Mallinckrodt, 1994). Notwithstanding the conceptual resemblance between the posited theoretical content domain of adjustment and Baker and Siryk's descriptive construct, the advantages of the present theoretical formulation of adjustment are two-fold. First, this account provides an integrative conceptualization of academic adaptation that can be linked to existing theories of integration and involvement (Astin, 1999; Tinto, 1975, 1993). Second, this unifying conceptualization allows for the formulation of testable, theoretically-derived hypotheses related to the dimensional structure of adjustment.

3.2 Psychological Adaptation

A growing body of literature suggests that a third dimension of university adjustment—psychological adjustment—may be as important as academic and social adjustment for understanding optimal functioning during the transition to university (Baker & Siryk, 1984; Chickering, 1969; Gerdes & Mallinckrodt, 1994; Hurtado et al., 1996). Most research on university adjustment relies on Baker and Siryk's (1984) descriptive construct of personal-emotional adaptation to conceptualize psychological adjustment to university. Personal-emotional adaptation refers to the absence of psychological distress and concomitant somatic

activity. Although Baker and Siryk's empirical taxonomy provides a parsimonious account of this psychological dimension of adjustment, it hinges on the assumption that adjusting psychologically to university involves numerous "pressure-filled circumstances" (Baker & Siryk, 1984, p. 181). Whilst this basic assumption is reasonable, there is little theoretical grounding for the delineation of the construct's conceptual content domain. In the present section, this dominant conceptualization of psychological adjustment is reconciled with existing theories of persistence and well-being. The theoretical content domain of the psychological adjustment construct is also extended to comprise broader perspectives on psychological functioning consistent with recent developments in the well-being literature (see Lent, 2004 for a review).

Early conceptualizations of psychological adjustment to university emerged in the student development and persistence literatures. As early as the 1960s, Chickering (1969) argued for the central role of psychological adjustment in student-institution fit. In his theoretical account of student psychosocial development, Chickering posited seven vectors of development as follows: developing competence; managing emotions; developing autonomy; establishing identity; freeing interpersonal relationships; developing purpose; and developing integrity (Chickering, 1969). Although most vectors in Chickering's theoretical model have found sufficient coverage in dominant theories of student persistence (Pascarella & Terenzini, 1991), comparatively little attention has been given to the vector of managing emotions. This is surprising because affective disorders are among the most prevalent functional psychiatric disorders in university student populations (Beeber, 1999; Daughtry & Kunkel, 1993; Hogg & Deffenbacher, 1988; Rawson, Bloomer, & Kendall, 1994). At the vector of managing emotions, student development is posited to occur when students acknowledge and regulate emotions. On the contrary, the development and maintenance of negative emotions, indicative of psychological maladjustment, is viewed as a risk factor for the disruption of the educational process.

In addition, at least one theoretical model of student attrition, though not of the quasi-paradigmatic status of Tinto (1993) and Astin's (1999) conceptual models, proposes the centrality of psychological adjustment to students' persistence behaviors (Bean & Metzner, 1985; see also Chartrand, 1992). Bean and Metzner's (1985) model of non-traditional student attrition posits that departure behaviors are primarily a function of six sets of person-environment factors. These factors include background and defining variables (e.g., age and

prior academic performance), academic variables (e.g., study habits, certainty of major, absenteeism), environmental antecedents of persistence (e.g., family responsibilities, finances and employment hours), academic outcomes (e.g., GPA) and psychological adjustment (e.g., absence of distress and satisfaction). Under this conceptual model, which has received some empirical support (Chartrand, 1992), psychological adjustment is hypothesized to mediate the effects of background, academic and environmental factors on the decision to withdraw (e.g., Metzner & Bean, 1987). The theoretical specification of psychological adjustment as a mediator in the causal ordering of factors implicated in student attrition underpins the centrality of the construct as an antecedent of persistence and a socially-valued outcome in its own right.

Heretofore, psychological adjustment in university adaptation studies has been typically conceptualized as the absence of psychological distress and operationalized via measures of (low) anxious and depressive affect (e.g., Baker & Siryk, 1984; Brissette et al., 2002; Chartrand, 1992; Gerdes & Mallinckrodt, 1994; Halamandaris & Power, 1997). This conceptual and operational definition appears reasonable from the perspective of hedonic well-being and consistent with the concept of subjective emotional well-being (Deci & Ryan, 2008; Lent, 2004; Ryan & Deci, 2001). There is, however, some concern that this affect-based conceptualization proffers a too narrow theoretical content domain of psychological adjustment, omitting core aspects of positive psychological functioning based on eudaimonic perspectives on well-being (Lent, 2004; Ryff, 1989, 1995). This may necessitate the reconceptualisation of psychological adjustment with reference to eudaimonic well-being in order to better understand optimal psychological functioning during key life transitions (Lent, 2004; Ryff, 1989, 1995). Before proposing an extension to the conceptual definition of psychological adjustment to encompass the eudaimonic position, it is beneficial to elucidate the hedonic and eudaimonic traditions and their concomitant constructs.

3.2.1 Hedonic Perspectives

Empirical inquiry into psychological adaptation has long been informed by hedonic and eudaimonic perspectives. Although conceptually related, hedonism and eudaimonism are distinct intellectual traditions founded on differing philosophical bases (Deci & Ryan, 2008; Ryan & Deci, 2001). In moral philosophy, hedonism refers to an ethical system that distinguishes the pursuit of sensuous pleasure and avoidance of pain as the primary goals of human conduct (Deci & Ryan, 2008; Huta & Ryan, 2010; Ryan & Deci, 2001). As early as

the fourth century B.C., Greek philosopher Aristippus promulgated that the purpose of life is to maximize pleasure and minimize pain (Ryan & Deci, 2001). Hobbesian moral theory and Benthamian utilitarianism subsequently elaborated this early theoretical account of hedonism, propounding, respectively, that happiness is derived from the satisfaction of human appetites and the experience of pleasure and absence of pain are the chief characteristics of a good life (Ryan & Deci, 2001). Hedonism, as the basis for psychological adaptation, may be recognized as involving the maximization of pleasures towards happiness where happiness is viewed as the sum of pleasures minus pains (Lent, 2004). From this hedonic perspective, psychological adaptation comprises a distinct affective core corresponding to the balance of pleasant and unpleasant affective experiences (Deci & Ryan, 2008; Lent, 2004). High psychological adaptation or well-being is a function of the experience of many pleasant and few unpleasant emotions whereas low well-being implies few pleasant and many unpleasant affective experiences (Deci & Ryan, 2008; Diener, 2000). This affective component of hedonic well-being, comprising the balance of positive and negative affect, underlies the dominant conceptualization of psychological adaptation in the scientific literature (Diener, 1984; Diener & Lucas, 1999; Diener, Suh, Lucas, & Smith, 1999; Lent, 2004).

The concept of subjective well-being (SWB) (Diener et al., 1999), which has become the dominant well-being construct in the psychological literature, emerged from the scientific study of psychological functioning within the hedonistic tradition (Deci & Ryan, 2008; Ryan & Deci, 2001). The growth of the construct and the concomitant SWB field can be traced to two major developments in the empirical well-being literature in the twentieth century. First, the SWB construct has its proximal roots in attempts by social scientists to develop valid indicators of quality of life in the United States during the 1950s (Keyes, Shmotkin, & Ryff, 2002). Compatible with the hedonistic view, life quality was indexed using measures of perceived happiness, achieved through an affective balance, predicated on the belief that individuals respond uniquely to their subjectively experienced worlds (F. M. Andrews & Withey, 1976; A. Campbell, Converse, & Rodgers, 1976; Diener et al., 1999). The focus on subjective appraisals reflected a growing dissatisfaction with social indictors of well-being, such as economic prosperity, which disregard the subjective dimension of life quality (Diener & Suh, 1997; Diener et al., 1999;). It was not until the 1980s, however, that sustained and systematic inquiry into subjective well-being appeared, in part, as a response to scholarly preoccupation with psychopathology and negative states (Diener et al., 1999). From this bourgeoning literature, the conceptual content domain of subjective well-being was defined

along hedonic lines in terms of affect balance and life satisfaction (Diener, 2000; Diener, Oishi, & Lucas, 2009; Diener et al., 1999;).

Both cognitive and affective dimensions of life quality are central to the concept of subjective well-being. In the psychological literature, subjective well-being has been typically defined in terms of three related, yet distinct, components: (a) life satisfaction; (b) positive affect; (c) (low) negative affect (Diener et al., 1999). Life satisfaction refers to the global cognitive evaluation of an individual's quality of life consistent with the individual's subjective judgment (Diener, 2000; Diener et al., 1999; Pavot & Diener, 1993) whereas positive and negative affect denote the extent to which individuals experience pleasant and unpleasant feelings, respectively (Diener et al., 1999). All three dimensions of subjective well-being may tap the extent of psychological adjustment to university. Cognitive appraisals of quality of life during the transition to university are likely to assign substantial weight to life circumstances in the novel environment because it is the first major life transition during adulthood (Cantor, Norem, Niedenthal, Langston, & Brower, 1987; Diener, Emmons, Larsen, & Griffin, 1985). These global assessments of life quality in relation to a subjectively defined set of criteria may reveal how well a student has psychologically adjusted to the cumulative demands associated with the transition (Lent, 2004; Werner & Crick, 1999). Sizeable discrepancies between life circumstances and self-imposed standards may serve as an indicator of suboptimal psychological adaptation (Coffman & Gilligan, 2002; Diener et al., 1985; Pavot & Diener, 1993).

Psychological functioning may also be indexed by the extent to which students experience positive and negative affect (Brissette et al., 2002; Keyes et al., 2002; Lent, 2004). Students may experience numerous pleasant and unpleasant emotions, with varying degrees of affect intensity, as they navigate a novel university setting, involving exposure to multiple academic and social stressors (Arthur & Hiebert, 1996; Credé & Niehorster, 2012). For instance, the experience of high interest generated by the commencement of the life transition may give way to feelings of calmness or even high anxious affect as students attempt to meet the academic demands of university. Furthermore, emotions of the same valence (e.g., depression and loneliness; happiness and pride) may co-occur as students form, or fail to form, personally satisfying interpersonal relations (Cutrona, 1982; Gerdes & Mallinckrodt, 1994). This definition of psychological adjustment in terms of the SWB components is not altogether straightforward, however, as researchers have questioned the compatibility of life

satisfaction with the hedonistic tradition on which the SWB concept is predicated (Deci & Ryan, 2008).

In the well-being literature, there is some concern that the inclusion of life satisfaction in the SWB content domain is inconsistent with the hedonistic approach (Deci & Ryan, 2008). As mentioned above, hedonism is characterized by an affective core involving the maximization of pleasant affect and minimization of unpleasant affect (Ryan & Deci, 2001). SWB researchers typically assume that life satisfaction and pleasant-unpleasant feelings reflect relatively distinct cognitive and affective dimensions of SWB, respectively (Diener et al., 1999; Pavot & Diener, 1993). A more precise definition of SWB in hedonic terms would presumably retain only the foregoing affective dimensions (i.e., positive and negative affect) because life satisfaction involves the cognitive, not affective, evaluation of life events (Deci & Ryan, 2008; Diener et al., 1999; Pavot & Diener, 1993). This binary categorization of the dimensions of SWB into cognitive and affective domains may, however, be overly reductive if not inaccurate. Recently, Lent (2004) proposed that life satisfaction may be viewed as an affective criterion as much a cognitive outcome. According to Lent, an individual's global judgment of satisfaction, weighing the importance of life domains in accordance with subjectively defined criteria, involves at least some consideration of "how I *feel*" about my life circumstances across life domains (Lent, 2004, p. 485). This theoretical account is empirically supported by numerous studies showing moderate to strong relationships between life satisfaction and positive-negative affect (e.g., Arrindell, Meeuwesen, & Huyse, 1991; Keyes et al., 2002; Lucas, Diener, & Suh, 1996).

Instead of reflecting qualitative distinctions in cognitive and affective domains, life satisfaction and pleasant-unpleasant affect may be demarcated along more quantitative lines relating to the intensity and specificity of affective experiences (Lent, 2004). Positive and negative affect refer to the experience of specific, valenced emotional states whereas life satisfaction taps global affective judgments of quality of life (e.g., the extent of general contentment) (Lent, 2004). Reconciling life satisfaction with hedonic well-being allows for the conceptualization of psychological adjustment as optimal psychological functioning, consistent with the construct of SWB, comprising (a) high life satisfaction, (b) the presence of positive affect and (c) the absence of negative affect (Lent, 2004). This conceptualization of psychological adjustment in accordance with the hedonistic tradition, however, disregards core components of positive functioning emerging from the eudaimonic tradition.

3.2.2 Eudaimonic Perspectives

A burgeoning literature suggests that optimal psychological functioning consists of more than simply life satisfaction and affective balance, and may be profitably reformulated in line with eudaimonia (Deci & Ryan, 2008; Lent, 2004; Ryff, 1989; Ryff & Keyes, 1995; Ryff & Singer, 1998, 2000). This literature has been concerned with positing a theory of psychological functioning based on the eudaimonic paradigm and challenging dominant conceptualizations of well-being within the hedonistic tradition (Ryff, 1989). In moral philosophy, eudaimonism refers to an ethical doctrine of human functioning, holding that the primary aim of human action is purposeful life engagement with a resolve to actualizing human potential (Ryff & Singer, 2008). The earliest account of eudaimonism can be traced to Aristotle's (trans. 2011) *Nicomachean Ethics*, which submits that (a) the maximization of pleasures toward the satisfaction of appetites is a vulgar human pursuit and (b) the highest of all goods achievable by human conduct is the realization of human capacity (Ryan & Deci, 2001; Ryff & Singer, 2008). Since this early formulation, numerous theoretical accounts of positive functioning in the psychological literature have emerged in accordance with eudaimonia (see Ryff, 1989 and Ryff & Keyes, 1995 for reviews). For instance, Maslow's (1968) concept of self-actualization and Rogers' (1961) account of the fully-functioning person are predicated on the eudaimonic tenet of self-realization (viz., the fulfilment of human potential as the chief criterion for a well-lived life) (Ryff, 1989; Ryff & Keyes, 1995).

As the basis for a theory of psychological adaptation, eudaimonism differentiates optimal psychological functioning from the experience of pleasant feelings (Deci & Ryan, 2008; Ryan & Deci, 2001). From this perspective, positive affect is not entirely equivalent to well-being because the maximization of pleasure may involve the gratification of desires that are neither virtuous nor foster wellness (Ryan & Deci, 2001). Contrary to hedonia, in the eudaimonic tradition, positive functioning may be achieved exclusive of maximum pleasure (Deci & Ryan, 2008; Ryan & Deci, 2001). In this view, optimal psychological adaptation involves purposeful engagement with life towards psychological growth through the identification of meaningful life pursuits and realization of human potential (Ryff, 1989; Ryff & Singer, 2008). This formulation of full life functioning, encompassing the achievement of meaning, purpose, growth and self-actualization, underlies an alternative conceptualization of well-being that has gained prominence in the psychological literature over the last two-decades (Ryff, 1989; Ryff & Keyes, 1995; Ryff & Singer, 1998, 2000, 2008).

Psychological well-being (PWB) is an alternative theoretical formulation of optimal psychological functioning that emerged from scholarly dissatisfaction with hedonic conceptions of well-being (Ryff, 1989; Deci & Ryan, 2008). The theoretical model of PWB was proposed by Ryff (1989) during the 1980s as a reaction to a growing preoccupation with affect-and-satisfaction based assessments of psychological functioning (Deci & Ryan, 2008; Ryff & Singer, 2008). Ryff disputed the dominant SWB conceptualization of well-being on two grounds. Firstly, though existing indices of SWB have been comprehensively evaluated and validated (Diener, 1984; Pavot & Diener, 1993), the formulation of SWB has been not only atheoretical but also largely a by-product of empirical research designed for purposes other than explicating the constituent elements of optimal functioning (Ryff, 1989). For instance, prevailing conceptual and operational definitions of happiness and life-satisfaction, which are the core elements of SWB, did not emerge from systematic inquiry into the theoretical structure of positive psychological functioning (Ryff, 1989; Ryff & Keyes, 1995). Instead, both dimensions in their contemporary manifestations were articulated in the empirical social change and gerontological literatures and subsequently adopted as indicators of SWB (Keyes et al., 2002; Ryff, 1989; Ryff & Keyes, 1995). Secondly, early conceptions of well-being, on which SWB is based, hinged on the erroneous translation of Aristotelian eudaimonia as happiness, paradoxically defined in terms of affective balance (Ryff, 1989). This conceptualization of well-being implies the equivalence of eudaimonia and hedonia. Such correspondence is, however, grossly inconsistent with Aristotle's (trans. 2011) distinction between the satisfaction of right and wrong appetites, which undercuts philosophical support for the understanding of well-being as happiness (Ryff, 1989). Of greater concern for Ryff (1989, 1995) was the absence of basic eudaimonic tenets of full functioning (e.g., self-realization) in dominant definitions of well-being. These limitations of hedonic well-being prompted Ryff's reconceptualization of psychological functioning along eudaimonic lines.

The multidimensional model of PWB was derived from a theoretical integration of multiple frameworks of optimal positive functioning positioned within the eudaimonic paradigm (Keyes et al., 2002; Lent, 2004; Ryff, 1989; Ryff & Keyes, 1995). These frameworks were drawn from the literatures of developmental psychology, clinical psychology and mental health. In totality, the following nine formulations of positive functioning were synthesized into a parsimonious theoretical account constituting the PWB conceptual framework (Ryff & Singer, 2008):

- Erikson's (1959) account of psychological stages or personal development;
- Bühler's (1935) formulation of basic life tendencies;
- Neugarten's (1973) account of executive processes of personality;
- Maslow's (1968) concept of self-actualization;
- Allport's (1961) depiction of maturity;
- Jung's (1933) theory of individuation;
- Frankl and Lasch's (1992) articulation of will to meaning; and
- Jahoda's (1958) criteria for positive mental health.

Ryff's identification of points of convergence among these frameworks resulted in the distillation of six dimensions of positive functioning constituting the PWB content domain (see Ryff, 1989). Each core element of PWB taps a specific aspect of human wellness, involving (a) awareness and acceptance of strengths and weaknesses (self-acceptance), (b) development and maintenance of warm and trusting interpersonal relations (positive relations with others), (c) feelings of continued growth and development towards the actualization of human potential (personal growth), (d) a sense of self-determination and personal authority (autonomy), (e) choosing and shaping environments to meet personal needs (environmental mastery), and (f) feelings of purpose, directedness and intentionality in life (purpose in life; Ryff, 1989; Ryff & Keyes, 1995). Collectively, these PWB dimensions tap the breadth of optimal human functioning in accordance with the eudaimonic tradition. This posited six-factor structure of well-being has been supported in the empirical well-being literature (e.g., Keyes et al., 2002; Ryff & Keyes, 1995).

3.2.3 The Convergence of Hedonic and Eudaimonic Perspectives

Although a good deal of literature over the past two decades has been preoccupied with expounding the distinctions between PWB and SWB, an emerging body of literature suggests that the constructs may be reconciled on theoretical and empirical grounds (Keyes et al., 2002; Lent, 2004). From a theoretical perspective, the satisfaction of human appetites and the experience of pleasure are not incompatible with the perception of engagement with life challenges towards realizing full human potential (Lent, 2004). Indeed, flow research, in the broader field of positive psychology, has generated a point of convergence between hedonic and eudaimonic well-being, observing that humans may experience pleasant affect during engagement with challenging activities and pursuit of goals (Csikszentmihalyi, 1990, 1997;

Nakamura & Csikszentmihalyi, 2002). Under this theoretical model, the co-occurrence of pleasant affect and engagement is entirely reasonable and constitutes optimal functioning or "the good life" (Nakamura & Csikszentmihalyi, 2002).

Empirically, well-being studies have yielded a relatively consistent pattern of findings showing moderate-to-strong statistical covariation between eudaimonic and hedonic well-being (see e.g., Keyes et al., 2002; Ryff & Keyes, 1995). A CFA test of the joint structure of PWB and SWB, for instance, revealed that an oblique two-factor solution for well-being, comprising strongly correlated first order SWB and PWB factors, provided a superior fit to the sample data relative to an orthogonal two-factor model (Keyes et al., 2002). Compton, Smith, Cornish, and Qualls (1996) also found that the dimensional structure of 18 indicators of well-being was best represented by two oblique SWB and personal meaning factors. These factor analytic results are underpinned by concurrent correlations of PWB dimensions with indicators of affect balance and life satisfaction typically in the order of .25 to .60 and .20 to .70, respectively, supporting the view that SWB and PWB reflect distinct, yet related, dimensions of positive psychological functioning (e.g., Keyes et al., 2002).

The convergence of the SWB and PWB frameworks of optimal functioning may serve as the theoretical basis for the elucidation of an integrative conceptualization of psychological adjustment. From this perspective, psychological adjustment is best conceived as optimal psychological functioning comprising both hedonic and eudaimonic perspectives on well-being (Keyes et al., 2002; Lent, 2004; Ryan & Deci, 2001). This conceptualization of psychological adjustment includes the following facets of positive functioning corresponding to the core components of SWB and PWB: satisfaction with life and affect balance; autonomy; purpose in life; growth; positive relations; mastery; and self-acceptance (Diener et al., 1999; Keyes et al., 2002; Lent, 2004; Ryff, 1989). Collectively, these dimensions of well-being tap the extent of positive functioning from both hedonic and eudaimonic perspectives. Despite the conceptual correspondence between this conceptualization of psychological adjustment and Baker and Siryk's (1984) descriptive personal-emotional adaptation construct, two notable advantages of this definition merit consideration. First, this conceptualization links the psychological adjustment construct to the rich well-being literature, thereby enabling researchers to forward hypotheses on the predictors or structure of adjustment and interpret results consistent with the broader well-being field. Second, this account provides a unifying conceptualization of positive functioning, comprising both

hedonic and eudaimonic conceptions, which extends Baker and Siryk's largely hedonic construct.

3.3 Relations among the Adaptation Constructs

The present formulation of university adjustment proposes a hierarchical, multidimensional structure of adjustment. Psychological adjustment and social adjustment are expected to define a higher-order psychosocial adjustment construct. Unlike Baker and Siryk's (1984) descriptive construct of personal-emotional adjustment, the present conceptualization of psychological adjustment integrates eudaimonic perspectives on human wellness. In adopting this broader perspective to guide the conceptualization of psychological adjustment, not only is there direct conceptual overlap between psychological and social adjustment (e.g., positive interpersonal relations) but also it is expected that these constructs share a good deal of empirical variance. Furthermore, in terms of the negative poles of these adaptation constructs, it may be that the internalization of the lack of social integration and involvement as feelings of loneliness is experienced, at least partly, as the low affective balance, lack of satisfaction with life and disengagement that are typical of low psychological functioning. Thus, it may be useful to deal with the social and psychological dimensions as higher-order indicators of a generalized psychosocial adjustment construct.

Notwithstanding the specification of a higher-order psychosocial adjustment factor, which is posited to account for the commonality between social and psychological adjustment at the first-order level, in the present formulation, the third adjustment domain—academic adjustment—is distinguished from psychosocial adjustment on conceptual and empirical grounds. Academic adjustment taps students' engagement with the educational demands of the university environment whereas psychosocial adjustment probes for cognitive-emotional evaluations of the extent of functioning across interacting social and emotional domains and involvement in the social environment. It is unlikely that new undergraduates make few distinctions about their adjustment in academic and psychosocial domains of the university experience; indeed, students may show within-person variation across these domains (Baker & Siryk, 1984; Credé & Niehorster, 2012). For example, it is entirely reasonable that a student, who is highly involved in campus activities, perceives satisfying social relations and feels little loneliness (i.e., high social adjustment) may not consistently organize and plan academic work, structure time, and maintain attention on academic tasks (i.e., high academic adjustment). Conceptual distinction does not, however, imply orthogonality. Even though

students may show intraindividual variation across the dimensions, theoretically, there are strong reasons to believe that the adjustment dimensions are related. For example, students who are psychosocially maladjusted may be expected to report poorer academic functioning than those who are psychosocially adjusted because of diminished motivation or drive for engaging in task-related activities (Feshbach & Feshbach, 1987; Peplau & Perlman, 1982). Similarly, the experience of psychosocial adaptation may regulate attention and behavior in ways that enhance an individual's management of academic activities and pursuit of desired academic goals (Fredrickson, 2001; Valiente et al., 2012). Figure 3.1 shows the proposed structure of university adaptation in line with the present conceptualization.

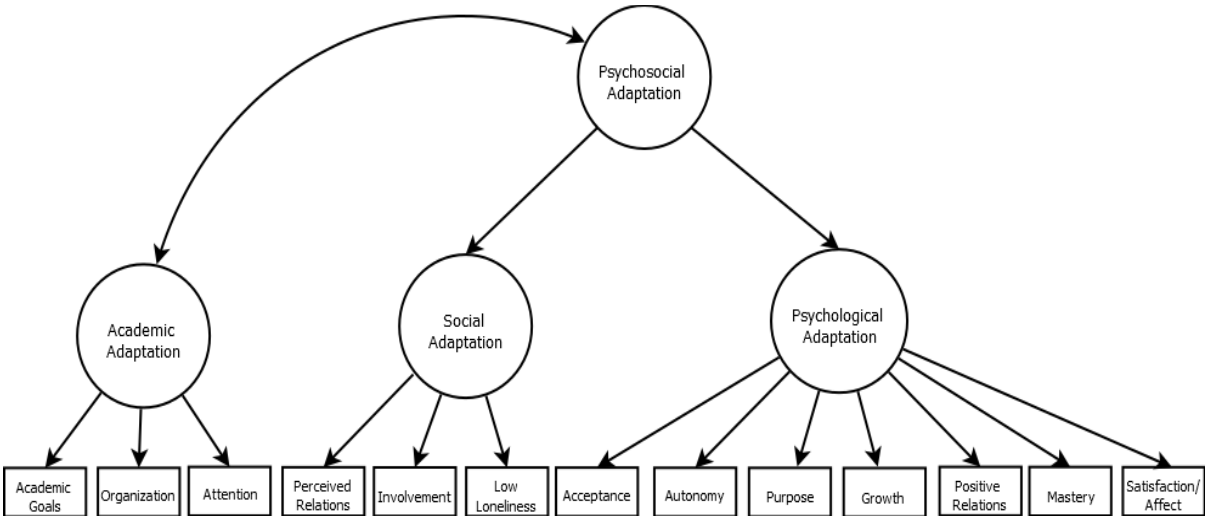

Figure 3.1. The hierarchical, multidimensional conceptualization of university adjustment.

Empirical evidence supports the theoretical position that the university adjustment dimensions are related, though distinct, constructs. Although not a direct empirical test of the relations among the core components in the present formulation, the conceptually similar SACQ dimensions have been shown to reflect associated, yet separable, components of adjustment (Baker & Siryk, 1984; Beyers & Goossens, 2002; Credé & Niehorster, 2012). For example, in a meta-analysis of the relations among these descriptive constructs, Credé and Niehorster (2012) reported sample-weighted mean correlations of academic adaptation with social and personal-emotional adaptation of 0.53 and 0.64, respectively, correcting for the attenuating effects of measurement error. While these correlations are uniformly moderate to high, they are not so strong as to indicate the generality of adjustment or dimensional redundancy. Importantly, the strong conceptual overlap between Baker and Siryk's descriptive constructs and the present constructs suggests that intercorrelations among the

adjustment dimensions in line with the present conceptualization should broadly resemble the foregoing validity coefficients in both direction and magnitude.

3.4 Summary of University Adaptation

In summary, university adjustment can be conceptualized as a multidimensional construct of optimal human functioning consisting of academic, social and psychological dimensions. The convergence of multiple conceptual frameworks of institutional integration, involvement and positive psychological adaptation served as the theoretical basis for the generation of this multidimensional conceptualization and distillation of its core components (Astin, 1999; Diener et al., 1999; Ryff, 1989). Consistent with this conceptualization, academic adjustment refers to positive academic functioning, involving the extent to which students set, monitor and pursue academic goals, organize and plan academic work to meet deadlines, structure time to allow for consistent and sustained engagement with study activities, and maintain attention on task-relevant information during formal classes and private study. Social adjustment is a multifaceted concept of positive interpersonal adaptation including engagement with university activity, perceptions of satisfying peer-group relations and low-loneliness. Psychological adjustment probes for positive psychological functioning in the novel environment characterized by satisfaction with life and affective balance, self-actualization, meaning, purpose, and growth. These social and psychological dimensions are posited to define a higher-order psychosocial adjustment factor that probes for generalized functioning across social and emotional domains. Together, these adjustment dimensions encompass the breadth of optimal functioning in the novel university environment. In the present research, the adjustment dimensions are conceptually and operationally defined in line with this novel formulation.

Chapter Four
Conceptual Models Linking TEI, Social Support, Coping, Adaptation and Achievement

This chapter specifies a target conceptual model linking TEI, perceived social support, engagement coping, adaptation, and achievement during the university transition with which the present research is centrally concerned. Although TEI theory provides an integrative, economical ordering of the affect-related aspects of personality, it is not a sufficient framework for understanding the role of TEI in adaptation and achievement to the extent that it does not offer transparent explanatory accounts of these relations. Accordingly, the present model specification draws on a number of theoretical accounts of emotion, regulation and adaptation, which, though not previously linked with TEI, are compatible with its conceptual definition from the perspective of TEI theory. These accounts include social-functional and broaden-and-build theories of emotion, expectancy-value and psychobiological models of regulation, stress-buffering accounts of social support, cognitive discrepancy and social needs models of social functioning, and the present formulation of university adaptation. Aligning the TEI construct with these richer accounts of emotion, regulation and adaptation allows for the development of a comprehensive picture of the ways in which TEI is implicated in adjusting to stressful life events and achievement. The present chapter also proposes plausible alternative models to facilitate the comparative testing of competing conceptual processes. In addition to these model specifications, this chapter advances a case for the conduct of a meta-analytic review of the TEI-achievement link to (a) clarify the validity of TEI for predicting achievement and, in turn, (b) lend weight to the model specifications linking TEI with student achievement. The chapter concludes with an overview of the research issues and specific predictions generated from the theoretical arguments advanced and evidence reviewed.

4.1 TEI and Academic Achievement

There is a lack of agreement among theorists on the role of TEI in academic performance (Perera & DiGiacomo, 2013). On the one hand, a prevailing postulate of TEI theory is that TEI should be orthogonal or only weakly related to cognitive-loaded outcomes, such as academic performance (Mavroveli et al., 2009; Mavroveli, Petrides, Shove, & Whitehead, 2008; Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011). On the other hand, theorists have argued that TEI is likely to exert influence on academic achievement when academic demands outweigh cognitive resources and under stressful conditions (Ferrando et al., 2011;

Petrides et al., 2004). Consistent with this dearth of theoretical clarity, empirical studies have yielded a seemingly inconsistent pattern of findings, with many studies showing heterogeneous results (e.g., Di Fabio & Palazzeschi, 2009; Newsome, Day, & Catano, 2000; Parker, Creque et al., 2004; Petrides et al., 2004). For instance, in one study of undergraduates taking an entry-level psychology course, R. O'Connor and Little (2003) found that higher TEI was modestly-to-moderately associated with better GPA. These results were replicated in a study of Canadian undergraduates (Parker, Summerfeldt et al., 2004). In a study of British upper secondary students, however, Petrides et al. (2004) obtained a close-to-null and non-significant association of TEI with performance attainment. Trivial and non-significant associations have also been observed in samples of undergraduate students (Newsome et al., 2000) and adolescents (Mavroveli et al., 2008; Qualter, Gardner, Pope, Hutchinson, & Whiteley, 2012). Taken together, the findings reveal an inconsistent pattern of relations between TEI and achievement. Contrary to the belief that inconsistent results are indicative of the absence of any effect (Mavroveli & Sánchez-Ruiz, 2011), heterogeneity often indicates that moderators, such as level of stress exposure, may influence the relation. Moreover, inconsistent or null total effects do not preclude the possibility of important direct and indirect relations (Rucker et al., 2011).

The divergent views concerning the role of TEI in academic performance have important implications for TEI theory and educational and counseling practice. On a theoretical level, elucidating the contribution of TEI to student achievement may inform understanding of the extent to which affective-motivational personality traits play a part in achieving important educational outcomes, particularly during stressful life circumstances. Clarifying the role of TEI in academic performance may also encourage the generation of testable hypotheses designed to evaluate the causal ordering of TEI and achievement. From an applied standpoint, divergent theoretical perspectives on the association between TEI and academic performance have implications for the allocation of time and resources to the development and implementation of structured interventions, such as coping or social support programs, designed to mitigate the adverse effects of affective personality dysfunction. For instance, the failure to employ affective personality assessments as diagnostic tools, on the theoretical basis that TEI should be unrelated to academic performance, may hinder practitioners' and counselors' early detection of students at risk of academic maladjustment, academic failure and ultimately attrition. The applied utility of TEI in academic settings, then, hinges on the clarity and testability of its theoretical position (Perera & DiGiacomo, 2013).

Although TEI theory posits that TEI should be only weakly related or unrelated to achievement (Mavroveli & Sánchez-Ruiz, 2011), there are at least two plausible theoretical explanations for a meaningful *direct* link. First, TEI may facilitate achievement by mobilizing the cognitive resources required for optimal learning and performance. TEI encompasses dispositional tendencies to experience positive emotions (e.g., enjoyment) in general (Petrides, 2011). In this regard, TEI reflects a generalized version of positive emotionality that has a broad range of applicability, spanning very narrow contexts (e.g., completing a discrete learning task) to broader contexts (e.g., attending school). Thus, those high on TEI should tend to experience positive emotions across diverse life situations or challenges. One such situation or challenge may be solving a novel academic problem in a classroom environment. The experience of positive emotions during the task, namely those relating to the task itself (e.g., the enjoyment of learning, interest), may broaden the repertoire of methods available for task engagement and direct attention to the focal activity, thereby enhancing performance (Fredrickson, 1998, 2001; Pekrun, 2006; Pekrun, Goetz, Titz, & Perry, 2002a, 2002b; Valiente et al., 2012).

TEI may also affect students' performance attainment by minimizing susceptibility to the potentially deleterious effects of negative emotions on cognitive functioning in learning and evaluation settings. This theoretical explanation can be profitably elaborated by momentarily considering the role of neuroticism in learning and achievement. Highly neurotic students are more anxious and predisposed to focusing on their emotional states (Derryberry & Rothbart, 1988). This increased attentional focus on negative emotions interferes with attention to academic tasks and narrows momentary thought repertoires by directing cognitive resources away from academic materials to the emotion-eliciting event, thereby distracting the individual from the academic task and reducing performance (Chamorro-Premuzic & Furnham, 2003; De Raad & Schouwenburg, 1996; Fredrickson, 2001; M. C. O'Connor & Paunonen, 2007; Petrides, Chamorro-Premuzic, Frederickson, & Furnham, 2005; Valiente et al., 2012). It follows that students high on TEI, who possess stable tendencies towards the regulation of emotions, including the down regulation or reappraisal of negative emotions (Petrides, 2011), may be less impaired by negative emotions in academic learning and evaluations contexts, which may promote better achievement (Pekrun, 2006; Perera & DiGiacomo, 2013; Valiente et al., 2012).

This theoretical mechanism may be especially applicable to TEI-achievement relations during the university transition. The university transition involves exposure to numerous academic and social stressors, such as increased academic demands (Arthur & Hiebert, 1996; Credé & Niehorster, 2012), time pressure (Park & Adler, 2003) making new friends, and new social activities (Petruzzello & Motl, 2006). The failure to manage these diverse stressors has been implicated in several deleterious outcomes, including academic failure (Credé & Niehorster, 2012). For high TEI individuals, a propensity for the regulation of emotions may minimize susceptibility to the adverse effects of negative emotion in response to novel academic stressors, thereby potentially maintaining greater focus on academic stimuli (T. Goetz, Frenzel, Pekrun, & Hall, 2005; Mikolajczak et al., 2009).

On the basis of these theoretical arguments, in the current research TEI is hypothesized to directly and positively predict student achievement during the university transition (H_{DR1}). This first component of the proposed conceptual model is shown in Figure 4.1. In addition to this direct pathway, there are also several plausible indirect pathways through which TEI may be associated with student achievement during the university transition. These potential mediational mechanisms are examined below.

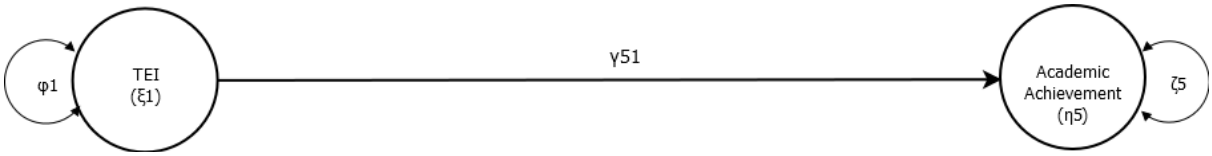

Figure 4.1. Specification of the direct path from TEI to academic achievement. *Note*. ξ = exogenous latent variable; φ = exogenous latent variable variance; γ = structural path from exogenous to endogenous latent variables; ζ = endogenous latent variable disturbance.

4.2 Distal Mediational Pathways between TEI and Achievement

The mediational processes through which TEI may be linked with achievement have not been established in the psychological literature. One reason for this may be that findings of null or near-null TEI-achievement associations have resulted in the presumption of the absence of any total effect (Mavroveli & Sánchez-Ruiz, 2011), leading researchers to prematurely terminate programs of research seeking to investigate direct and indirect links. Yet, important indirect effects can emerge in the presence of null or weak total effects (Rucker et al., 2011).

Specifying the possible mediational mechanisms linking TEI and achievement may in fact serve to clarify both the theoretical underpinnings of the expected relationship and the temporal ordering of the constructs. Indeed, there have been recent calls for the consideration of the intermediary processes linking trait and achievement (Perera & DiGiacomo, 2013).

In the present research, potential mediators are distinguished on the basis of their temporal location in a chain of causally-related events. Distal mediators refer to intervening variables that are temporally proximal to the outcome whereas proximal mediators refer to intermediate variables that are temporally adjacent to the causal agent (Kenny, Kashy, & Bolger, 1998). Distal and proximal mediators may be linked in a multi-stage network of events leading to the outcome. Adjustment to the university environment has been raised as a potential distal mediating mechanism linking TEI with student achievement (Austin, Evans et al., 2005). In the sections that follow, theoretical arguments are advanced and evidence is reviewed for the distal mediating roles of academic and psychosocial adaptation in carrying the effects of TEI to achievement during the university transition.

4.2.1 The Distal Mediating Role of Academic Adjustment

4.2.1.1 TEI and academic adjustment. Academic adaptation to the university transition may be one pathway through which TEI promotes student achievement. In line with the present conceptualization of university adjustment elaborated in Chapter Three, academic adaptation refers to the organization of and attention to study activities and academic goal commitment (Perera & McIlveen, 2014). Despite a growing interest in understanding how the affective aspects of personality influence adaptation (e.g., Kong et al., 2012a, 2012b; Mikolajczak et al., 2006, 2009; Parker, Summerfeldt et al., 2004), heretofore, no studies have investigated the role of TEI in first year students' adaptation to the academic domain of university life. This is puzzling because, theoretically, TEI is posited to exert its most beneficial effects on academic functioning under conditions of high emotional arousal, such as adjusting to a novel academic environment (Petrides et al., 2004). Although no studies have directly examined this link, there are at least four plausible explanations for a direct association. Given the dearth of empirical literature, the burden of justification for the presumed relation between the constructs will rest primarily upon the weight of theoretical considerations. This is not altogether undesirable because difficulties presently hampering progress in the TEI literature, such as findings of inconsistent relations of TEI with several

criteria, have emerged from a lack of theoretical elaboration guiding empirical research efforts (Perera & DiGiacomo, 2013).

First, core motivational processes outlined in goal-based models of regulation may link TEI with academic adaptation. According to TEI theory (Petrides, 2011; Petrides & Furnham, 2001), TEI encompasses an optimistic disposition, reflecting generalized favorable outcome expectancies. This trait expectancy construct can be tied to expectancy-value theories of motivation and regulation. In expectancy-value models, favorable expectancies for the future are posited to lead to engagement and increased effort to reach desired outcomes (Carver et al., 2010; Nes & Segerstrom, 2006; Scheier, Carver, & Bridges, 1994). Contrariwise, generalized negative expectancies, reflected in low TEI, are believed to result in decreased effort and disengagement from the pursuit of valued goals (Carver et al., 2010; Nes & Segerstrom, 2006; Scheier et al., 1994). This is because expectancy-value theories assume that behavior reflects the pursuit of desired goals and individuals remain engaged in efforts to pursue and attain valued goals provided that their expectancies for success are sufficiently positive (Carver & Scheier, 1998; Scheier et al., 1994). There has been a good deal of empirical support for this model of behavioral self-regulation with several studies reporting that those who possess an optimistic disposition take an active approach towards the achievement of goals across multiple contexts (e.g. Carver, Blaney, & Scheier, 1979; Carver, Peterson, Follansbee, & Scheier, 1983; Geers, Wellman, & Lassiter, 2009), including the university transition (Aspinwall & Taylor, 1992; Brissette et al., 2002; Segerstrom, Taylor, Kemeny, & Fahey, 1998). As TEI reflects a generalized optimistic disposition with broad applicability, it may be expected to influence engagement and sustained efforts to attain valued goals across several life domains, perhaps including academic goals in educational contexts. For students high on TEI, then, it may be that an optimistic disposition fosters successful academic adaptation to the university transition by promoting engagement in efforts to meet the academic demands of the novel environment.

Second, the role of TEI in academic adaptation may also be explained with reference to psychobiological models of human regulation. These models view behavior as reflecting fundamental approach and avoidance tendencies and the regulation of these tendencies in response to environmental cues of reward or threat (Davidson, 1998; Gray, 1994; Rothbart & Rueda, 2005). According to TEI theory (Petrides, 2011), TEI encompasses dispositional tendencies towards the experience of positive emotions, which may be grounded in a biologically-based approach or appetitive system of emotion and regulation. In

psychobiological models of temperament, the appetitive system is sensitive to reward cues and is involved in approach behavior (Derryberry et al., 2003; Rothbart, Ahadi, & Evans, 2000). This appetitive system underpinning dispositional positive emotionality may provide a framework for the activation of approach behavior and the engagement of effort in response to rewarding environmental stimuli (Connor-Smith & Flachsbart, 2007; Derryberry & Reed, 2008; Derryberry et al., 2003). For individuals with high levels of TEI, these approach tendencies underlying trait positive emotionality may encourage academic adaptation to the university transition by facilitating movement towards desired academic goals with distinct cues of reward or benefit (Davidson, Jackson, & Kalin, 2000; Valiente et al., 2012).

Another psychobiological system underlying TEI that may support adaptation to the academic environment of university is the attentional system. Consistent with TEI theory (Petrides, 2011), TEI encompasses self-motivation traits, including dispositional tendencies towards determination, perseverance and an achievement orientation. These traits may be rooted in a biologically-based attentional system of motivation that functions as a supervisory system that can reorder the priorities that an individual pursues (Carver & Connor-Smith, 2010; Derryberry & Reed, 2008). It is theorized that neural circuitry underlying the attentional system supports the volitional and effortful control of emotional and behavioral responses through the regulation of attention and preservation of engagement and effort (Derryberry et al., 2003; Rothbart et al., 2000). This circuitry is known as the executive attention network, primarily involving the anterior cingulate cortex (Posner, Rothbart, Sheese, & Tang, 2007; Rothbart et al., 2000; Rothbart & Rueda, 2005; Rueda, Posner, & Rothbart, 2004). Activity in the cingulate cortex has been implicated in the regulation of attentional orienting and response behavior (Rothbart et al., 2000; Rueda & Rothbart, 2009). For individuals with high levels of TEI, it may be that this attentional system, presumed to underlie self-motivation traits, enhances the individual's ability to focus on and persist in valued academic tasks toward optimal academic adaptation notwithstanding exposure to transition stressors.

Finally, for individuals high on TEI, self-control dispositions, which are also grounded in a biologically-based attentional system of control (Derryberry & Reed, 2008; Derryberry et al., 2003), may also support the regulation of efforts and attention necessary for positive academic adaptation. According to TEI theory (Petrides, 2011), TEI encompasses a cluster of relatively stable affective traits reflecting an individual's propensity for low impulsivity.

Those who are high in TEI tend to delay momentary gratification in the service of pursuing long-term goals, whereas low TEI individuals tend toward impulsivity, yielding to the temptation of immediate gratification (Perera & DiGiacomo, 2013; Petrides, 2009). In the academic domain of the university environment, examples of self-control include persevering with a long-term assignment notwithstanding the opportunity to socialize with friends or choosing to study for an algebra exam over watching television.

Among those with high levels of TEI, self-control dispositions may offset the potentially deleterious effects of proximal, externally-elicited motives on behavior by facilitating attention towards goal-related cues and in turn increasing the efficacy of approach behavior (Fishbach & Shah, 2006; Fujita, 2011; Perera & DiGiacomo, 2013). For instance, the invitation to socialize with friends may trigger the reorientation of attention toward the long-term goal of completing an assignment, which in turn may enhance commitment to the goal (Fishbach, Friedman, & Kruglanski, 2003; Fishbach & Shah, 2006; Fujita, 2011). Indeed, where the long-term goal is well-defined and the temptation-related stimulus is particularly strong, self-control dispositions may lead to more pronounced goal-approach and temptation avoidance behaviors (Fishbach & Shah, 2006). Furthermore, individuals high on TEI, who possess strong self-control dispositions, may preserve proximity to goal-related stimuli and maintain distance from tempting stimuli in the pursuit of higher-goals (Fishbach & Shah, 2006; Fujita, 2011; Perera & DiGiacomo, 2013; Trope & Fishbach, 2000, 2005). In preparing for an examination, for example, a student with high TEI may choose to remove the threat of momentary pleasure, such as viewing a preferred television program, by studying at the university library. To the extent that individuals set well-defined academic goals, which is typical of those high on TEI (Perera & DiGiacomo, 2013), self-control tendencies may regulate attention towards these goal-related stimuli, sustaining and even strengthening academic-goal-approach towards optimal academic functioning (Derryberry & Reed, 2008).

This theoretical explanation for the association of TEI with academic adaptation may be particularly relevant in the university transition context. Across the transition, increased autonomy (Mattanah, Ayers et al., 2010), exposure to a lower level of academic structure (Credé & Niehorster, 2012) and greater social opportunities and temptations (Mattanah et al., 2010; Petruzzello & Motl, 2006; Shaver et al., 1985) are potential post-matriculation risk factors for academic maladjustment. Students with lower TEI may be especially susceptible to early academic disengagement in this environment. This is because low TEI students, who

tend towards high impulsivity (Petrides, 2009, 2011), may succumb to social pressures and distractions when faced with a self-control dilemma (Arneklev, Grasmick, Tittle, & Bursik, 1993; Fishbach & Shah, 2006; Fujita, 2008, 2011; Trope & Fishbach, 2000). In the university environment, high dispositional self-control may, then, be integral to regulating attention and behavior in accordance with meeting high-priority academic demands (Duckworth & Seligman, 2006; Kuhnle, Hofer, & Kilian, 2012).

Taken together, the weight of the theoretical arguments advanced suggests that TEI may promote academic adaptation to the university transition. For individuals with high TEI, it may be that an optimistic disposition and propensities for positive emotionality, self-motivation and self-control confer important adaptational advantages in the regulation of effort and attention towards meeting the academic demands of the novel university environment. Accordingly, higher TEI is postulated to be directly associated with better academic adjustment (H_{DR2}). Figure 4.2 shows the proposed path from TEI to academic adaptation in the multistage mediation model. Better academic adaptation to the university transition may, in turn, promote higher first-semester achievement, raising the possibility that academic adaptation carries the effect of TEI onto achievement. This possibility is examined in detail in the next section.

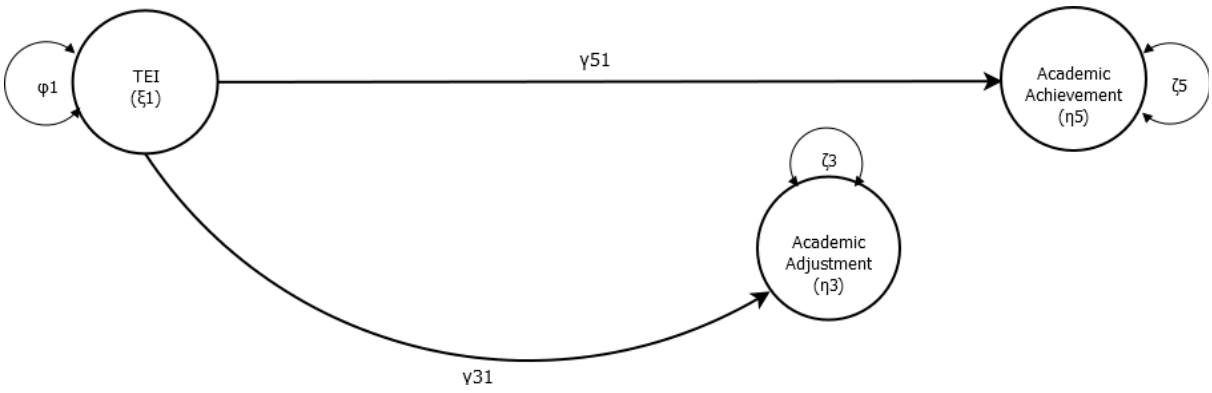

Figure 4.2. Specification of the direct path from TEI to academic adjustment

4.2.1.2 Academic adjustment and academic performance. Students who adjust academically to the initial transitional period of university may attain better first-semester academic outcomes than those who are academically maladjusted. Cumulative university achievement indices, such as first-semester GPA, typically tap long-term achievement across

multiple subject domains (Duckworth, Quinn, & Tsukayama, 2012; Duckworth & Seligman, 2005). These aggregate achievement measures also tap performance across several evaluative tasks, reflecting the ability to prepare for examinations, class presentations and complete long-and-short-term class assignments on time (Duckworth & Seligman, 2006). Cumulative academic performance, then, depends on sustained engagement with the academic environment, involving organization and planning to meet academic deadlines, sustained attention to academic tasks notwithstanding competing psychosocial distractions, and commitment to academic goals (Duckworth and Seligman, 2006; Pintrich & De Groot, 1990; Robbins et al., 2004), which are components of academic adaptation in line with the present conceptualization of university adjustment (see Chapter Three). To the extent that individuals are behaviorally active in their efforts to meet the academic demands of the university environment, reflected in their academic adaptation, they may be expected to perform better than those who are less academically adjusted (Credé & Kuncel, 2008).

The results of three large meta-analytic reviews over the past decade converge to provide evidence for robust positive associations of the organization, attention and academic-goal related components of academic adaptation with university achievement (Credé & Kuncel, 2008; Richardson, Abraham, & Bond, 2012; Robbins et al., 2004). In one review of approximately two decades of research into the psychosocial antecedents of university outcomes, Robbins et al. (2004) obtained a weighted mean correlation of .18 between academic goal commitment and GPA. A similar review, covering the period 1997 – 2013, yielded a comparable validity coefficient (r = .12) for the goal commitment-achievement relation (Richardson et al., 2012). In this review, Richardson et al. (2012) also obtained comparatively stronger weighted mean true-score correlations of academic organization (r = .20), time/study management (r = .20) and attention (r = .18) with university performance attainment based on the synthesis of six, seven and 12 independent effect sizes, respectively. Yet a third meta-analytic review of study skill predictors of university GPA reported moderate weighted mean true score associations of attention (r = .29) and time management (r = .26) with university GPA (Credé & Kuncel, 2008). Notably, the population validity coefficient for time management was modestly stronger for first year students, raising the possibility that initial time management may confer modest, yet important, academic benefits during the transition to university (Credé & Kuncel, 2008). Not surprisingly, given the reviewed meta-analytic evidence, these facets of positive academic functioning have been

characterized as the "third pillar" underpinning university achievement (Credé & Kuncel, 2008, p. 425).

It is inferred from this evidence that academic adaptation to the university transition may promote better student achievement. This may be the case because academically adjusted students are behaviorally engaged in efforts to meet the academic demands of the novel university environment. In line with the reviewed evidence, greater academic adaptation is predicted to be prospectively associated with better first semester achievement (H_{DR3}). This hypothesized path is incorporated into the expanding multistage mediation model as shown in Figure 4.3. Taken with the evidence for the link between TEI and academic adjustment (as per H_{DR2}), the weight of evidence is also suggestive of an indirect pathway in which academic adjustment transmits the effect of TEI onto achievement. Thus, TEI is also predicted to be indirectly associated with first-semester achievement through academic adaptation (H_{IR1}).

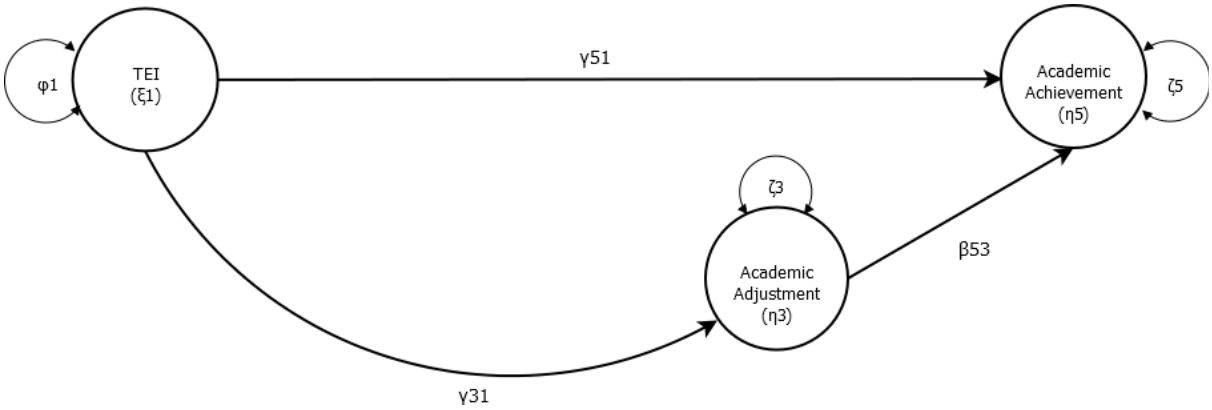

Figure 4.3. Specification of the direct path from academic adjustment to academic achievement. *Note*. β = structural path between endogenous latent variables.

4.2.2 The Distal Mediating Role of Psychosocial Adjustment

4.2.2.1 TEI and psychosocial adjustment. Psychosocial adjustment to the university transition may be a second pathway through which TEI fosters student achievement. In the present research, psychosocial adaptation refers to generalized positive functioning across emotional and social domains, involving not only affective balance, life satisfaction, and feelings of meaning, purpose and growth, but also satisfying interpersonal relations, social

involvement, and the absence of loneliness (Astin, 1999; Lent, 2004; Tinto, 1993; see Chapter Three for an overview). Higher TEI has been consistently linked to indices of better psychosocial adaptation, such as teacher-and-peer-rated prosocial behavior and social competence (Frederickson et al., 2012; Mavroveli & Sánchez-Ruiz, 2011), lower loneliness (K. J. Gardner & Qualter, 2010), relationship satisfaction (Malouff et al., 2014), and better mental health (Freudenthaler, Neubauer, Gabler et al., 2008; Martins et al., 2010; Petrides, Pérez-González et al., 2007). This consistent evidence notwithstanding, because much of the pioneering research in this area was not theoretically driven, considerable ambiguity surrounds the precise role of TEI in psychosocial adaption.

The associations of TEI with indices of psychosocial adaptation may be attributed to at least four distinct mechanisms. First, greater dispositional emotion expressivity and perception among high TEI individuals may help to sustain the flow of emotion-based communication between social partners that is integral to adaptive social functioning. As early as 1872, Darwin (1872/1998) proposed that emotional expressions evolved in the human species as a basic mechanism for not only preparing organisms to respond adaptively to environmental cues but also social communication. Since this early theoretical account, numerous researchers have elaborated these propositions, postulating that the initial self-regulatory function of emotion expression has evolved to serve a social-communicative purpose (e.g., Chapman, Kim, Susskind & Anderson, 2009; Ekman, 1992; Shariff & Tracy, 2011; Tracy & Robins, 2007). From this evolutionary standpoint, emotionally expressive behaviors are hypothesized to have emerged as basic cues with distinct physiological, but not direct communicative, functions (Shariff & Tracy, 2011). Over time, however, these cues evolved into sophisticated social signals, shaped by natural selection to maximize Darwinian fitness, as the survival of species increasingly depended on the communication of important social information (Andersen & Guerrero, 1998; Shariff & Tracy, 2009, 2011; Tracy & Robins, 2008). This general proposition about the social-communicative function of emotion-expressive behaviors is consistent with the social-functional account of emotions.

The social-functional account of emotion posits that emotions are multichannel (e.g., verbal and non-verbal) response systems that have evolved over human evolutionary history to enable people to respond adaptively to the challenges of social living (Frijda, 1986; Keltner & Kring, 1998; Kring, 2000; Levenson, 1992). Under the social-functional model, emotional expressions are hypothesized to coordinate social interactions towards meeting social goals and resolving social problems through their informative, evocative and incentive

functions (Keltner, 2003; Keltner & Haidt, 1999, 2001; Keltner & Kring, 1998). Emotional displays may serve an informative function by enabling the rapid transmission of valenced information about a sender's (a) emotional state (Ekman, 1993), (b) social intentions (Fridlund, 1994) and (c) orientation towards relationships (Knutson, 1996; see Keltner & Haidt, 2001; Keltner & Kring, 1998 for reviews). Emotional expression also have an evocative function to the degree that they elicit (i.e., evoke) complementary emotional responses in others (Keltner & Haidt, 1999, 2001; Keltner & Kring, 1998). These complementary emotions may, in turn, encourage individuals to respond adaptively to social events (Keltner, Young, & Buswell, 1997). Finally, emotional expressions may function as incentives for, or social reinforces, of others' social behaviors during ongoing social interactions (Keltner & Haidt, 1999; Keltner & Kring, 1998; Klinnert, Campos, Sorce, Emde, & Svejda, 1983). In these ways, emotion expressivity serves an important social-communicative function.

It follows that generalized difficulties in expressing emotions, typical of those low in TEI, may interfere with social communication, which is integral to positive social functioning. From a social-functional standpoint, there are at least two reasons for expecting that generalized difficulties in communicating emotions will directly impede social adaptation. Firstly, the dissociation of affective experiences from human expression may impair the communication of internal states that is crucial to adaptive social functioning (e.g., relationship satisfaction) (Harker & Keltner, 2001; Shariff & Tracy, 2011; Srivastava, Tamir, McGonigal, John, & Gross, 2009). For instance, difficulties expressing positive emotion, which are characteristic of those low in TEI, may impede the signaling of approachability and intent to affiliate (Harker & Keltner, 2001), while difficulties communicating personal distress may serve as a barrier to achieving satisfying social outcomes, such as the elicitation of sympathy and care-giving behaviors (Eisenberg, Fabes, Schaller, & Miller, 1989; Labott, Martin, Eason, & Berkey, 1991). Secondly, it may be that those with low TEI struggle to negotiate relative position in social groups because generalized difficulties expressing self-conscious emotions (e.g., pride, shame and embarrassment displays) disrupt the communication of status and may lead to the experience of loneliness (Shariff & Tracy, 2009, 2011).

Among individuals who possess high levels of TEI, dispositional emotion perception may also help to preserve the exchange of emotion-based communication between social partners

that is integral to adaptive social functioning. Individuals who are high in TEI tend to perceive others' emotional expressions and discriminate among emotional signals in verbal and nonverbal expressions whereas those low in TEI experience generalized difficulties in perceiving emotion cues and are consequently less responsive to emotional expressions (Petrides, 2009, 2011; Petrides & Furnham, 2003; Petrides, Furnham, & Mavroveli, 2007). Evidence for this theoretical account of the tendencies of high TEI individuals to perceive emotion cues has been obtained in at least three studies (Austin, 2004; Kreifelts, Ethofer, Huberle, Grodd, & Wildgruber, 2010; Petrides & Furnham, 2003). For example, Austin (2004) observed that individuals high on TEI, namely emotional appraisal, which reflects a propensity for the recognition of others' emotions, were faster to process happy and sad emotional expressions than their low TEI counterparts on a standard facial emotion inspection time task. In another study examining response latencies to affectively valenced targets, Petrides and Furnham (2003) found that students with high TEI were faster to recognize six basic emotional facial expressions presented at different levels of emotional intensity. Analyses of frame data, indexing the progression of facial targets from neutral to prototypical displays, also revealed that high TEI participants required fewer phases than those low in TEI to identify the emotional expressions (Petrides & Furnham, 2003).Taken together, these results suggest that those with high TEI possess superior facial emotion information processing, which accords with their propensity for perceiving emotion cues (Austin, 2004; Petrides, 2009, 2011; Petrides & Furnham, 2003).

Recent functional magnetic resonance imaging (fMRI) data are also consistent with the proposition that individual high on TEI tend to perceive emotions. In an fMRI study of subjects exposed to nonverbal emotion signals, Kreifelts et al. (2010) found an association between high TEI and increased activation in the right posterior superior temporal sulcus (pSTS). As the right pSTS is a region of the brain that is sensitive to social information and involved in the audio-visual synthesis of socio-emotional cues (Kreifelts, Ethofer, Grodd, Erb, & Wildgruber, 2007), this raises the possibility that the successful integration of emotional signals into a unitary social perception may be a core component of TEI that forms the basis for early emotion perception. Importantly, the integration of emotional signals into an adequate social perception is instrumental in positive social interaction and communication (Kreifelts et al., 2010).

Although it is clear from the social-functional account of emotions that social communication is dependent on emotion expressivity (Keltner, 2003; Keltner & Haidt, 1999, 2001; Kring, 2000), because emotions are relational processes that coordinate the actions of individuals and their social partners (Campos, Campos, & Barrett, 1989; Keltner & Kring, 1998; Lazarus, 1991), it is unlikely that expressivity is the only emotional response tendency implicated in social communication and interaction. Indeed, to the extent that the instructive, evocative and incentive functions of emotions hinge on the flow of emotion communication (Keltner & Kring, 1998), the perception of emotions may play an equally important role in coordinating social interactions in the service of adaptive social functioning (Izard, 2001; Izard et al., 2001; Izard, Schultz, Fine, Youngstrom, & Ackerman, 2000). In the context of ongoing social interactions, it may be that a relationship of dependency emerges between emotion perception and expressivity characterized by a reciprocal process of encoding, expressing, perceiving and decoding emotion-related information. For example, distress-related cues, such as displays of sadness or fear, may only serve a communicative function to the degree that they are perceived by conspecifics as signaling appeasement (Shariff & Tracy, 2011). Thus, the normal flow of emotion-based communication, which is crucial to maintaining social interactions (Srivastava et al., 2009), may depend, in part, on perceiving expressions of emotion cues (Izard, 2001). It may be that the propensity for perceiving emotion-related information among individuals high on TEI enables them to keep up with and maintain the flow of emotion-based communication in the service of maximizing social outcomes during social interactions. The sustained flow of affective communication may, in turn, provide socially-relevant information about partners' emotional states and social intentions that sufficiently prepares the organism to respond adaptively to social events (Izard, 2001; Izard et al., 2000; Izard et al., 2001; Keltner & Kring, 1998).

It follows that disturbances in emotional responses may interrupt the flow of affective communication (Keltner & Kring, 1998; Srivastava et al., 2009). One such disturbance may be perceptual impairments generated by emotion perception dysfunction that is typical of low TEI. If low TEI individuals experience difficulties in discriminating and processing emotion expressive behavior (Petrides, 2009, 2011), then they may struggle to keep up with the flow of emotion-based communication and, consequently, become less responsive to key emotion cues (Izard, 2001). This reduced responsiveness may lead to an irrevocable breakdown in emotion communication, generating situationally-inappropriate and socially-discordant

behavioral responses that may threaten social interactions and lead to social maladjustment (Bänninger-Huber, 1992; Izard, 2001; Izard et al., 2001).

Consistent with this theorizing, empirical research on emotion perception in the social-functional tradition has yielded evidence of a link between emotion perception and social functioning. Early studies showed that high emotion recognition among elementary-school-age children was associated with indices of positive social adjustment, such as high peer status (Izard, 1971; see Denham, 1998 for a broad review). Since these early studies, a good deal of research has demonstrated that those who perceive and discriminate emotions cues in expressive behavior are more popular and better liked (Edwards, Manstead, & MacDonald, 1984; Leppänen & Hietanen, 2001), report higher relationship well-being (Carton, Kessler, & Pape, 1999), have higher peer-and-teacher-rated social competence and prosocial behavior (Denham et al., 2003; Leppänen & Hietanen, 2001), and are more inclined to make positive judgments about others and demonstrate altruistic behavior (A. A. Marsh, Kozak, & Ambady, 2007). On the contrary, those who have difficulties in recognizing emotions, and are less responsive to emotion cues, experience greater peer rejection and higher levels of affective-interpersonal disturbances (Blair & Coles, 2000; Boyatzis & Satyaprasad, 1994; Edwards et al., 1984), find it difficult to interpret the intentions of others (E. E. Rowe & Carton, 1995), and show greater problem behavior and impulse conduct problems (Blair and Coles, 2000; Izard et al., 2001).

Together, dispositional emotion perception and expressivity may be particularly important for successful social adaptation to university. Across the university transition, involving numerous social challenges, such as making new friends and participating in new social activities (Mattanah et al., 2010; Petruzzello & Motl, 2006), dispositional emotion expressivity and perception may sustain the flow of emotion-based information between social partners, leading to more situationally appropriate and socially-concordant behavioral responses that enhance social interactions. Disruptions to the normal exchange of emotion-related information, triggered by deficits in expressivity or perception reflected in low trait, may result in the breakdown of communication between social partners that may jeopardize social functioning in the university environment. Stable tendencies towards the expression and perception of emotions, then, likely confer those with high TEI a selective advantage in adapting to the social environment of university.

A second theoretical explanation for the TEI-psychosocial adaptation link is that TEI may moderate pathogenic biological responses to stress, thereby preserving psychological functioning in the face of adversity. In the psychoendocrine research, one of the most consistently documented endocrine responses to stressful events is the activation of the hypothalamic-pituitary-adrenal (HPA) axis, which regulates the release of cortisol (Dickerson & Kemeny, 2004). Under stressful conditions, the HPA axis receives several excitatory and inhibitory inputs, suggestive of stress, that converge at the paraventricular nucleus (PVN) of the hypothalamus (Chrousos & Gold, 1992; Tafet & Bernardini, 2003). Neural activity in the PVN leads to an increase in the secretion of corticotropin releasing hormone (CRH), which is transported to the anterior pituitary gland via hypophyseal portal blood (A. J. Dunn & Berridge, 1990; Ehlert, Gaab, & Heinrichs, 2001; Gunnar & Quevedo, 2007; Gunnar & Vazquez, 2006). Stimulation of the anterior pituitary gland results in the release of adrenocorticotropic hormone (ACTH), which, in turn, stimulates the adrenal gland to release glucocorticoids, including cortisol (Axelrod & Reisine, 1984; Gunnar & Quevedo, 2007; Gunnar & Vazquez, 2006).

Activation of the HPA axis in response to stress is designed to promote an individual's adaptation to stressful conditions, primarily through diverting energetic resources to coping efforts (Burke, Davis, Otte, & Mohr, 2005; Tafet & Bernardini, 2003). Under exposure to chronic stressors, however, prolonged hyperactivation of the HPA axis, involving hypersecretion of cortisol, may lead to pathophysiological changes that trigger the development of psychological distress (Ehlert et al., 2001; Gunnar & Quevedo, 2007). One reason for this is that sustained excessive cortisol release may cause neural damage in the hippocampus, resulting in (a) diminished typical cortisol-induced hippocampal inhibition to CRH release and, by extension, (b) diminished inhibition to HPA hyperfunction (Stokes, 1995). Indeed, hypercortisolism, induced by HPA hyperfunction, plays a role in the pathogenesis of psychological distress (e.g., depression) through impairing serotonergic function (Gunnar & Vazquez, 2006; Stokes, 1995;). To the extent that high TEI prevents prolonged hypersecretion of cortisol in response to stressors, individuals with high TEI may be less likely to experience psychological distress under stressful conditions, such as adjusting to the university transition.

There is some evidence that TEI serves as a protective factor for psychological well-being by preventing increased and prolonged cortisol release under stressful conditions

(Mikolajczak, Roy et al., 2007; Salovey, Stroud, Woolery, & Epel, 2002). Preliminary evidence for the potential moderating role of TEI in the stress-psychological reactivity link was obtained by Salovey et al. (2002) in two studies of the relation between TEI and physiological reactivity under stressful conditions. The researchers found that high TEI predicted lower cortisol responses to acute laboratory-induced stressors, such as completion of visuospatial puzzles and serial subtraction with time pressure (Salovey et al., 2002). Although this finding is suggestive of a buffering effect of TEI on the impact of stress on physiological reactivity, the studies do not provide a direct empirical test of the moderating hypothesis, which would require either (a) a subjective measure of stressor severity during or post-exposure or (b) manipulation of stress in an experimental design. In a more recent study designed to redress these methodological limitations, Mikolajczak, Roy et al. (2007) experimentally manipulated exposure to acute stressors to empirically test this moderating hypothesis. The researchers found that individuals high on TEI, assigned to the stress condition, displayed significantly lower overall cortisol secretion in response to the laboratory-induced stressor relative to individuals low in TEI (Mikolajczak, Roy et al., 2007). This moderating effect of trait on the stress-physiological reactivity link held even after controlling for the potentially confounding effects of broad bandwidth personality traits (Mikolajczak, Roy et al., 2007). By preventing prolonged hyper-reactive physiological responses, TEI may preserve psychological well-being under exposure to stressful life events, such as the university transition.

A third explanation for the TEI-psychosocial adaptation link is that TEI may minimize susceptibility to mood deterioration under stressful conditions. This theoretical mechanism reflects a second stress-buffering hypothesis, positing that TEI serves as a protective factor against psychological distress by minimizing mood deterioration in response to exposure to stressful life events (Mikolajczak, Roy et al., 2007; Mikolajczak et al., 2009). There is some empirical support for this stress-buffering hypothesis. For example, in an experimental study examining the influence of TEI on psychological reactivity under laboratory induced stress, Mikolajczak, Roy et al. (2007) found that individuals with high levels of TEI reported significantly less mood deterioration, indexed by fewer increases in negative affectivity, following exposure to stressful social evaluative speech and cognitive tasks, relative to their low TEI counterparts. This result has been replicated in two other experimental studies of the moderating role of TEI in the stress-mood deterioration relationship. Across two studies of university students, Mikolajczak et al. (2009) demonstrated that TEI moderated the effect of

stress, generated by completion of difficult cognitive tasks with unrealistic time constraints, on mood, such that high TEI individuals experienced smaller increases in negative affect under acute stress exposure as compared with individuals low in TEI. Altogether, the available evidence suggests that TEI serves as a protective factor for psychological well-being by minimizing deleterious mood alterations in response to stressful events (Mikolajczak, Roy et al., 2007; Mikolajczak et al., 2009).

Finally, the TEI-psychosocial adaptation link may be attributed to an optimistic disposition, which serves as a resource for the maintenance of positive psychological functioning when confronting adversity. A remarkably consistent finding in the psychological literature is that an optimistic disposition contributes to better psychological adaptation to stressful events (see Carver, Scheier, & Segerstrom, 2010 for a review). Associations have been obtained in samples as varied as victims of missile attacks (Zeidner & Hammer, 1992), patients experiencing in vitro fertilization failure (Litt, Tennen, Affleck, & Klock, 1992), HIV seropositive men (S. E. Taylor et al., 1992), women with postpartum depressive disorders (Carver & Gaines, 1987), patients undergoing coronary bypass (Fitzgerald, Tennen, Affleck, & Pransky, 1993; Scheier et al., 1989) and joint replacement (Chamberlain, Petrie, & Azariah, 1992) surgeries and amputation (D. S. Dunn, 1996), cancer (Carver et al., 1993), bone-marrow transplantation (Curbow, Somerfield, Baker, Wingard, & Legro, 1993) and rheumatoid arthritis (Long & Sangster, 1993) patients. Particularly important for the present research are findings that an optimistic disposition is predictive of better psychological functioning during the university transition (e.g., Aspinwall & Taylor, 1992; Brissette et al., 2002; Segerstrom et al., 1998).

How might an optimistic disposition among individuals with high TEI promote better psychological functioning during stressful events? The positive effect on an optimistic disposition on psychological adaptation has been attributed, in part, to the disjunction between positive and negative affect emerging from generalized favorable and unfavorable outcome expectancies, respectively (Carver & Scheier, 1990a; Scheier et al., 1994). This theoretical explanation is based on expectancy-value models of behavioral self-regulation which posit that generalized positive outcome expectancies lead to the increased exertion of effort towards goal attainment whereas negative expectancies result in goal disengagement (Carver et al., 2010; Carver & Scheier, 1990b). From this theoretical perspective, to the extent that people possess generalized favorable expectancies for behavioral discrepancy

reduction, which is typical of those high on TEI, they may be expected to experience positive affect as they move appreciably towards desired goals (Carver & Scheier, 1990a; Scheier et al., 1994). Additionally, under stressful conditions, which may impede goal attainment, it may be that favorable expectancies for the reconciliation of discrepancies between current attainment and valued goals minimizes defeat-related negative affect (Carver & Scheier, 1985; Segerstrom et al., 1998). On the contrary, individuals who possess unfavorable expectancies for discrepancy reduction, such as those low in TEI, may be expected to experience negative affect due to their inability to progress at a sufficient rate towards discrepancy reduction while remaining bound to the behavioral reference value itself (Carver & Scheier, 1990a; Scheier et al., 1994). According to Carver and Scheier (1990a), it is this bind—the inability to relinquish a goal that is simply unattainable—that is central to exogenous depression.

Taken together, the weight of the theoretical arguments advanced and evidence reviewed suggests that TEI may promote psychosocial adaptation to the university transition. It may so do because greater dispositional emotion expressivity and perception among high TEI individuals may sustain the flow of emotion-based communication between social partners, leading to more socially adaptive behavioral responses that enhance social functioning. Furthermore, TEI may moderate pathogenic biological responses and minimize susceptibility to mood deterioration in response to diverse stressors, thereby preserving psychological functioning when confronting adversity. Finally, among individuals high on TEI, generalized favorable expectancies for behavioral discrepancy reduction between valued goals and current attainment may promote long-term positive affect and minimize defeat-related negative affect. Higher TEI is thus expected to directly predict better psychosocial adaptation to the university transition (H_{DR4}). This hypothesized path in the expanding multistage mediation model is shown in Figure 4.4. Better psychosocial adaptation to the university transition may, in turn, promote first semester academic success, raising the possibility that psychosocial adaptation also transmits some of the effect of TEI onto achievement. The possibility of this mediational pathway is examined below.

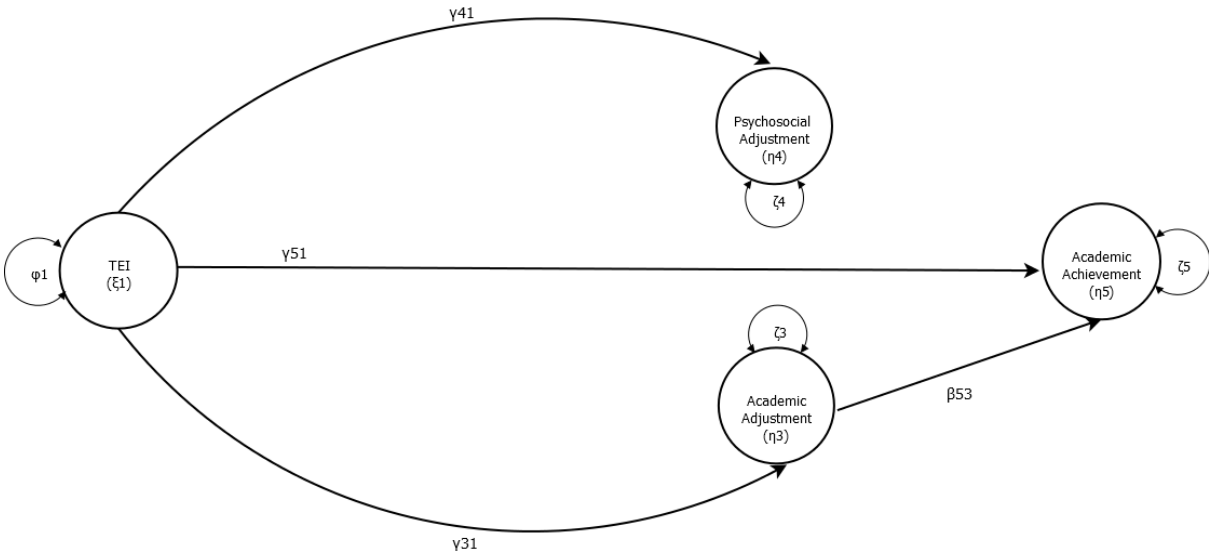

Figure 4.4. Specification of the direct path from TEI to psychosocial adjustment

4.2.2.2 Psychosocial adjustment and academic performance. Individuals who are psychosocially well-adjusted to the university transition may perform academically better than those who are poorly adjusted. Research has yielded a consistent pattern of findings showing that socially-valued successes are associated with the experience of psychological well-being, which is one of the core components of psychosocial adaptation from the perspective of the present conceptualization of university adjustment (see Lyubomirsky, King, & Diener, 2005 for a review). For instance, psychological well-being has been linked to better job performance and career success (Boehm & Lyubomirsky, 2008; Staw & Barsade, 1993), higher supervisory evaluations (Cropanzano & Wright, 1999) and income (Staw, Sutton, & Pelled, 1994), marital status (Harker & Keltner, 2001), and better academic achievement (Pekrun et al., 2009). Historically, these associations have been theorized to be due to the direct effects of success on well-being (Lyubomirsky et al., 2005). In recent years, however, an emerging body of literature has examined an alternative pathway in which dimensions of psychological adaptation, such as affect balance, temporally precede success in a causal sequence (Fredrickson, 1998, 2001). This pathway may be particularly informative for understanding the role of psychosocial adaptation in student achievement during the university transition.

The idea that psychological well-being contributes to favorable life outcomes, perhaps even academic success, can be traced to at least two distinct literatures on the approach and

resource building functions of positive affect (Fredrickson, 1998, 2001; Watson, 2000). The first literature is concerned with the motivational direction or action tendencies associated with affective states and has its roots in neuropsychology (Carver & White, 1994; Davidson, 1993; Watson, 2000; Watson, Wiese, Vaidya, & Tellegen, 1999). In this literature, the experience of positive affect is expected to (a) trigger behavioral approach towards desired goals and (b) prepare the organism to identify and approach new goals (Cacioppo, Gardner, & Berntson, 1999; Fredrickson, 2001; Lyubomirsky et al., 2005; Valiente et al., 2012). Indeed, a large body of literature now suggests that positive affectivity reflects activity in a core appetitive motivational system, which also implicates dispositional affective traits (e.g., TEI) and engagement coping in a causal chain of events leading to the activation and maintenance of approach behavior (e.g., Cacioppo et al., 1999; Carver, 2003; Carver & White, 1994; Gray, 1990; S. E. Taylor & Stanton, 2007; Watson, 2000). It may be that psychosocial adaptation to the university transition, involving, in part, positive affect, confers important academic benefits in evaluation settings by sustaining approach-related behavior towards desired academic goals (Davidson et al., 2000; Valiente et al., 2012). One limitation of this theoretical account of the approach function of positive affect is, however, that homogenous approach tendencies are assumed to underlie all positive affective states, thereby precluding the possibility that discrete positive states may have unique functions (Fredrickson, 2001).

The broaden-and-build model of positive emotions redresses this shortcoming by considering the form and function of discrete positive emotions, which may help to illuminate the ways in which psychological well-being contributes to educational achievement. The broaden-and-build model posits that positive emotions serve to uniquely broaden the scope of an individual's cognition, attention and action and, in turn, build the individual's long-term personal resources (Fredrickson, 1998, 2001; Fredrickson & Branigan, 2005; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Fredrickson & Levenson, 1998; Fredrickson & Losada, 2005). For example, the affective experience of interest is thought to (a) broaden momentary thought and action repertoires as the individual explores the environment and seeks out novel information and (b) build long-term personal resources, such as an expanded knowledge base, as the individual sustains exploration through repeated experiences of interest over time (Fredrickson, 1998).

There has been a good deal of empirical support for both the "broaden" and "build" hypotheses. Several studies have shown that the experience of positive affect expands the repertoire of action urges (Fredrickson & Branigan, 2005), broadens the scope of attention (Fredrickson & Branigan, 2005; G. Rowe, Hirsch, & Anderson, 2007; Wadlinger & Isaacowitz, 2006), including attentional breadth and flexibility (K. J. Johnson, Waugh, & Fredrickson, 2010), and promotes resourcefulness (Lyubomirsky et al., 2005). Under this theoretical model, a crucial adaptational function of positive emotions is to prepare the organism for environmental challenges (Fredrickson, 2001). One such challenge across the university transition may be sustaining performance in multiple, and oftentimes novel, academic achievement tasks. In this context, the experience of positive emotions may foster academic performance by (a) broadening the repertoire of methods for problem solving, (b) expanding existing knowledge bases, and (c) integrating novel information (Fredrickson, 1998; Lyubomirsky et al., 2005; Valiente et al., 2012). These personal resources may then function as durable reserves from which to draw to manage future academic challenges.

The absence of negative affect, which is also a core component of psychosocial adaptation, may likewise serve to foster achievement. This theoretical pathway may be best explained in terms of the positive pole of negative affect (i.e., high negative affect) reflecting feelings of distress and unpleasant arousal (Watson, Clark, & Tellegen, 1988). One reason for this link may be that negative affect leads to attentional biases that interfere with academic achievement (Valiente et al., 2012). Considerable evidence suggests that negative affective experiences promote attentional biases for negative stimuli and a narrowing of attentional focus (Bradley, Mogg, & Lee, 1997; Derryberry & Reed, 2002; Derryberry & Tucker, 1994; Easterbrook, 1959; M. W. Eysenck, 1992; Mathews & MacLeod, 1994; Wells & Matthews, 1994). Attentional orientation refers to the direction of attention toward a specific object quite apart from attentional focusing, which refers to adjustments in expanding or narrowing the scope of attention (Derryberry & Reed, 1998; Derryberry & Tucker, 1994). Both attentional orientation biases favoring negative information and attentional narrowing may hinder academic performance because cognitive resources are directed away from academic tasks as the individual orients attention towards, and increases attentional focus on, the unpleasant event or situation or the affective state itself (Valiente et al., 2012). For incoming undergraduates high in negative affect, it may be that increased attention on common sources of unpleasant affect, especially extracurricular pressures (e.g., financial strains, forming new relationships), interferes with academic learning and, ultimately, impedes achievement.

A second reason for the contribution of negative affect to poor achievement may simply be that unpleasant affect decreases motivation for, and promotes withdrawal from, academic activity. Unpleasant affective states, such as depression and anxiety, are believed to reflect underactivity in the appetitive system of motivation and overactivity in the withdrawal or inhibition system that serves to regulate sensitivity to cues of threat (Carver & White, 1994; Depue & Iacono, 1989; Gray, 1987, 1990; Henriques & Davidson, 1991). Evidence from neurobiological and psychosocial investigations are consistent with this proposition, with studies showing that depressive and anxious affect are associated with higher withdrawal activity and weaker appetitive activation (Carver & White, 1994; Henriques & Davidson, 1991, 2000; Henriques, Glowacki, & Davidson, 1994; Kasch, Rottenberg, Arnow, & Gotlib, 2002). Under long-term stressful conditions, which may generate intense and prolonged negative affect, it may be that an individual is better served by inhibiting ongoing behavior in the service of protecting existing personal resources and avoiding harm (Carver & White, 1994; Gray, 1990). This behavioral withdrawal response may, in turn, hinder achievement by inducing individuals to discontinue approach behaviors and avoid novel stimuli, perhaps even including new academic challenges, which may be perceived as potentially threatening (Davidson et al., 2000; Valiente et al., 2012). For individuals who are psychosocially well-adjusted, reflecting, in part, low negative affect, performance in challenging academic settings may be optimized because they are less likely to retreat into a self-protective stance and inhibit ongoing behavior in response to stressful conditions.

There is ample empirical evidence supporting the theoretical view that psychosocial adaptation promotes achievement. Psychosocial functioning has been linked to achievement in several educational samples (Shahar et al., 2006; Sznitman, Reisel, & Romer, 2011; Tesiny, Lefkowitz, & Gordon, 1980), including university students (B. Andrews & Wilding, 2004; Ayyash-Abdo & Sánchez-Ruiz, 2012; DeRoma, Leach, & Leverett, 2009; Howell, 2009). There are also data suggesting that psychosocial adaptation fosters achievement during the university transition (see e.g., Credé & Niehorster, 2012; DeBerard, Spielmans, & Julka, 2004; Napoli & Wortman, 1998; Petersen, Louw, & Dumont, 2009). For instance, in one study of 204 first year undergraduates, DeBerard et al. (2004) found that initial psychosocial maladjustment to the university transition predicted lower academic performance a year later. Comparable results were obtained in a larger study of 1100 incoming undergraduates by Napoli and Wortman (1998) who found that students reporting better psychological adjustment at the end of the first semester of university attained higher first semester GPA.

This evidence converges with results from the largest meta-analytic review of the adjustment-performance association in the university setting (Credé & Niehorster, 2012). Credé and Niehorster (2012) obtained a modest-to-moderate positive validity coefficient (r = .19) for the association between psychological adjustment and freshman GPA based on the synthesis of 19 unique effect sizes.

It is inferred from these theoretical arguments and the reviewed evidence that psychosocial adaptation may foster achievement during the transition to university. The experience of psychosocial adaptation may regulate attention and behavior in educational settings in ways that enhance the individual's pursuit of valued academic goals. Thus, greater psychosocial adaption is predicted to be directly associated with first semester achievement (H_{DR5}). Figure 4.5 shows this hypothesized path incorporated into the mediation model. The present arguments and evidence, taken with evidence for the link between TEI and psychosocial adaptation (as per $H_{DR4)}$, are also suggestive of a mediational process in which psychosocial adaptation carries some of the effect of TEI onto achievement. Accordingly, TEI is predicted to be indirectly associated with first semester achievement via psychosocial adaptation (H_{IR2}).

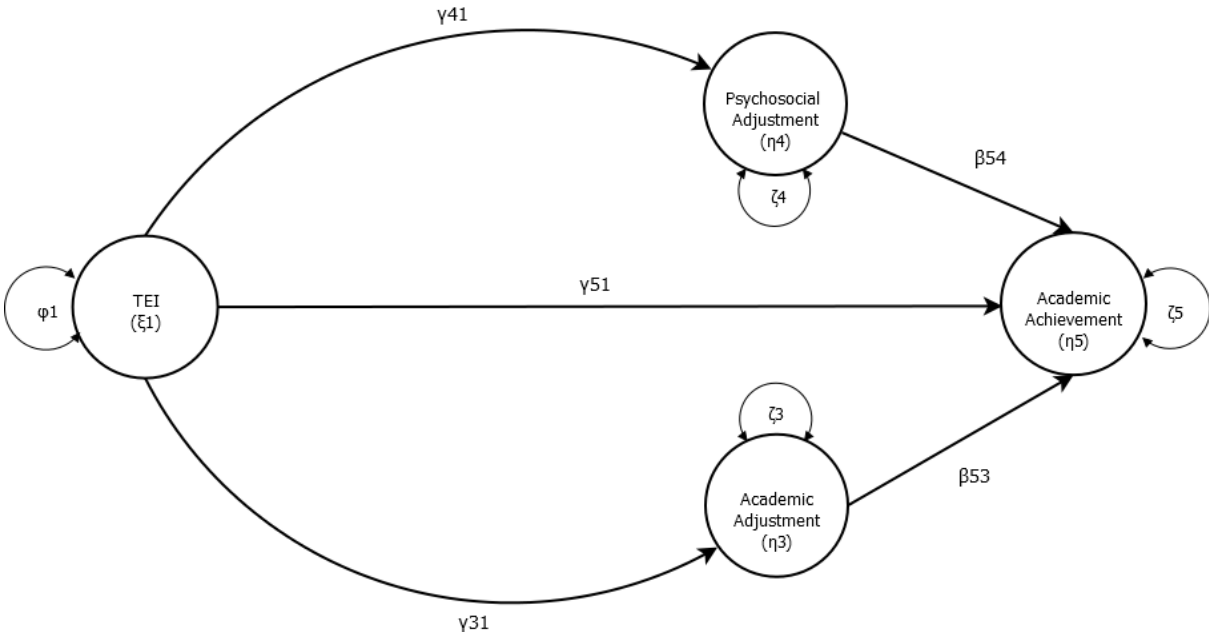

Figure 4.5. Specification of the direct path from psychological adjustment to academic achievement

4.2.3 Summary of Distal Mediational Pathways

Both academic and psychosocial adaptation to the university transition are expected to, at least in part, mediate the link between TEI and first semester achievement. These mediational hypotheses reflect two underlying pathways of influence in which academic and psychosocial adaptation transmit some of the effect of TEI onto achievement under stressful conditions. These mediational processes are expected to unfold over the first semester of university. The specification of academic and psychosocial adaptation as distal intervening mechanisms in a temporal chain linking TEI and achievement supports the role of adaptation as not only an antecedent of socially-valued educational outcomes but also a desirable outcome in its own right. Moreover, the specification and testing of these mediational pathways may serve to clarify and refine the theoretical position concerning the role of TEI in achievement, including the temporal ordering of the constructs in a sequence of unfolding events. These proposed pathways linking TEI, adaptation and achievement may be further mediated by more proximal intervening mechanisms in a multistage mediational process. These proximal mediating mechanisms are the focus of the next section.

4.3 Proximal Mediational Pathways Linking TEI, Adaptation and Achievement

The proximal mediating mechanisms through which TEI may facilitate adaptation to stressful events and, in turn, achievement have not been fully determined. Proximal mediators are intervening factors, temporally proximal to a predictor, that transmit the effects of the predictor to more distal mediators and outcomes (Kenny et al., 1998). Elucidating the potential proximal mediational processes linking TEI, adaptation and achievement may help to further clarify the role of TEI in achievement, particularly under stressful conditions such as the university transition. An emerging body of literature points to the roles of perceived social support and engagement coping as proximal mediators that carry the effects of TEI to adaptation and possibly, in turn, achievement (Austin, Saklofske, & Mastoras, 2010; Downey, Johnston, Hansen, Birney, & Stough, 2010; Kong et al., 2012a, 2012b; Zeidner et al., 2012). This is consistent with current models of personality and affect, which view perceived social support and engagement coping as proximal mediators that link distal dispositional constructs (e.g., personality) with adaptation and performance outcomes (see e.g., Aspinwall & Taylor, 1992; Brissette et al., 2002; G. Matthews, Zeidner et al., 2006; Zeidner et al., 2012).

There is some evidence that perceived social support and engagement coping mediate the relationship between distal individual difference resources and adaptation to stressful life events. For example, in one longitudinal investigation, Brissette et al. (2002) found that (a) secondary-control engagement coping (i.e., positive reinterpretation and growth) and (b) increases in the perceived availability of social support mediated the effect of optimism on psychological adjustment to the university transition. A second longitudinal study of university students reported that the greater use of engagement coping (i.e., active coping) and social support mediated relations between individual differences resources (e.g., optimism, control, self-esteem) and adjustment to the transition (Aspinwall & Taylor, 1992). In yet another study of university students, Kong et al. (2012a) found that the association between higher TEI and greater life satisfaction was mediated by more perceived social support. Although these findings are important and suggestive, they do not illuminate the achievement consequences of adaptation in a causal-chain of events beginning with individual difference resources. Consistent with the evidence reviewed in Sections 4.2.1 and 4.2.2, successful adaptation to stressful educational events may promote academic success. In the following sections, theoretical arguments are advanced and evidence is reviewed for the proximal mediating roles of perceived social support and engagement coping in transmitting the effects of TEI to university adaptation and, in turn, achievement during the university transition.

4.3.1 The Proximal Mediating Role of Perceived Social Support

4.3.1.1 TEI and social support. The perceived availability of social support may be one proximal mediating pathway through which TEI fosters psychosocial adaptation to stressful life events and, in turn, achievement. Consistent with one of the most commonly used conceptualizations of social support in the psychological literature, perceived social support is defined in the present research as an individual's appraisal of the availability and adequacy of support provisions from social networks, such as informational, emotional, belonging, esteem, and material support as well as the opportunity for nurturance (S. Cohen, 1992; S. Cohen & Willis, 1985; Weiss, 1974; see Cutrona & Russell, 1987 for a review). From this perspective, perceived support is viewed as being characteristic of an individual's dynamic social network rather than a reflection of stable expectations concerning available provisions (Brissette et al., 2002).

It is well-established that individuals high on TEI perceive a greater availability of social support. For example, Austin, Saklofske and Egan (2005) found that individuals high in TEI reported greater perceived social support in a sample of predominantly Canadian and Scottish university students. This finding has been replicated in several other student samples, including Chinese (Kong et al., 2012a), Indian (Koydemir et al., 2013), Belgian (Mikolajczak, Luminet et al., 2007) and Spanish (Montes-Berges & Augusto, 2007) university students, and Canadian secondary-school students (Hogan et al., 2010), as well as adult volunteers (Kong et al., 2012b). Although these studies have demonstrated a link between TEI and perceived social support, they have not offered a transparent theoretical explanation for this relationship, which limits understanding of the temporal ordering of the constructs in a chain of causally-related events. In this section, two novel theoretical explanations are proposed to explain the observed covariation between TEI and perceived social support, with a view to elucidating the ways in which perceived social support may carry the effect of TEI to psychosocial adaptation and, in turn, academic achievement.

The observed association between TEI and perceived social support may be attributed to the propensity among those high on TEI to express and perceive emotions, which are instrumental in identifying, developing and maintaining supportive social relationships (Izard, 2001; Shiota et al., 2004). Unsurprisingly, the theoretical rationale posited for the association between TEI and psychosocial adaptation, involving the expression and perception of emotions, may also be applicable to the relationship of TEI with perceived social support (see Section 4.2.2.1). As mentioned above, TEI encompasses stable components of emotion expression and perception, reflecting individual differences in the degree to which people tend to communicate their emotions to others via verbal and nonverbal channels and recognize and decode emotion cues in others' expressive behavior (Petrides, 2009, 2011). Those high on TEI tend to communicate their emotions fluently and perceive and discriminate among emotional signals in social partners' emotional expressions (Petrides, 2009). On the contrary, those low in TEI tend to experience generalized difficulties in communicating emotions and recognizing emotion cues in others' expressive behavior (Petrides, 2011). Consistent with recent theorizing on the role of emotions in interpersonal relationships in the social functional tradition (see e.g., Keltner & Haidt, 1999; Keltner & Kring, 1998; Shiota et al., 2004), emotion expression and perception may promote the bidirectional transmission of emotion-based information between social partners that is

crucial to identifying, developing and maintaining supportive interpersonal relationships (Shiota et al., 2004).

The notion that emotions play an instrumental role in the identification, development and maintenance of supportive social relationships is well-established in the social-functional tradition (see Shiota et al., 2004 for a review). As has been discussed at length in Section 4.2.2.1, the social-function account of emotion posits that emotions evolved to promote and maintain social communication in the service of the survival of hominids in the social environment (Keltner & Gross, 1999; Keltner & Haidt, 2001). In social-functional terms, emotions mediate adaptation to the social environment by coordinating social interactions and regulating interpersonal relationships at both dyadic and group levels (K. C. Barrett & Campos, 1987; Ekman, 1992; Keltner & Haidt, 1999; Lazarus, 1991). For example, in the domain of romantic dyads, the emotions of desire and romantic love may regulate interpersonal interactions by increasing sexual contact and signaling commitment to long-term bonds towards the identification, development and maintenance of reproductive relations (Shiota et al., 2004). In group-level interactions, the emotion of pride and its relational analogue awe may help solve problems of group governance, such as group organization, by communicating and conferring heightened social status in response to socially valued successes (Shariff & Tracy, 2009, 2011). At both dyadic and group levels of interaction, the successful regulation of interpersonal relationships involves (a) identifying potential relationship partners and (b) developing and maintaining these relationships (Shiota et al., 2004). Emotions, and especially the expression of emotions, may contribute to the identification, formation and maintenance of supportive social relations.

The role of emotion expressivity in identifying, developing and maintaining dyadic and group level relationships has received a good deal of attention in the social-functional literature (see e.g., Harker & Keltner, 2001; Keltner, 1995; Keltner & Haidt, 1999; Keltner & Kring, 1998). According to the social-functional account of emotion, emotion expressivity may regulate interpersonal relationships and coordinate social interactions in ways that enhance humans' ability to identify attractive relationship partners, develop supportive social bonds and maintain the stability of these supportive bonds (Keltner & Kring, 1998; Shiota et al., 2004). There are several psychosocial processes through which emotion expressiveness may contribute to identifying, developing and maintaining supportive social relations, though the specific processes may differ as a function of the relationship model. For example, in

dyadic friendships, expressions of happiness and joy serve important informative functions in coordinating the identification and development of attractive social relations by communicating a lack of threat and signaling the intent to affiliate (Preuschoft & van Hooff, 1997; Shariff & Tracy, 2011; Shiota et al., 2004). Once a dyadic friendship has been established, affection cues, such as expressions of compassion, may regulate relationship commitment towards long-term relationship maintenance (J. L. Goetz, Keltner, & Simon-Thomas, 2010; Shiota et al., 2004). For example, compassion displayed in response to partner suffering may signal the actor's willingness to forego self-interest in the service of maintaining the relationship in the long run (Shiota et al., 2004). Furthermore, negatively valenced emotional cues, such as expressions of sadness and fear, may play important informative and evocative functions in stabilizing relationships by signaling distress and eliciting partner sympathy and corresponding care-giving behaviors, which may, in turn, strengthen the actor's commitment to the relationship (Keltner & Haidt, 2001; A. A. Marsh, Ambady, & Kleck, 2005; A. A. Marsh et al., 2007).

Emotion expressivity may also contribute to the identification, development and maintenance of social relations beyond the dyadic level. In the domain of group relationships, displays of amusement, evoking collective or shared laughter among some conspecifics, may assist individuals in identifying a supportive network that constitutes the ingroup (Provine, 2000; Shiota et al., 2004). Once the ingroup has been identified and formed, the relative position of individuals in the group must be negotiated and renegotiated as social status hierarchies become increasingly dynamic and complex (Shariff & Tracy, 2011; Shiota et al., 2004). Self-conscious emotional cues, such as expressions of pride, embarrassment and shame, may serve important informative functions in negotiating status relationships and maintaining group cohesion (Shariff & Tracy, 2011). For example, pride displays in response to a social success may signal heighted social status, and, to the extent the success is socially valued, may result in the increased status of the individual within the group (Shariff & Tracy, 2009, 2011; Tracy & Matsumoto, 2008). On the contrary, expressions of embarrassment or shame in response to social transgressions may communicate (a) lessened social status, (b) the intent to appease and (c) acknowledgement of group norms in the service of preserving group affiliation (Keltner, 1995; Keltner & Harker, 1998; Shariff & Tracy, 2011). Emotion expression may not, however, be the only emotion response tendency involved in the development and maintenance of social relationships. Indeed, it seems unreasonable to postulate that the unidirectional transmission of emotion-related information via expressivity

is sufficient to sustain the flow of emotion-based communication that is necessary for regulating interpersonal relationships.

The importance of emotion to the regulation of interpersonal relationships lies not only in expressivity but also in the concomitant perception of the expressive behavior. Indeed, to the extent that the development and maintenance of supportive social relations hinge on the ongoing communication of emotion-based information related to social partners' needs, expectations and intentions (Ekman & Friesen, 1971; Srivastava et al., 2009), the recognition and decoding of emotional cues in human expressive behavior may also be instrumental in regulating interpersonal relationships (Izard, 2001). This proposition is consistent with the earlier theorizing about a possible relationship of dependency emerging between expressivity and perception in the context of ongoing social interactions (see Section 4.2.2.1). From this standpoint, the regulation of interpersonal relationships depends on the ongoing flow of emotion-based communication, which is itself governed by a reciprocal process of encoding and expressing and perceiving and decoding emotion-related information. In this reciprocal process, it may be that the perception of emotion cues in expressive behavior reinforces and promotes the flow of emotion-based communication, thereby providing individuals with sufficient information about others' emotional states, needs, expectations and intentions to respond adaptively to social opportunities (Izard, 2001). As the perception of emotions may facilitate the exchange of emotion-based information between social partners, it stands to reason that this emotion response tendency is implicated in interpersonal relationships across the spectrum of regulatory tasks, including relationship identification, development and maintenance.

The contribution of emotion perception to the identification, development and maintenance of supportive interpersonal relationships is part of the broader reciprocal process of expressivity and perception that governs the flow of emotional communication. In successful interpersonal relationships, this reciprocal process is likely to play out along the entire timeline of the unfolding relationship, with emotion perception playing a particularly important role in sustaining the exchange of emotion-based information between social partners. This reciprocal process, as it unfolds across all three regulatory tasks, is perhaps best elucidated with reference to dyadic friendships, though comparable processes are implicated in other relationship models, such as romantic dyads and group-level relations. In the domain of dyadic friendships, emotions may coordinate relationship identification,

primarily through their informative functions (Keltner & Kring, 1998; Shiota et al., 2004). For example, joy, expressed by Duchenne smiling, serves as a universally reliable and recognizable cue signaling approachability and a desire to affiliate that may assist others in identifying promising friendship partners (Harker & Keltner, 2001; Shiota et al., 2004). The joy expression may, however, only serve this informative function to the degree that it is perceived by potential friendship partners as signaling a lack of threat and willingness to affiliate (Harker & Keltner, 2001; Shariff & Tracy, 2011). Thus, the perception of the joy display and decoding of its affiliative cue would seem to be minimum requirements for the successful recognition of the expresser as a promising friendship partner and the evocation of comparable displays signaling mutual interest in relationship formation.

Emotion perception may also contribute to coordinating the development and maintenance of supportive friendships once promising relationship partners have been identified. For a friendship to develop and survive, social partners must negotiate rules of interaction governing partner roles, communication and behavior (Shiota et al., 2004). According to Shiota et al. (2004), this type of relationship development is unlikely to involve intentional negotiations of interpersonal protocol; instead, underlying exchanges of emotion, regulated by the reciprocal process of expressivity and perception, may lead to the negotiation of friendship norms. For example, an individual may express disgust when a friendship partner engages in a morally objectionable behavior (Chapman et al., 2009). From a social-functional perspective on emotions, this display of disgust, communicating an unfavorable evaluation of the behavior, may serve an incentive function insofar as it demands and elicits behavioral adjustment in the target (Cacioppo & Gardner, 1999; Keltner & Kring, 1998). This incentive function, however, depends not just on the expression of the disgust emotion, but on the target's perception of the basic disgust cue as warning about the distasteful behavior (Chapman et al., 2009; Shariff & Tracy, 2011). Consequently, to the degree that the target perceives the disgust display and decodes the concomitant cue of reprehensibility, he or she may be more likely to recognize the behavior as transgressive and redress the transgression through submissive displays (e.g., embarrassment) (Keltner, 1995). In this way, the exchange of emotional information, which depends, in part, on the perception of expressive behavior, may shape mutually recognized standards of behavior in the service of developing and maintaining the supportive dyadic friendship. It follows that generalized difficulties in the recognition and decoding of emotional cues, which are characteristic of low TEI, may interrupt the flow of emotion-based communication between social partners at both ends of

the communication chain (Srivastava et al., 2009), thereby impeding the identification, development and maintenance of supportive social relationships.

The available empirical evidence is consistent with the proposition that emotion expressivity and perception are implicated in the identification, development and maintenance of supportive social relationships. For example, Harker and Keltner (2001) found that observers, who were asked to rate their expected social responses to unacquainted women based only on viewing their college yearbook photographs, were more likely to approach and accept women in hypothetical interactions who displayed more intense Duchenne smiles. This finding is consistent with earlier theorizing on the approach-signaling function of positive emotion expressivity (e.g., displays of joy), which may assist conspecifics in identifying promising relationship partners (Shiota et al., 2004). In this thin-slicing literature, the extent of positive emotional expressivity in photographs taken early in life has also been shown to predict (a) marital status (Harker & Keltner, 2001), (b) relationship closeness (Freese, Meland, & Irwin, 2007; Harker & Keltner, 2001) and (c) relationship survival decades after the initial expressive behavior (Hertenstein, Hansel, Butts, & Hile, 2009). Also consistent with this proposal are data indicating that those who perceive emotions in others' expressive behavior may be better able to identify, develop and maintain positive social relationships. For example, it has been found that children who recognize and decode emotional cues in expressive behavior are more likely to interpret the intentions of others, which would seem necessary for the identification of promising and supportive relationship partners (E. E. Rowe & Carton, 1995). It has also been shown that the perception of emotions in expressive behavior predicts both greater interpersonal acceptance (Boyatzis & Satyaprasad, 1994; Edwards et al., 1984), and the provision of interpersonal support in response to distress cues (A. A. Marsh et al., 2007), which may signal relationship commitment (Shiota et al., 2004)

It is inferred from these theoretical arguments and evidence reviewed that both emotion expressivity and perception play instrumental roles in the identification, development and maintenance of supportive social relationships. These emotion response tendencies may do so by regulating the flow of emotion-based communication in a reciprocal process of emotion exchange during ongoing social interactions. This sustained exchange of emotion-related information between social partners may, in turn, provide sufficient information about others' emotional states, behavioral intentions and orientations towards the relationships to prepare

the individual to respond adaptively to social opportunities that emerge across the spectrum of relationships tasks. It follows that, for high TEI individuals, who possess relatively stable tendencies towards the expression and perception of emotions, the ability to identify supportive relationship partners, develop these social bonds and maintain their stability may account for their greater perceptions of social support.

Individuals who possess high TEI may also perceive a greater availability of social support because an optimistic disposition may play an important role in developing and maintaining supportive social networks (Brissette et al., 2002; Carver et al., 2010). An optimistic disposition is one of the core primary-level traits of TEI in line with TEI theory (Petrides, 2009, 2011). Individuals who are high on TEI possess generalized positive outcome expectancies whereas those low in TEI have generalized negative expectancies for the future (Petrides, 2011; Petrides, Furnham et al., 2007). What is it about an optimistic disposition that promotes the development and maintenance of supportive social networks? Although the role of dispositional optimism in relationship formation and maintenance has not been a topic of extensive scholarly investigation (Srivastava, McGonigal, Richards, Butler, & Gross, 2006), a growing body of literature attests to the centrality of an optimistic disposition in the development of supportive social ties (Brissette et al., 2002; Carver et al., 2010; Carver, Kus, & Scheier, 1994; Helweg-Larsen, Sadeghian, & Webb, 2002; Srivastava et al., 2006).

One reason for the contribution of an optimistic disposition to relationship formation may simply be that individuals who possess generalized favorable outcome expectancies are more socially attractive and easier to like than those who hold negative expectancies and are, thus, more likely to be integrated into new social networks (Brissette et al., 2002; Carver et al., 2010; Scheier & Carver, 1987; Vollmann, Renner, & Weber, 2007). Indeed, dispositional expectancies, both positive and negative, may influence how social partners respond to individuals in interactions (Carver et al., 1994; Helweg-Larsen et al., 2002). It may be that potential social partners are more willing to engage in positive social interactions with individuals who hold generalized expectancies for favorable life outcomes and less socially accepting or rejecting of individuals who possess broad negative outcome expectancies (Carver et al., 1994; Carver et al., 2010; Helweg-Larsen et al., 2002; Vollmann et al., 2007). This may be the case because potential social partners perceive those who dispositionally hold negative expectancies as dysphoric, and may find their intense focus on negative possibilities in social interactions aversive (Carver et al., 1994; Coyne, 1976; Helweg-Larsen

et al., 2002). On the contrary, generalized positive outcome expectancies among those high on TEI may be perceived by social partners as co-occurring with positive affect, which may be more attractive to social partners during interpersonal interactions (Carver et al., 1994). Following from this, the presumed social acceptance of those with an optimistic disposition may, in turn, reinforce their positive expectancies about relationship outcomes in future social interactions, thereby potentially strengthening their social connections and perceptions of interpersonal support (Carver et al., 1994; Srivastava et al., 2006).

In line with this theorizing, there is some empirical evidence suggesting that people have a preference for engaging in social interactions with those possessing an optimistic disposition (Carver et al., 1994; Helweg-Larsen et al., 2002; see Carver et al., 2010 for a review). For example, in two experimental studies of the influence of mood and generalized expectancies on social acceptance, Carver et al. (1994) found that observers, who were asked to rate their degree of acceptance of target individuals exhibiting positive, neutral and negative moods and optimistic, neutral and pessimistic outlooks, were more socially accepting of those with an optimistic disposition. Notably, in the second study, once cues of chronicity or stability of mood were omitted from the experimental manipulation, dispositional expectancy exerted an independent effect on social acceptance, such that observers were more willing to engage in social interaction with target individuals possessing generalized favorable outcome expectancies compared with those holding broad expectancies for unfavorable life outcomes (Carver et al., 1994). In addition to the foregoing results, correlational research has also shown that individuals with an optimistic disposition experience fewer negative social interactions (Räikkönen, Matthews, Flory, Owens, & Gump, 1999). Altogether, this evidence suggests that an optimistic disposition may be attractive to potential social partners; it may promote social acceptance or a willingness to engage in social interaction and should thus be useful for developing supportive social networks (Brissette et al., 2002; Carver et al., 1994; Carver et al., 2010; Helweg-Larsen et al., 2002). In this regard, it may explain why those high on TEI perceive a greater availability of social support.

Taken together, the theoretical arguments forwarded and available evidence reviewed suggest that those high on TEI may perceive a greater availability of social support. This may be the case because high dispositional emotion expressivity and perception and an optimistic disposition confer important social advantages for those high on TEI in the identification, development and maintenance of supportive interpersonal relationships. On the basis of this

theorizing and reviewed evidence, greater TEI is hypothesized to be directly associated with higher perceived social support (H_{DR6}). This hypothesized path is incorporated into the multistage mediation model as shown in in Figure 4.6. Greater perceived social support may, in turn, promote better psychosocial adaptation to the university transition, raising the possibility that perceived social support serves as a proximal mediator that, at least in part, transmits the effect of TEI onto psychosocial adaptation and, in turn, achievement. The possibility of this three-path mediational process is examined below.

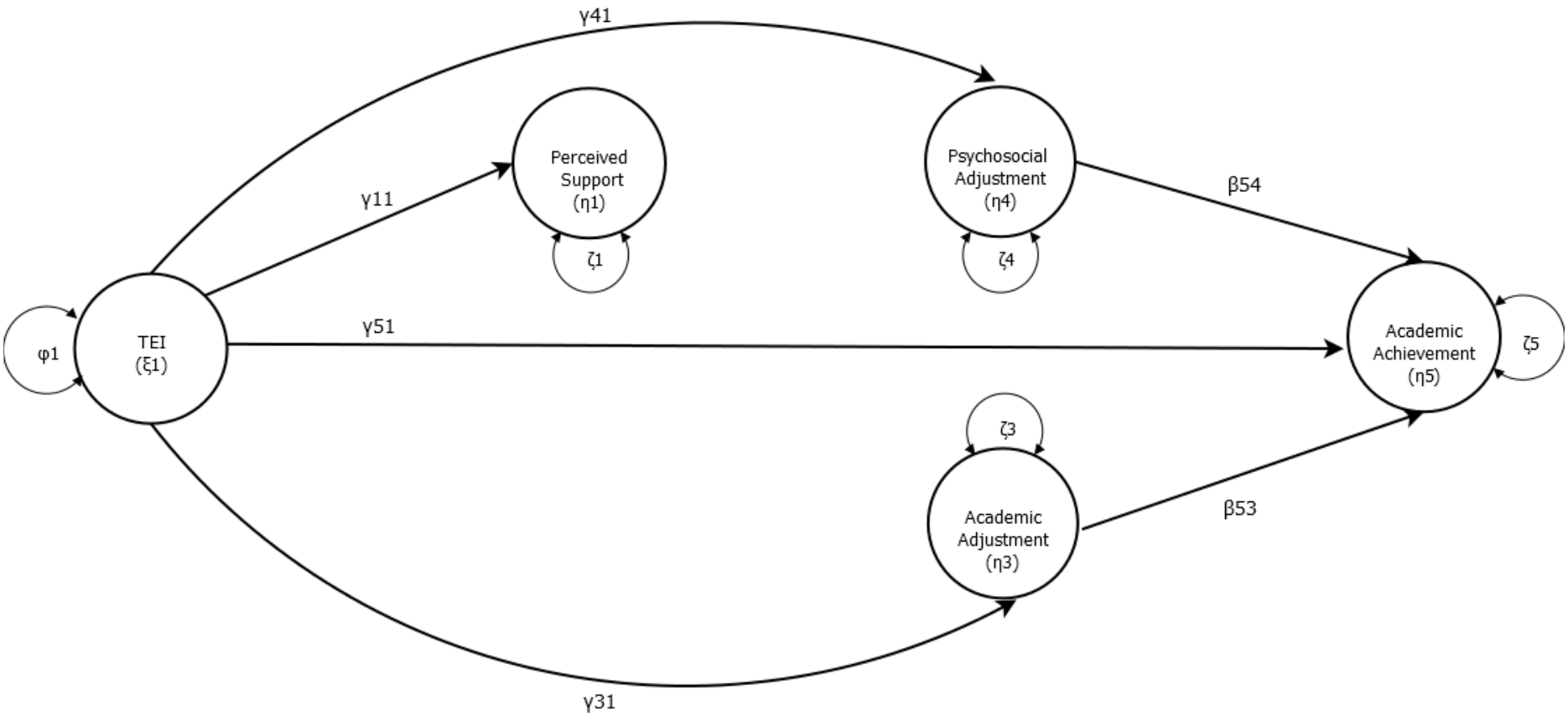

Figure 4.6. Specification of the direct path from TEI to perceived social support

4.3.1.2 Social support and psychosocial adjustment. Incoming students who perceive a greater availability of social support may be better psychosocially adjusted to the university transition and, in turn, achieve better performance outcomes than those who perceive little support. There is abundant empirical evidence that perceived social support fosters psychosocial adaptation to stressful life events (see S. Cohen & Willis, 1985), including the university transition (Aspinwall & Taylor, 1992; Brissette et al., 2002; S. Cohen & Hoberman, 1983; S. Cohen, Sherrod, & Clark, 1986; Friedlander et al., 2007; Holahan, Valentiner, & Moos, 1995). For example, Brissette et al. (2002) found that students who reported increases in perceived social support during the first semester of university experienced smaller increases in distress across the transition relative to those who perceived less support (Brissette et al., 2002). Similar results were observed by Friedlander et al. (2007), using a comparable longitudinal design, in which incoming undergraduates reported on their perceived social support and adjustment initially during the fall semester and again at the beginning of the spring semester. From the fall to spring semesters, students who perceived increases in their interpersonal resources from friends also reported improved social (e.g., involvement in university activities) and psychological (e.g., lower depressive affect) adjustment (Friedlander et al., 2007). Furthermore, Cutrona (1982) found that incoming students who perceived a greater availability of interpersonal provisions reported better social adjustment as indexed by lower scores on the UCLA loneliness scale. These results were replicated by Pierce, Sarason, and Sarason (1991) who observed that generalized perceptions of the availability of social support predicted lower loneliness using two distinct measures of perceived social support.

These findings of the association of perceived social support with indices of psychosocial adaptation can be attributed to at least two theoretical mechanisms. The first mechanism concerns the psychological functioning and social involvement components of psychosocial adaptation and can be explained from the perspective of the stress-buffering account of social support. This account of social support proposes that stress will have potentially pathogenic effects on individuals' psychological well-being to the extent that they possess little social support or perceptions thereof, whereas stressor effects will be attenuated or diminished for those with strong social support systems (S. Cohen & McKay, 1984; S. Cohen & Willis, 1985; Thoits, 1995). Thus, social support effects are expected to intervene at two points along the temporal pathway from stress to distress. First, social support may intervene between the stressful event and the initial cognitive-emotional reaction by attenuating or diminishing

strong threat appraisals (S. Cohen, Gottlieb, & Underwood, 2000; S. Cohen & Syme, 1985). It may be that the perceived availability of informational, emotional and instrumental provisions leads to a more benign or less-threatening appraisals of the event and increased self-perceived ability to cope, thereby preventing the development of negative affective and physiological and behavioral responses to stressors that give rise to psychological distress (S. Cohen et al., 2000). Second, further along the temporal chain linking stress and distress, perceived support may interfere with the hypothesized link between the stressful experience and the onset of psychological distress by dampening concomitant behavioral and neuroendocrine responses to stress (S. Cohen et al., 2000; Kawachi & Berkman, 2001).

Although the stress-buffering account has typically been used to explain the process through which perceived social support preserves psychological and physical health (S. Cohen, 1988; S. Cohen & Willis, 1985), this account can be extended to explain the association of perceived social support with social involvement. Under the buffering model, one of the key pathways by which perceived social support is posited to influence well-being is through alterations of strong threat appraisals (S. Cohen et al., 2000). This mechanism may be especially informative for elucidating the role of perceived social support in social involvement. One possibility is that perceptions of the availability of specific social provisions, such as informational and emotional support (S. Cohen, 1988), might lead to greater involvement in social activities by modifying threat appraisals of social events. For instance, perceptions of the availability of network provision of information about social events may result in more benign appraisals of such events, which, in turn, may increase the likelihood of involvement in social activities. Similarly, it may be that the perceived availability of support provisions increases feelings of personal control over the social environment (S. Cohen, 1988), which may lead to less-threatening appraisals of social events and, ultimately, greater social involvement.

The second mechanism linking perceived social support with psychosocial adaptation centers on the (low) loneliness and relationship satisfaction components of psychosocial adaptation and can be explicated in terms of cognitive discrepancy and social needs models of social adaptation. The cognitive discrepancy hypothesis holds that people may feel lonely or dissatisfied with their social relationships to the degree that there is a perceived discrepancy between actual and optimally desired levels of social functions (de Jong Gierveld, Van Tilburg, & Dykstra, 2006; Marangoni & Ickes, 1989; Perlman & Peplau,

1982). On the contrary, social needs models posit that low relationship satisfaction and loneliness result from unmet social needs due to actual deficits in social contact (i.e., low social network size, infrequency of social contact) (Archibald, Bartholomew, & Marx, 1995; Marangoni & Ickes, 1989; Weiss, 1973). Although the cognitive discrepancy and social needs model represent distinct theoretical traditions in the investigation of social functioning (i.e., cognitive process vs. objective social deficits) (Marangoni & Ickes, 1989), there is a good deal of convergence between the models that is particularly informative for elucidating the role of perceived social support in loneliness and relationship satisfaction.

First, though the social needs model posits that loneliness arises from objective deficits in social contact (Weiss, 1973), loneliness may also assume an underlying process of cognitive mediation of the effect of relationship deficiencies on social maladjustment. According to the social needs model, individuals possess inherent needs for basic social provisions (e.g., reassurance of worth, guidance, sense of belonging) (Weiss, 1973, 1974). Optimal social adjustment is expected when all or most of an individual's needs are met whereas social maladjustment is posited to increase as fewer needs are met (Archibald et al., 1995). These propositions imply a direct effect of objective social deficits on indices of social adjustment irrespective of subjective evaluations of network characteristics. It is, however, unlikely that objective characteristics of social networks are not, at least in part, subjectively evaluated with respect to desired or expected levels of support provisions (de Jong Gierveld, 1987, 1998). This is consistent with Peplau and Perlman's (1982) proposition that loneliness is not synonymous with objective social isolation; individuals with limited social relationships in terms of absolute size or frequency of contact may be objectively socially isolated but they are not necessarily lonely or dissatisfied with their relationships.

A second point of convergence of the social needs models with the cognitive discrepancy approach, which may be informative for clarifying the role of perceived social support in loneliness and relationships satisfaction, is the commonality between desired levels of social functions and social needs. As mentioned above, under the cognitive discrepancy model, perceived discrepancies between desired or expected levels of social provisions and actual provisions are posited to result in social maladjustment (Archibald et al., 1995; Perlman & Peplau, 1981, 1982). According to the social needs perspective, unmet interpersonal needs are hypothesized to lead to feelings of loneliness and relationship dissatisfaction (Weiss, 1973). It may be that desired or expected levels of social relations reflect underlying

interpersonal needs, such as reassurance of worth, attachment and guidance (Marangoni & Ickes, 1989; Shaver & Hazan, 1986). As an individual's needs change in the social environment, so too may their expected or desired levels of social functions, thereby impacting their perceptions of the sufficiency of existing support provisions.

These lines of theorizing suggest that the experience of loneliness and relationship dissatisfaction may be expected to arise when desired or expected levels of social provisions, based on existing social needs, are perceived as unavailable or deficient. Put another way, loneliness and dissatisfaction with peer relations may be responses to perceived discrepancies between social needs, as reflected in desired or expected level of social provisions, and the perceived availability of interpersonal resources to meet these needs. This theorizing may be especially applicable to first year students as they adjust to the university transition. Across the transition, individuals are exposed to numerous normative academic and socio-emotional stressors, such as academic overload and making new friends (Arthur & Hiebert, 1996; Credé & Niehorster, 2012; Petruzzello & Motl, 2006), which may increase needs for social provisions. To the extent that basic interpersonal needs underlie desired forms of social relationships (Shaver & Hazan, 1986), students' expected levels of social provisions may be particularly high as they adjust to the transition. Following from this, the experience of feelings of loneliness and relationship dissatisfaction may be precipitated when social provisions are perceived as unavailable to meet social needs as reflected by desired levels of support.

Taken together, the weight of the theoretical assertions and evidence suggests that perceived social support may foster better psychosocial adaptation to the university transition. It may be that perceptions of the availability of social support promote greater psychological well-being and involvement in the university social environment by modifying threat appraisals of stressful events. Social support may also serve as a protective factor against the experience of loneliness and relationship dissatisfaction under stressful conditions to the extent that it is perceived as available to meet the individual's social needs. Accordingly, perceived social support is expected to directly and positively predict psychosocial adaptation to the university transition (H_{DR7}). Figure 4.7 shows this hypothesized path in the expanding multistage mediation model. Furthermore, taken with evidence linking TEI with social support and psychosocial adaptation with achievement as per hypotheses H_{DR6} and H_{DR5}, respectively, the present assertions and evidence suggest that perceived social support may

proximally intervene in the pathway linking these constructs. Thus, TEI is expected to be indirectly associated with (a) psychosocial adaptation via perceived social support (H_{IR3}) and (b) first semester achievement through perceived social support and psychosocial adaptation linked serially in a three-path mediated sequence (H_{IR4}).

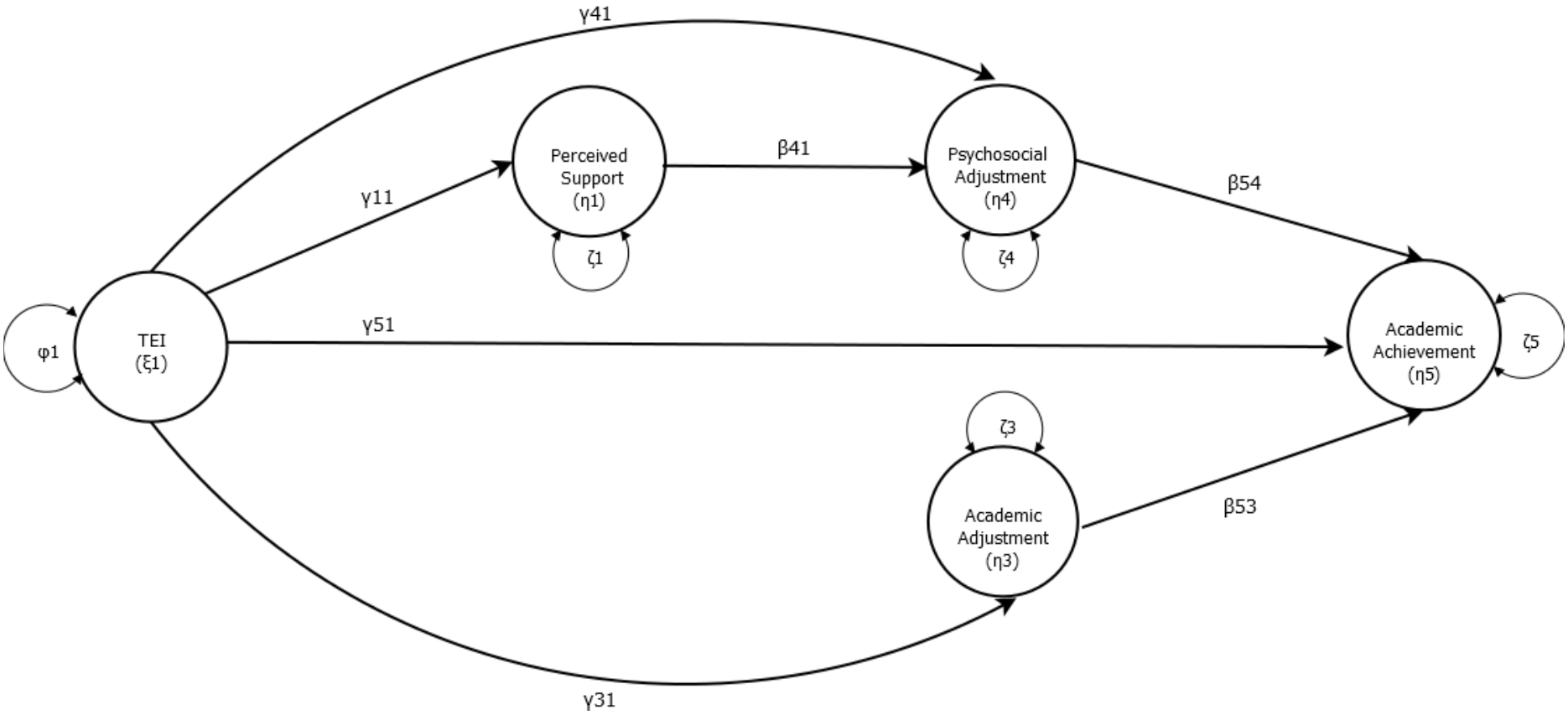

Figure 4.7. Specification of the direct path from perceived social support to psychosocial adjustment

4.3.2 Proximal Mediating Role of Engagement Coping

Engagement coping constitutes a second proximal mediating pathway through which TEI may promote adaptation to the university transition and, in turn, achievement. Consistent with the widely-accepted hierarchical model of coping (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000), in the present research, engagement coping is defined as active attempts to manage a stressful situation or the associated emotions, involving both primary and secondary control strategies. Primary control engagement refers to problem-focused attempts to control, remove or circumvent the stressor to ameliorate its effects through initiating direct action, increasing effort and planning (Connor-Smith et al., 2000; Connor-Smith & Flachsbart, 2007). Secondary control engagement strategies refer to emotion-focused attempts made by the individual to adapt to the stressor to generate an optimal fit between person and environment, such as positive reinterpretation (Skinner, Edge, Altman, & Sherwood, 2003). Notwithstanding these distinctions between primary and secondary control engagement efforts, both strategies reflect more general approach-oriented coping responses directed towards reactions to the stressor or the stressor itself (Connor-Smith & Flachsbart, 2007).

Increasing evidence supports the view that TEI influences the ways that people cope under stressful conditions. Researchers have found that individuals high on TEI are more likely to report the use of both primary and secondary control engagement coping strategies in response to exposure to stress (see e.g., Davis & Humphrey, 2012; Mavroveli, Petrides, Rieffe, & Bakker, 2007; Petrides, Perez-Gonzalez et al., 2007; Mikolajczak, Nelis, Hansenne, & Quoidbach, 2008; Petrides, Pita et al., 2007; Saklofske, Austin, Mastoras, Beaton, & Osborne, 2012). Although these studies have demonstrated robust relations of TEI with engagement strategies, theoretical explanations for these links have been largely overlooked. Indeed, this dearth of theoretical underpinning has led to considerable conflating of TEI with coping in the psychological literature. For example, at least three studies of TEI, coping and adaptation have conceptualized TEI and coping strategies as superordinate composite components of coping on the basis of factor-analytic results (Austin et al., 2010; Saklofske et al., 2012). This approach unwittingly confounds distal personality determinants with situational mediating processes as TEI is believed to be a collection of relatively stable affective personality traits whereas coping strategies refer to conscious, volitional and dynamic cognitive and behavioral efforts to control, remove, circumvent or accommodate

stressors (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). In this section, specific theoretical links between TEI and engagement coping strategies are proposed, which distinguish the constructs on conceptual grounds and clarify conceptually their temporal ordering in a sequence of unfolding events. Such theoretical elaboration also serves as a basis for understanding the ways in which engagement coping may carry the effects of TEI onto academic and psychosocial adaptation and, in turn, achievement.

4.3.2.1 TEI and engagement coping. One explanation for the association between TEI and engagement coping is that an optimistic disposition may promote increased engagement and effort to overcome adversity through regulating the environment or reactions to the environment. According to TEI theory (Petrides, 2011), individuals high in TEI possess generalized positive outcome expectancies whereas those low on TEI tend to hold generalized negative expectancies for the future. For at least the past two decades, a good deal of empirical and theoretical literature has focused on a model of behavioral self-regulation in the expectancy-value tradition to explain the link between an optimistic disposition and engagement coping (see e.g., Carver et al., 2010; Carver & Scheier, 1981 Scheier et al., 1994; Scheier & Carver, 1988). In this model, favorable outcome expectancies are postulated to lead to increased effort to overcome adversity to attain valued goals whereas negative expectancies for the future are posited to lead to decreased effort and disengagement from the threatened goal (Carver et al., 2010; Nes & Segerstrom, 2006; Scheier et al., 1994). This is because expectancy-value theories hold that people are sufficiently engaged in efforts to pursue and attain desired goals to the degree that their expectancies for success in meeting these goals are adequately favorable (Scheier et al., 1994). To the extent that an optimistic disposition reflects generalized favorable outcome expectancies (Carver et al., 2010), it may be expected to influence engagement and sustained effort across several life domains, including people's efforts to cope in response to stressful life events.

The ways in which those with optimistic and pessimistic dispositions differ in their coping responses may reflect general differences in two categories of behavioral tendencies: (a) approach tendencies (e.g., continued striving, increased effort); (b) avoidance tendencies (e.g., reduced effort, giving up, turning away) (Carver et al., 2010; Nes & Segerstrom, 2006). According to Nes and Segerstrom (2006), an optimistic disposition may be a source of the disjunction between approach and avoidance behaviors. This distinction between broad approach and avoidance resembles the important distinction between engagement and disengagement strategies proposed in the widely-accepted hierarchical model of coping

(Carver & Connor-Smith, 2010; Connor-Smith et al., 2000; Connor-Smith & Flachsbart, 2007; Nes & Segerstrom, 2006; Skinner et al., 2003). Thus, an optimistic disposition among those high on TEI may be expected to facilitate broad engagement strategies in response to stressful situations. It may be that an optimistic disposition promotes the greater use of primary control engagement strategies, such as active coping and planning, because generalized positive expectancies for eventual success lead to greater engagement and increased effort to overcome adversity (Carver & Connor-Smith, 2010; Carver et al., 2010; E. E. Matthews & Cook, 2009; Nes & Segerstrom, 2006; Scheier, Weintraub, & Carver, 1986). It may also be that those who possess an optimistic disposition use secondary control engagement strategies, such as cognitive restructuring, because they tend to frame even unfavorable events in a positive light, thereby potentially mitigating the impact of threat appraisals on goal attainment (Carver et al., 2010).

There is abundant evidence supporting these theoretical accounts of the role of an optimistic disposition in facilitating the use of engagement coping. Indeed, dozens of studies over the past two-and-a-half decades have found modest-to-moderate positive associations between generalized positive expectancies and engagement coping in samples ranging from HIV positive men (e.g., J. M. Johnson & Endler, 2002; Kurdek & Siesky, 1990; S. E. Taylor et al., 1992) to in vitro fertilization patients (e.g., Litt et al., 1992) and Kosovo refugees (Riolli, Savicki, & Cepani, 2002). An optimistic disposition has also been linked to the use of engagement coping in response to exposure to stressors during the university transition (Aspinwall & Taylor, 1992; Brissette et al., 2002). For instance, in an empirical test of a multi-wave model of university adaptation, Aspinwall and Taylor (1992) found that dispositional optimism exerted a positive effect on active coping, even after partialling out the influence of negative and positive mood and psychological control. Similarly, Brissette et al. (2002) observed that incoming undergraduates who were higher in dispositional optimism were more likely to report the use of primary control (e.g., active coping, planning) and secondary control (e.g., positive reinterpretation) engagement strategies to manage transition stressors over the course of the first semester of university.

These empirical results are consistent with findings of the largest-ever meta-analysis of the optimism-coping link. In this meta-analytic review, Nes and Segerstrom (2006) obtained a modest weighted mean association between optimism and broad engagement coping (r = .15) based on a synthesis of effect sizes drawn from almost fifty independent samples.

Comparable validity coefficients were obtained at lower levels of conceptual aggregation, with optimism correlating positively with both primary-control (r = .16; k = 36) and secondary-control (r = .12; k = 26) engagement coping (Nes & Segerstrom, 2006). The studies reviewed suggest that an optimistic disposition facilitates greater use of engagement coping in response to stressful events. For high TEI individuals, who possess an optimistic disposition, generalized favorable expectancies for eventual goal attainment, which may lead to increased approach behavior, may explain, at least in part, why they are more likely to use primary control engagement coping strategies in response to stressful events. Further, tendencies among high TEI individuals to appraise even undesirable events in a positive light may contribute to their greater use of secondary-control engagement strategies.

A second reason why TEI might facilitate the use of engagement coping under stressful conditions is that biologically-based temperament systems underlying the construct may serve as regulatory guides for approach behavior and engagement, involving efforts to change and accommodate stressors consistent with environmental demands. TEI reflects tendencies towards positive emotionality and assertiveness that may be grounded in a basic appetitive motivational system. According to Derryberry et al. (2003), the neural circuitry underlying the appetitive system has evolved over human evolutionary history to trigger approach responses to rewarding environmental stimuli in the service of species' survival. The neural circuitry underpinning the appetitive system comprises the striatum, orbitofrontal cortex and amygdala (Rueda & Rothbart, 2009), which are implicated in not only the automatic detection and expectations of rewards but also motor activation and the planning of goal-oriented behavior (Cromwell, Hassani, & Schultz, 2005; Depue & Collins, 1999; Forbes & Dahl, 2005; Schultz, Tremblay, & Hollerman, 2000). Activation of the appetitive system in the presence of reward cues evokes the coordination of these neural structures that may guide approach behavior (Forbes & Dahl, 2005). For those high on TEI, approach tendencies, reflected in primary traits, such as positive emotionality and assertiveness, should lead to efforts to initiate primary control engagement strategies, which require approach behavior, when confronting adversity (Carver & Connor-Smith, 2010; Connor-Smith & Flachsbart, 2007). Indeed, the shared motivational underpinnings of TEI and engagement coping raise the possibility that engagement coping may reflect TEI in action under stress (Bolger, 1990). A danger in possessing an over-reactive appetitive system is, however, that coordinated engagement strategies may be impeded by unrestrained approach motives, leading to coping responses that are misdirected and ineffective (Derryberry et al., 2003). For high TEI

individuals, high underlying attentional control may serve as a protective factor by modulating reactivity in the appetitive system.

The high perseverance, determination and achievement orientation and low impulsivity that, in part, define high TEI may be grounded in an underlying attentional temperament system that also influences coping behavior under stressful conditions (Compas, Connor-Smith, & Jaser, 2004). In psychobiological models of temperament, the attentional system is involved in modulating reactivity in primary temperament systems (Carver & Connor-Smith, 2010; Derryberry et al., 2003; Derryberry & Rothbart, 1997; Rothbart, Sheese, & Posner, 2007). The neural circuitry that underlies the attentional system enables the volitional and effortful control of emotional and behavioral responses through the regulation of attention, inhibition of inappropriate response tendencies and maintenance of required responses (Derryberry et al., 2003; Rothbart et al., 2000). This circuitry is known as the executive attention network, primarily involving the anterior cingulate cortex (ACC) (Posner et al., 2007; Rothbart et al., 2000; Rothbart & Rueda, 2005; Rueda et al., 2004). Cingulate activity has been consistently linked to effortful control over (a) dominant but situationally inappropriate response behaviors, including the monitoring and resolving of conflict among competing responses (Rothbart et al., 2000; Rothbart et al., 2007; Rueda et al., 2004; Rueda & Rothbart, 2009), (b) affective information for conscious processing (Rothbart & Posner, 2006) and (c) attentional orienting (Rothbart et al., 2000).

For those high on TEI, it may be that the high effortful control, which underlies traits such as perseverance, determination and low impulsivity (Connor-Smith & Flachsbart, 2007; Jensen-Campbell et al., 2002), enables individuals to not only persist in primary engagement coping efforts but also inhibit potentially destructive, overactive approach motives that may interfere with situationally appropriate coping responses (Carver & Connor-Smith, 2010; Derryberry et al., 2003). It may also be that the strong attentional regulation tendencies underpinning TEI facilitate the use of secondary control engagement strategies, such as cognitive restructuring, which require the reorientation of attention from negative thoughts to neutral or positive thoughts (Carver & Connor-Smith, 2010; Compas et al., 2004; Connor-Smith & Flachsbart, 2007). For individuals low in TEI, it is likely that an interaction between an underreactive appetitive system and low effortful control interferes with attempts to respond to stressors using primary and secondary engagement strategies by inhibiting both approach behavior and attentional regulation (Derryberry et al., 2003).

Accumulating evidence from the temperament literature is consistent with the view that appetitive and attentional regulation systems, which may underlie TEI, provide a general framework for engagement coping behavior. For example, three early studies showed that high positive emotionality (Willis, DuHamel, & Vaccaro, 1995) and attentional control (Eisenberg et al., 1993; Fabes & Eisenberg, 1997), indexing activity in the appetitive and attentional systems, respectively, were associated with greater use of primary control engagement coping strategies, such as constructive coping, active coping and problem-solving. More recently, De Boo and Spiering (2010) found that children who scored higher on measures of positive emotionality and effortful control were more likely to report using primary engagement strategies, including active problem solving. Furthermore, in an empirical test of a theoretical model of the effects of children's temperament on post-divorce threat-appraisals, coping and psychological functioning, Lengua, Sandler, West, Wolchik, and Curran (1999) found positive relations of positive emotionality and inhibitory control with primary and secondary control engagement coping. Finally, in an unpublished path-analytic study of the relations among temperament, coping and symptoms in a sample of children with recurrent abdominal pain, secondary control engagement coping was found to meditate the relationship between attentional control and symptoms of anxiety, such that those children with higher attentional control were more likely to use secondary control engagement strategies, such as cognitive reappraisal, which lead to the experience of lower levels of anxious and depressive affect (Compas et al., 2004). It is inferred from this evidence that high TEI individuals are more likely to use engagement coping strategies in response to stressful events. This is because basic appetitive and attentional temperament systems may be developmental substrates of TEI that provide a general framework for the selection of voluntary, controllable coping strategies when confronting adversity (Carver & Connor-Smith, 2010; Compas et al., 2004; Connor-Smith & Flachsbart, 2007; Derryberry et al., 2003; Rueda & Rothbart, 2009).

Taken together, the theoretical arguments put forward and evidence reviewed suggests that TEI may facilitate the use of engagement coping under stressful conditions. This may be the case because an optimistic disposition among those high on TEI promotes engagement in efforts to both change and accommodate stressors. It may also be that appetitive and attentional temperament systems, which are presumed to underlie TEI, provide a framework for the selection of engagement coping strategies in response to stressful events. A major advantage of this temperament approach to the TEI-coping link is that it is anchored in

psychobiological accounts of the neural structures that underlie temperament systems (see e.g., Derryberry & Rothbart, 1997; Rothbart et al., 1994; Rothbart et al., 2000), thereby providing a functional basis for the potential role of TEI in facilitating the use of engagement coping strategies (Derryberry et al., 2003). On the basis of these assertions advanced and evidence reviewed, TEI is expected to directly and positively predict the use of engagement coping strategies during the university transition (H_{DR8}). This hypothesized path is included in the proposed mediation model shown in Figure 4.8. The greater use of engagement coping strategies in response to transitions stressors may, in turn, foster better academic and psychosocial adaptation, raising the possibility that engagement coping also serves as a proximal mediator that carries some of the effects of TEI onto adaptation and, in turn, achievement. The possibility of these three-path mediated effects is examined below.

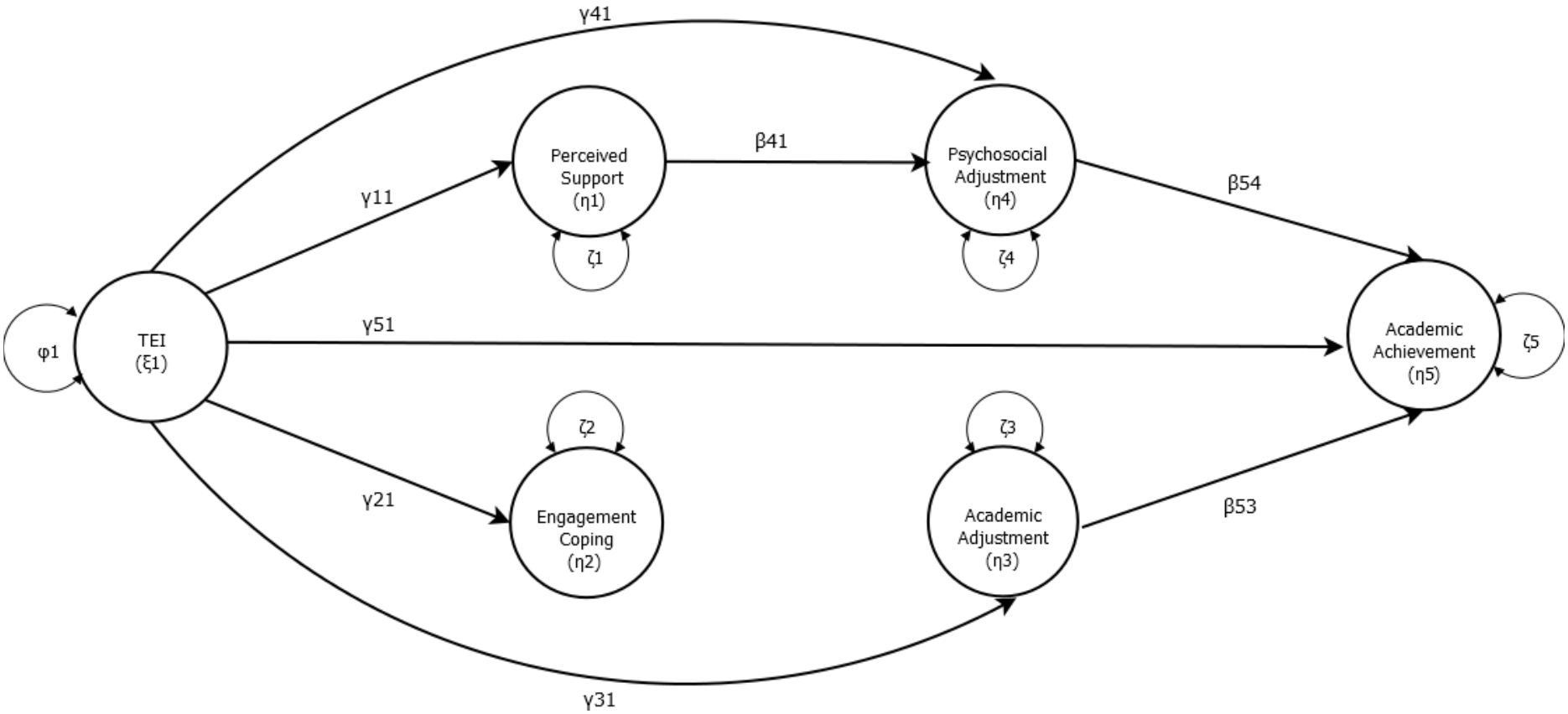

Figure 4.8. Specification of the direct path from TEI to engagement coping.

4.3.2.2 Engagement coping and adaptation. Incoming students who use engagement coping strategies to manage university transition stressors may experience better academic and psychosocial adjustment to the university and, in turn, achieve better performance outcomes than those who refrain from using engagement strategies.

Although engagement coping has been consistently linked with better psychosocial adaptation to stressful educational transitions (e.g., Aspinwall & Taylor, 1992; Brissette et al., 2002; Bouteyre, Maurel, & Bernaud, 2007; Holahan et al., 1995; Park & Adler, 2003; Tao, Dong, Pratt, Hunsberger, & Pancer, 2000), little attention has been paid to its role in academic adaptation. At least two lines of theory and research, however, point to the possibility that the roles of engagement coping in academic and psychosocial adaptation to stressful events may be quite compatible.

First, engagement coping reflects increased cognitive and behavioral efforts to control, change, resolve and adapt to stressors emerging, at least in part, from generalized expectancies for favorable adaptational outcomes (Carver et al., 2010; Carver & Scheier, 1998; Scheier & Carver, 1985; Scheier, Weintraub, & Carver, 1986). This is consistent with models of behavioral self-regulation in the expectancy-value tradition (Carver et al., 2010). From this perspective, to the extent that individuals remain engaged in efforts to attain academic goals when confronting adversity, reflected in their engagement coping strategies, they may be expected to experience (a) better academic adaptation and (b) approach-related positive affect as they move towards desired goals (Carver & Scheier, 1990a, 1998; Nes, Segerstrom, & Sephton, 2005; Scheier & Carver, 1985). Thus, engagement coping may be viewed as a proximal mediator that transfers the effect of dispositional expectancies on adaptational outcomes in a causal chain of events fostering the activation and maintenance of goal-directed behavior.

A second, complementary, literature suggests that engagement coping in response to stress reflects underlying activity in a core motivation system that may support academic and psychosocial adaptation. Recent theorizing on the neural underpinnings of engagement coping has implicated the appetitive system in the use of engagement strategies under stressful conditions (S. E. Taylor & Stanton, 2007). As mentioned above, this system of motivation is believed to regulate appetitive stimulation and govern the goal-driven activation of behavior (Amodio, Master, Yee, & Taylor, 2008; Gray, 1990). When exposed to cues signaling reward or benefit, the level of activity in the appetitive system is expected to

increase and trigger movement towards desired goals (Carver & White, 1994). During the university transition, common sources of academic stress that may be implicated in adaptation include a lower level of academic structure, increased academic demands and study loads and greater time pressure. To the degree that these stressors are appraised by the individual as challenging, rather than threatening, holding the potential for reward or gain (Folkman, Lazarus, Gruen, & DeLongis, 1986), activation of the appetitive system may promote primary-control coping efforts, such as problem solving, to manage these stressors in the service of (a) optimizing engagement in the academic environment and (b) experiencing approach-related well-being elicited by appreciable movement towards a desired goal (Amodio et al., 2008; Carver & White, 1994; Davidson & Irwin, 1999; Davidson et al., 2000)

Secondary-control engagement strategies, such as cognitive reappraisal, may also assist individuals in adjusting psychosocially to stressful life. Along the timeline of the unfolding stress and coping process, involving primary and secondary appraisals (Lazarus & Folkman, 1984), a stressful person-environment transaction, which is initially appraised as threatening to well-being, may be cognitively reappraised as sufficiently neutral or positive after secondary appraisal, thereby altering subsequent emotional and neurobiological trajectories (S. E. Taylor & Stanton, 2007). Specifically, reappraisal of a stressful event as benign or favorable may prevent prolonged HPA axis hyperfunction (Dedovic, Duchesne, Andrews, Engert, & Pruessner, 2009; S. E. Taylor et al., 2008; S. E. Taylor & Stanton, 2007). As HPA hyperactivity-induced hypercortisolism has been implicated in psychological distress (e.g., depression) (Holsboer, 2001; Stokes, 1995), it follows that cognitive reappraisal may serve a protective function for individuals exposed to stressful events. This modulation of neurobiological pathways from stress to distress may explain, at least in part, the way in which engagement coping, specifically cognitive restructuring, carries the effect of TEI on psychosocial adjustment.

Only a handful of studies have examined the role of engagement coping in adjusting academically to the university transition (Aspinwall & Taylor, 1992; Leong et al., 1997; Tao et al., 2000). The small amount of available evidence does, however, suggest that engagement strategies are associated with academic adaptation. For example, in one study of 161 incoming students attending an Ivy-League college in the United States, Leong et al. (1997) found that active coping was the strongest predictor of academic adaptation in a regression model of coping influences. Two further studies of the university transition, though limited

by their aggregation of domain-specific adjustment indices, provide tentative prospective evidence for the important role of engagement coping in academic adaptation (Aspinwall & Taylor, 1992; Tao et al., 2000). First, Aspinwall and Taylor (1992) reported on a study of the effects of individual differences and coping on adjustment. The researchers found that active coping, appraised at the start of the first semester, predicted greater university adjustment, indexed, in part, by academic adaptation, three months thereafter (Aspinwall & Taylor, 1992). A second prospective study of the university transition reported a moderate positive association between positive coping —a composite of primary and secondary control engagement strategies—and university adjustment (Tao et al., 2000). First year students who reported using more positive coping strategies during the first few weeks of the semester also reported higher semester-end global adjustment, measured, in part, by the academic adjustment subscale of the SACQ (Tao et al., 2000).

Empirical evidence for the engagement coping-psychosocial adaptation link is much more extensive. For example, engagement strategies have been shown to predict concurrent and subsequent psychosocial adjustment to life stressors as varied as military deployment (Sharkansky et al., 2000), combat stress (Solomon, Avitzur, & Mikulincer, 1989), parental divorce (Sandler, Tein, & West, 1994), bereavement (Folkman, Chesney, Collette, Boccellari, & Cooke, 1996), and acculturative stress (Crockett et al., 2007). A few studies have also investigated the effects of engagement coping on psychosocial adjustment during the university transition (see e.g., Abdullah, Elias, Uli, & Mahyuddin, 2010; Aspinwall & Taylor, 1992, Brissette et al., 2002; Dyson & Renk, 2006; Gall et al., 2000; Holahan et al., 1995; Leong et al., 1997; Tao et al., 2000). In one longitudinal study of psychological adjustment to university, Brissette et al. (2002) observed that first year students, who reported the greater use of engagement strategies, including active coping, planning, and positive reinterpretation, experienced better psychological adjustment to the transition as indexed by smaller increases in depressive symptoms across the first semester. Similar results were obtained by Aspinwall and Taylor (1992) who found that engagement coping prospectively predicted higher adjustment indexed, in part, by higher psychological well-being and social adaptation (Aspinwall & Taylor, 1992). Yet another study among 241 incoming undergraduates in the United States, though reporting cross-sectional data, found that the percent of approach coping (i.e., positive reappraisal and problem-solving) used by incoming undergraduates to manage stressors in the previous 12 months was associated with greater higher well-being and lower distress (Holahan et al., 1995).

Altogether, the weight of the theoretical arguments advanced and evidence reviewed suggests that the use of engagement coping strategies to manage stressors may promote academic and psychosocial adaptation to the university transition. It may do so because increased cognitive and behavioral effort is directed at controlling, changing, resolving or adapting to novel transition stressors towards attaining valued goals, experiencing approach-related well-being and reducing pathological biological responses to stress. Accordingly, the greater use of engagement coping strategies is expected to be associated with better academic (H_{DR9}) and psychosocial (H_{DR10}) adaptation to the university transition. These hypothesized paths are incorporated into the expanding multistage mediation model shown in Figure 4.9. It is also inferred from the present assertions and reviewed evidence, taken together with evidence suggestive of associations of TEI with academic and psychosocial adaptation and the adaptation constructs with achievement (as per hypotheses H_{DR2}, H_{DR3}, H_{DR4} and H_{DR5}), that engagement coping may carry some of the effect of TEI onto both academic and psychosocial adaptation and, in turn, achievement. Therefore, TEI is expected to be indirectly associated with academic adaptation (H_{IR5}) and psychosocial adaptation (H_{IR6}) via engagement coping. Furthermore, TEI is expected to be indirectly associated with first semester achievement via (a) engagement coping and academic adaptation linked serially (H_{IR7}) and (b) engagement coping and psychosocial adaptation linked serially (H_{IR8}) in two three-path mediational sequences.

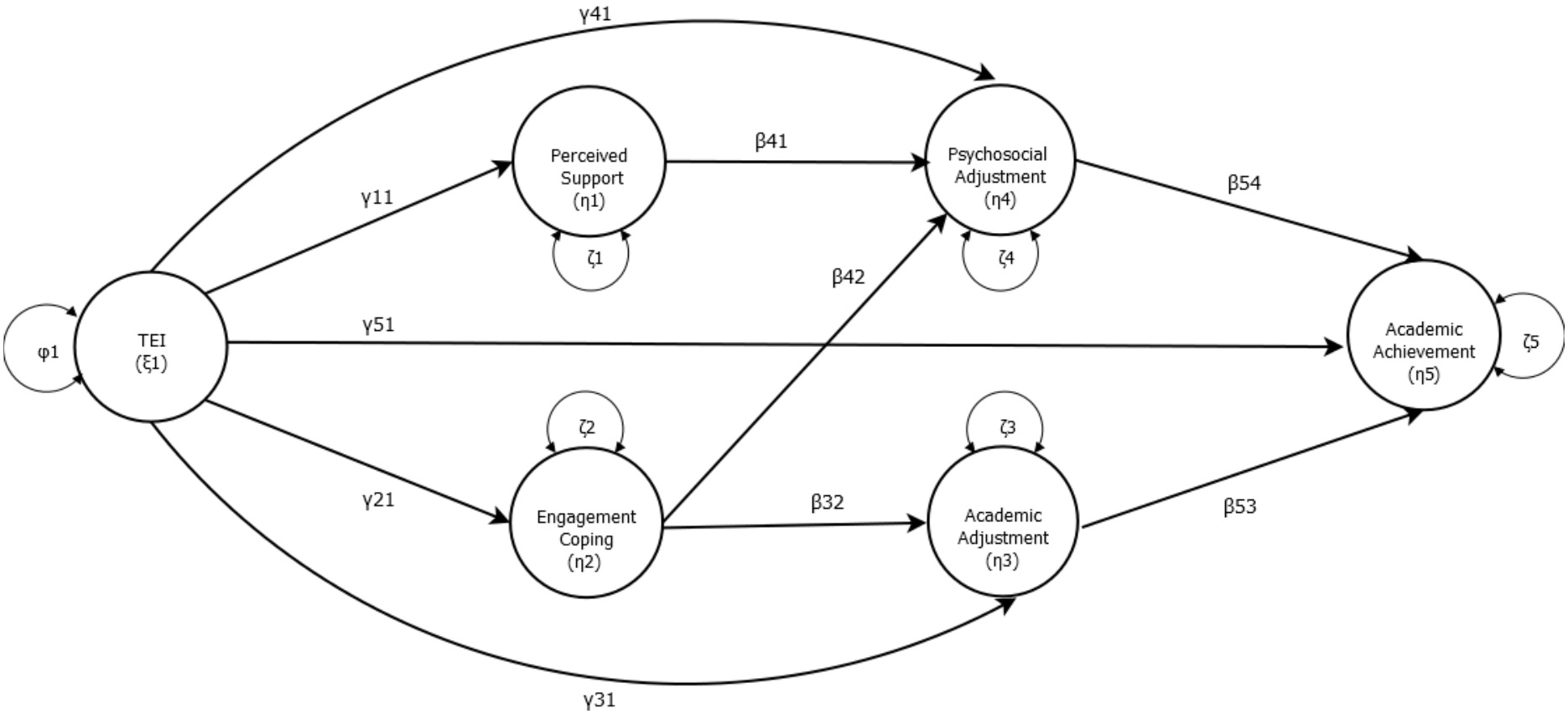

Figure 4.9. The final target model specification incorporating the direct paths from engagement coping to academic adjustment and psychosocial adjustment

4.3.3 Summary of Proximal Mediational Pathways

In sum, both perceived social support and engagement coping are proposed to serve as proximal mediators that, at least partly, link TEI with the adaptation and, in turn, achievement in a multistage model of mediation. The specification of perceived social support and engagement coping as proximal mediators in this temporal chain of events underpins the centrality of social support and coping as not only antecedents of adaptation but also potential portals for structured psychosocial interventions, such as coping effectiveness training and peer support programs, designed to optimize adaptation and, in turn, performance during key life transitions (Folkman & Moskowitz, 2004; Lidy & Kahn, 2006; S. E. Taylor & Stanton, 2007). The specification and testing of this multistage mediational process may also serve to clarify and refine the theoretical position concerning the role of TEI in educational adjustment and achievement, especially under stressful conditions such as the university transition. The final target mediation model for empirical testing is shown in Figure 4.9.

4.4 Alternative Theoretical Specifications

An important consideration in the specification and testing of any conceptual model is alternative model specifications. It is widely recognized that multiple a priori models exist for any multivariate data set (McDonald & Ho, 2002). These models may reflect nested or non-nested theoretically-defensible equivalent, near-equivalent or non-equivalent alternative specifications that explain the sample data as well as, or better than, the hypothesized target model (MacCallum, Wegener, Uchino, & Fabrigar, 1993; Tomarken & Waller, 2003). Although the consideration of alternative models may serve to protect against confirmation biases (MacCallum & Austin, 2000), if not reveal plausible competing theoretical views that may threaten the internal validity of the target model (MacCallum et al., 1993), researchers routinely disregard alternative specifications in applied research.

In multistage process studies, such as the present one, the number of alternative models that offer competing theoretical explanations can be substantially reduced by ensuring that the data collection reflects the effect priority or temporal precedence that is assumed in the target model (Cole & Maxwell, 2003; Tomarken & Waller, 2003; L. J. Williams, 2012). For instance, a directional path from an outcome to a mediator, reflecting reverse causation, is not theoretically meaningful if measurement of the mediator temporally precedes measurement of the outcome. Notwithstanding this degree of protection offered by multi-wave designs, the

present investigation examines three theoretically-plausible alternative specifications. This alternative models approach provides a useful framework for the conduct of model specification and testing that may not only guard against confirmation biases but also strengthen support for the favored model (see Hoyle, 2012; MacCallum & Austin, 2000 for reviews of the alternative models strategy).

In the present research, the alternative conceptual models concern the specification of fully versus partially mediated relations. In statistical mediation analyses, partial mediation is indicated when *X* has a direct association with *Y* (*c'*) over and above its indirect relationship via the mediator *M* (Shrout & Bolger, 2002). Complete mediation is indicated when the indirect association is equal to the total effect of *X* on *Y* (Shrout & Bolger, 2002). Although the "full" and "partial" mediation labels have, in recent times, received some criticism in the methodological literature, the most common of which is their dependence on *N* (see e.g., Preacher & Kelley, 2011; Rucker et al., 2011), they still hold conceptual and statistical value. Assuming sufficient statistical power and valid measurements, partial versus full mediation may be viewed as an indication of the possibility that important intervening variables have been omitted from the target model (MacKinnon, 2008). Furthermore, taken with quantitative indices of the strength of statistical mediation (e.g., residual-and-proportion-based indices; see Preacher & Kelley, 2011; Shrout & Bolger, 2002), the full and partial mediation terminology may convey important information about the practical importance of a mediator in a given context. Finally, in line with the basic principles of the philosophy of science, researchers should seek to retain the most parsimonious models. Tests of completely versus partially mediated relations may help to retain the most scientifically parsimonious model (James, Mulaik, & Brett, 2006).

Three alternative theoretical models were specified to assess the tenability of complete mediation of the relations of TEI with (a) first semester academic performance, (b) psychosocial adaptation and (c) academic adaptation. The first alternative model is one in which the direct relation of TEI with achievement is fixed to zero (AM1; see Figure 4.10). The second alternative model specifies a null direct relation between TEI and psychosocial adaptation (AM2; see Figure 4.11). The third alternative model is one in which the direct path from TEI to academic adaptation is fixed to zero (AM3; see Figure 4.12). These alternative specifications are more parsimonious, nested submodels of the less restrictive target model.

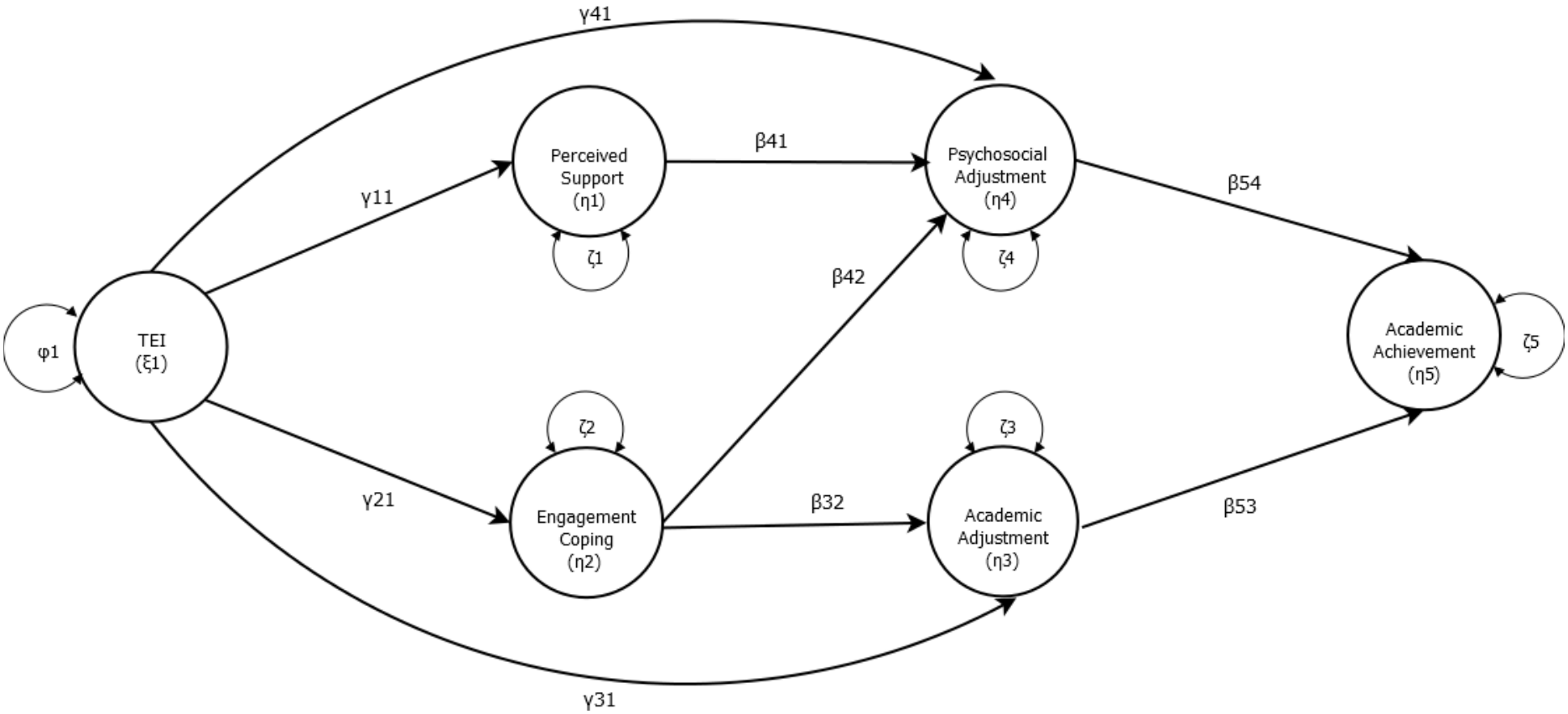

Figure 4.10. Alternative model AM1 with the direct path from TEI to achievement constrained to zero, reflecting full mediation of the TEI-achievement link.

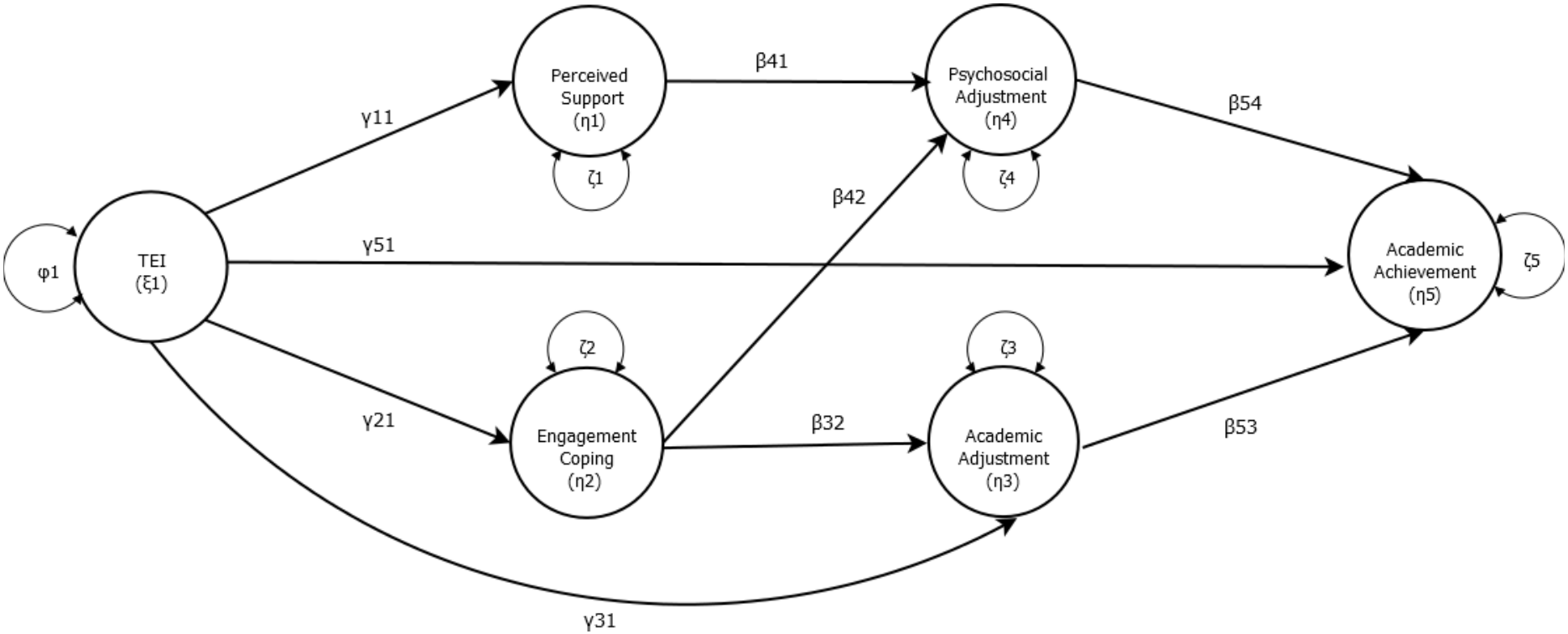

Figure 4.11. Alternative model AM2 with the direct path from TEI to psychosocial adaptation constrained to zero, reflecting full mediation of the TEI-psychosocial adaptation link.

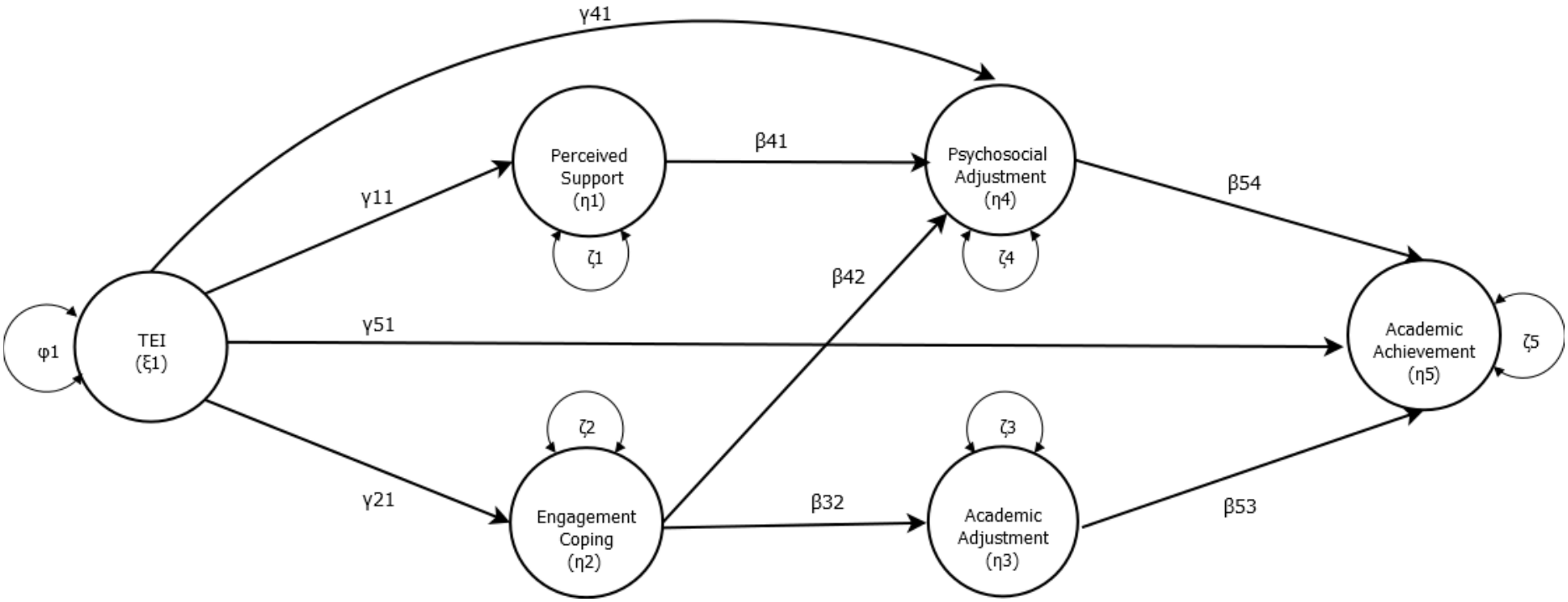

Figure 4.12. Alternative model AM3 with the direct path from TEI to academic adaptation constrained to zero, reflecting full mediation of the TEI-academic adaptation link.

4.5 Potential Third Variable Confounds in the Mediation Models

Two sources of possible confounding might substantially obfuscate the interpretation of the relations among the constructs in this study and thus necessitate adequate statistical control. First, extraversion is known to share conceptual ground with TEI with correlations in the order of .50 to .60 (Greven, Chamorro-Premuzic, Arteche, & Furnham, 2008; Petrides et al., 2010; Vernon, Villani, et al., 2008). In addition, higher extraversion has consistently been shown to be associated with the use of engagement coping (Connor-Smith & Flachsbart, 2007), more perceived social support (Asendorpf & Wilpers, 1998; Halamandaris & Power, 1997; Lidy & Kahn, 2006), and better psychosocial adaptation (DeNeve & Cooper, 1998; Halamandaris & Power, 1997). These findings raise the possibility that TEI predicts perceived social support, engagement coping and psychosocial adaptation chiefly because it is associated with high extraversion and not due to the effects of TEI itself. Thus, the current study controlled for the variance in engagement coping, perceived social support and psychosocial adaptation explained by extraversion. Second, neuroticism also shares conceptual territory with TEI (Petrides et al., 2010; Petrides, Pita et al., 2007) and predisposes individuals to the experience of distress (i.e., psychological maladjustment; Carver et al., 1993; DeNeve & Cooper, 1998; Scheier et al., 1994). Furthermore, neuroticism has been linked with academic adaptation to university (Lidy & Kahn, 2006). Thus, the present research also controlled for the variance in academic and psychosocial adaptation explained by neuroticism. These statistical controls were included to assess the extent to which the associations involving TEI are specific to TEI.

4.6 The Case for a Meta-Analytic Review of the Relationship between TEI and Achievement

Given the inconsistent findings of previous research on the TEI-achievement relationship (see Section 4.1), a meta-analysis was first conducted to clarify the validity of TEI for predicting achievement. Heretofore, no studies have reported a systematic quantitative synthesis of studies on the TEI-achievement link in spite of an increasing number of studies reporting relevant, albeit seemingly inconsistent, effects (see Mavroveli & Sánchez-Ruiz, 2011 for a narrative review). In a recent narrative review of the relation between TEI and academic performance (Mavroveli & Sánchez-Ruiz, 2011, p. 114), the authors' suggestion of the absence of an association between TEI and academic performance was attributed to their

finding of an "inconsistent pattern" of relations between the constructs on the basis of statistical significance. The narrative review, however, lacks a sound mechanism for assessing the consistency of effects across studies because much emphasis is placed on evaluating discrete *p*-values (Meehl, 1990). A quantitative synthesis may serve to mitigate the bias inherent in findings of narrative reviews generated by processes such as vote counting. More importantly, results obtained from a meta-analysis may serve to (a) clarify the TEI-achievement link and, in turn, (b) lend weight to the specifications of the a priori conceptual models linking TEI and achievement during the university transition. Based on the theoretical arguments advanced and evidence reviewed in this chapter, TEI is expected to have near-moderate validity for predicting achievement (H_{MA1}). Furthermore, this predicted summary effect is expected to be moderated by university transition status, such that the positive association increases in magnitude during periods of normative university transition (H_{MA2}). The methods and results of this meta-analysis are reported in Chapter Five.

4.7 Overview of the Present Research and Specific Predictions

The present research consists of two studies that tested the twenty hypotheses generated from the review of the literature in Chapters Two, Three and Four. Studies one and two are presented in Chapters Five and Seven, respectively (Chapter Six reports the results of a preliminary Monte Carlo simulation conducted to determine *N* requirements for the target mediation model). In the first study, the first-ever meta-analytic review of the TEI-achievement relation was conducted to clarify the validity of TEI for predicting academic performance. Moderator analyses were also conducted to test the influence, if any, of university transition status on the summary effect as well examine other supplementary moderators of the theorized relation.

The second study empirically tested the target partial mediation model shown in Figure 4.9. This model is one in which higher TEI is proposed to prospectively predict better achievement during the university transition both directly and indirectly via (a) perceived social support and engagement coping and (b) academic and psychosocial adaptation linked serially in a temporal chain of events unfolding across the transition. In addition, the second study examined three alternative models that provide competing conceptual accounts of the relations among TEI, perceived social support, engagement coping, adaptation, and first semester achievement. The target and alternative models are multistage parametric structures with TEI appraised within days of students' arrival at university, and engagement coping and

perceived social support assessed four weeks later. Measures of adaptation to the transition were obtained mid-semester, and cumulative academic performance records were obtained at semester-end. The testing of these models is expected to extend the meta-analytic investigation by elucidating some of the processes by which greater TEI is prospectively linked with better achievement. A summary of the specific predictions and research issues as a function of study follows.

4.7.1 Study One: A Meta-Analytic Review of the Relationship of TEI with Achievement

In terms of the meta-analytic review, the following predictions are advanced:

- H_{MA1}: TEI is positively associated with academic performance; and,
- H_{MA2}: the weighted mean association between TEI and academic performance is moderated by university transition status, such that the hypothesized positive association increases in magnitude during periods of normative university transition.

In addition to meta-analytically testing these predictions, several subsidiary research issues relating to the TEI-achievement link were examined in this meta-analysis. These include the moderating effects of gender, age, academic level, and TEI measure on the TEI-achievement link. The methods and results of this meta-analysis are reported in Chapter Five.

4.7.2 Study Two: Empirical Tests of the Conceptual Models

The hypotheses implied by the target multistage mediation model are as follows:

- H_{DR1}: TEI directly and positively predicts first semester achievement;
- H_{DR2}: TEI directly and positively predicts academic adaptation;
- H_{DR3}: academic adaptation directly and positively predicts first semester achievement;
- H_{DR4}: TEI directly and positively predicts psychosocial adaptation;
- H_{DR5}: psychosocial adaptation directly and positively predicts first semester achievement;
- H_{DR6}: TEI directly and positively predicts perceived social support;
- H_{DR7}: perceived social support directly and positively predicts psychosocial adaptation;
- H_{DR8}: TEI directly and positively predicts engagement coping;
- H_{DR9}: engagement coping directly and positively predicts academic adaptation;

- H_{DR10}: engagement coping directly and positively predicts psychosocial adaptation;
- H_{IR1}: TEI is indirectly associated with first semester achievement through academic adaptation;
- H_{IR2}: TEI is indirectly associated with first semester achievement through psychosocial adaptation;
- H_{IR3}: TEI is indirectly associated with psychosocial adaption through perceived social support;
- H_{IR4}: TEI is indirectly associated with first semester achievement via perceived social support and psychosocial adaptation linked serially in a three-path mediated sequence;
- H_{IR5}: TEI is indirectly associated with academic adaptation through engagement coping;
- H_{IR6}: TEI is indirectly associated with psychosocial adaptation via engagement coping;
- H_{IR7}: TEI is indirectly associated with first semester achievement via engagement coping and academic adaptation linked serially in a three-path mediated sequence; and,
- H_{IR8}: TEI is indirectly associated with first semester achievement via engagement coping and psychosocial adaptation linked serially in a three-path mediated sequence.

In addition to testing the foregoing predictions implied by the target model, the second study examined three alternative theoretical models that provide competing accounts of the relations among TEI, perceived social support, engagement coping, adaptation, and achievement during the university transition (see Section 4.4). The second study also examined the dimensionality of university adaptation in line with the conceptual formulation of adaptation advanced in Chapter Three. The methods and results of this study are reported in Chapter Seven. In the next chapter, the methods and results of the meta-analytic review of the relationship between TEI and achievement are reported.

Chapter Five
A Meta-Analytic Review of the Relationship of TEI with Academic Achievement

The present chapter reports the methods and results of the first meta-analytic review of the TEI-achievement link. Although the relation between TEI and achievement has been investigated in a large number of studies, much debate still remains over whether TEI is in fact associated with achievement (Perera & DiGiacomo, 2013). Theoretically, TEI may be directly and indirectly associated with achievement (as argued in Chapter Four); however, relations between the constructs have been inconsistent across studies (Mavroveli & Sánchez-Ruiz, 2011). Despite this heterogeneity, no studies have reported a systematic, quantitative review of the TEI-achievement relationship. A meta-analysis may serve to (a) clarify the TEI-achievement relationship and (b) reinforce the present model specifications linking TEI with first semester achievement with which this research is centrally concerned.

On the basis of the theoretical arguments advanced and evidence reviewed in Chapter Four, the following hypotheses were tested meta-analytically:

- H_{MA1}: TEI is positively associated with academic achievement; and,
- H_{MA2}: the weighted mean association between TEI and academic performance is moderated by university transition status, such that the hypothesized positive association increases in magnitude during periods of normative university transition.

Several subsidiary research issues relating to the TEI-achievement link are also investigated separately in this meta-analysis. These include the moderating effects of gender, age, academic level, and TEI measure on the TEI–achievement link. Although only tangential to the present research, the investigation of these supplementary research issues will lead to a more refined understanding of the TEI–achievement relation towards the advancement of scientific knowledge that drives research on affective personality traits in achievement settings. These supplementary research issues are discussed in detail below.

5.1 Supplementary Research Issues

5.1.1 The Moderating Role of Gender

The moderating role of gender in the relationship of TEI with academic achievement has been a thorny issue in the TEI literature. With few exceptions (e.g., Arteche et al., 2008; Austin, Evans et al., 2005), there has been little theoretical reasoning guiding the generation of testable hypotheses concerning potential moderating effects of gender (Mavroveli et al., 2008; Qualter et al., 2012). One reason for this deficiency is that most existing investigations of the role of TEI in achievement have used aggregated indices of both predictor and criterion in their study designs, which complicates the development of specific predictions concerning gender differences in the presumed influence of TEI on academic performance (Perera & DiGiacomo, 2013).

For instance, males tend to score higher on the primary-level emotion regulation disposition than females, whereas the opposite has been found in the case of empathy and emotion perception (Petrides, 2009). Similar results have been observed in the mainstream personality literature with males reporting higher levels of emotional stability, whereas females tend to be higher in agreeableness, warmth and emotion recognition (Costa, Terracciano, & McCrae, 2001; McClure, 2000). Any selective advantage for females in collaborative academic settings endowed by higher emotion perception, or any benefit for males in high-stakes assessment settings as a result of higher emotion regulation, may not be evident at the highest levels of conceptual aggregation. This is because component primary-level facets are summed or averaged to produce a compound construct in most study designs. As the present meta-analytic review seeks to assess the validity of TEI for predicting academic achievement at the highest level of conceptual aggregation (i.e., global TEI), it is unlikely that gender will moderate the relationship between global TEI and achievement (Perera & DiGiacomo, 2013).

5.1.2 The Moderating Roles of Age and Academic Level

Both sample average age and educational level may moderate the relation between TEI and achievement. As discussed in Chapter Four, TEI may positively influence achievement by promoting adaptive social functioning in collaborative academic contexts, such as group-work settings. This effect is likely to strengthen as a function of decreasing age and academic level as learning is typically more collaborative and interaction-based in the younger years

(H. J. Eysenck & Cookson, 1969; Perera & DiGiacomo, 2013; Poropat, 2011). Specifically, based on this reasoning, it may be that primary-school-level effect sizes are stronger than corresponding effects in university samples.

This account of the potential moderating effects of age and academic level on the TEI-academic performance relation is consistent with the existing personality literature examining the influences of age and educational level on the association of affect-related personality dimensions with academic achievement (Poropat, 2009, 2011). For instance, Poropat (2011) found that both age and academic level exerted moderating effects on the association of Eysenckian neuroticism and extraversion with academic performance. Poropat (2009) also reported moderating effects of age and educational level on the correlation between FFM emotional stability and academic performance. In both studies, the correlations of affect-related personality dimensions with academic performance declined as function of increasing age and academic level (Poropat, 2009, 2011). These theoretical and empirical considerations raise the possibility that age and academic level may moderate the TEI-achievement link.

5.1.3 The Moderating Role of TEI Measure

The chosen measure of TEI is a methodological factor that may also moderate the relation between TEI and achievement. TEI instruments vary widely in their content and, by extension, coverage of the TEI content domain from the perspective of TEI theory (Pérez et al., 2005; Petrides, 2009). This heterogeneity in content coverage is statistically manifested as correlations of about .50 among the major TEI instruments purported to measure the same construct (Petrides, 2009). Among the three most widely used measures of TEI, (i.e., the EQ-i, TEIQue and SEIS), there is substantial divergence in the extent to which the measures provide coverage of the TEI domain. For instance, the TEIQue provides comprehensive coverage of the construct's content domain via the operationalization of core TEI primary-level dispositions. On the contrary, both the EQ-i and SEIS are restricted in their range and depth of the coverage of the TEI domain, omitting core facets, such as emotion regulation (see Petrides, 2009 for a review). This raises the possibility of attenuation of the association between TEI, operationalized via the EQ-i and SEIS, and achievement because coverage of the TEI content domain is limited in these instruments. It should be noted that only the EQ-i, SEIS and TEIQue were included in the omnibus test of the moderating influence of operationalization measure. This is because these instruments are used in multiple measurements of TEI across the primary studies included in this quantitative synthesis.

Moderator analyses involving less widely used measures of TEI will likely suffer from insufficient statistical power (Hedges & Pigott, 2004).

5.2 Summary of Research Issues

In sum, then, the present meta-analysis aims to assess the validity of TEI for predicting academic achievement and test the moderating influence of university transition status on the summary effect. In addition, other supplementary research issues important to the advancement of scientific knowledge bearing on the TEI-achievement, but only tangential to the present research, were assessed. These include the moderating effects of gender, age, academic level, and TEI measure on the summary relation between TEI and academic performance. The results of this meta-analysis may serve to not only clarify the TEI-achievement relationship but also potentially reinforce to the present model specifications linking TEI with first semester achievement during the university transition.

5.3 Method

5.3.1 Inclusion Criteria

Studies were included in the present meta-analysis if they satisfied five criteria. First, only studies published or presented between 1998 and March 2012 were considered for inclusion. Earlier studies could not be appropriately integrated with TEI theory because the trait and ability EI conceptual frameworks had not been proposed and distinguished. Second, studies were only included if they measured the TEI construct or used a typical performance operationalization of EI, thereby allowing for the interpretation of results within the TEI theory framework (Petrides, 2009, 2011; Petrides & Furnham, 2001). Third, studies had to either report (a) a statistical test of the relationship between TEI and academic performance or (b) sufficient data to enable the computation of such a test of association. If studies simply reported that a non-significant or significant association or effect was found, attempts were made to contact study authors directly to retrieve the effect size and *N* or variance data. No studies were excluded on this basis. Fourth, only studies that examined at least three dimensions of TEI were included in this meta-analysis (see also Martins et al., 2010). Studies that measured one or two primary-level facets of the TEI domain were excluded. This criterion was imposed to ensure that the TEI construct was sufficiently represented and operationalized in the studies. Finally, academic performance indices in the primary studies

had to be appraised directly (e.g., GPA, standardized test results, subject attainment) or via self-report (e.g., Bastian, Burns, & Nettelbeck, 2005; Shipley, Jackson, & Segrest, 2010). Studies reporting self-estimated academic achievement were included in the present synthesis because these indices have been shown to be reliable and valid (Kuncel, Credé, & Thomas, 2005).

5.3.2 Literature Search

Multiple search strategies were used to identify primary studies that satisfied the inclusion criteria. First, computerized searches of the following databases were conducted to detect primary studies examining the link between TEI and achievement: PsychINFO, MEDLINE, ERIC, ISI Web of Science databases and ProQuest Dissertations and Theses. These databases were searched for relevant records using the keywords and Boolean operators *(Trait EI [Trait emotional intelligence] or EI) AND (achievement or performance or grade or GPA) AND (university or college or school or education or elementary or secondary)*. It should be noted that the keyword "EI", as distinguished from "TEI", was also included in the electronic searches as the TEI-ability EI distinction is not entirely observed in the scientific literature. Omission of this keyword would have resulted in a substantial truncation of the body of relevant search results, which may have introduced bias into the meta-analytic findings. Second, a manual search of *Personality and Individual Differences* and the *British Journal of Educational Psychology* was conducted for volumes published between 1998 and March 2012. This search strategy was implemented primarily as a safeguard against omitting relevant studies during the electronic search phase. All studies located during the manual search were also identified in the electronic phase. Third, ancestry searches were performed to supplement the electronic searches in which reference sections of relevant primary studies were inspected for further pertinent citations. Finally, to obtain any articles that may have been omitted by our initial computerized and manual search strategies, as well as obtain any unpublished data, we directly contacted scholars who conduct research in the area of EI and achievement. This resulted in the identification and retrieval of an additional two published articles and three unpublished dissertations.

The search strategies yielded approximately 350 references to primary studies. The majority of these studies were omitted because they (a) investigated the ability EI construct using maximum-performance operationalizations or (b) reported on constructs not related to TEI and/or academic performance. The retained studies were further scrutinized for their

adherence to the remaining selection criteria. This yielded a total of 40 primary studies, comprising 48 independent samples, which provided 74 effect sizes, with a cumulative *N* of 10,292. Notably, of the 40 retrieved studies, 12 (30%) were unpublished dissertations. Table 5.1 shows the studies and independent samples included in this meta-analytic review.

5.3.3 Coding Frame

Studies included in the meta-analysis were coded for the following characteristics: university transition status; gender; age; operationalization instrument; educational level. This coding frame is consistent with the examined moderators of the TEI–achievement relation. As the study characteristics coded in this meta-analysis were basic demographics or research design features, few inferences needed to be made beyond the reported information in the primary studies. Where insufficient or ambiguous data were reported, which prohibited the coding of study characteristic in accordance with the predetermined coding frame, attempts were made to contact researchers to clarify or obtain such information. In all cases, study coding was conducted by two researchers with an average of 99.5% inter-rater agreement across codes. Table 5.1 provides university transition status, gender, age, instrument, and educational level codes for the individual studies.

Table 5.1

Summary of Studies Included in the Meta-analysis with Corresponding N, Gender, Age, Academic Level, Transition Status Codes, TEI measure, and Achievement Outcome

Study	N	Average Age	Academic Level	% Female	Gender	Transition	Trait EI Measure	Type of achievement index
Adeyemo (2007)	300	19.40	Tertiary	53	Mixed	No	SEIS	Average exam results
Austin, Evans et al. (2005)	154	18.61	Tertiary	67	Mixed	Yes	SEIS	Exam grade
Barchard (2003)	150	21.50	Tertiary	63	Mixed	No	Multiple	Average grades
Barisonek (3rd Grade) (2005)	23	8.50	Primary	48	Mixed	No	EQ-i	Achievement test
Barisonek (6th Grade) (2005)	21	11.50	Primary	48	Mixed	No	EQ-i	Achievement test
Bastian et al. (2005)	185	19.90	Tertiary	72	Mixed	No	SEIS	Self-reported achievement
Bradshaw (2008)	60	20.22	Tertiary	100	Female	No	EQ-i	GPA
Colston (2008)	115	36.15	Tertiary	77	Mixed	No	EQ-i	GPA

Study	N	Average Age	Academic Level	% Female	Gender	Transition	Trait EI Measure	Type of achievement index
Di Fabio & Palazzeschi (2009)	124	17.49	Secondary	73	Mixed	No	EQ-i	GPA
Downey et al. (2008)	209	13.89	Secondary	59	Mixed	No	ASUEIT	GPA
Drati (2010)	165	16.00	Secondary	–	Mixed	No	EQ-i	Achievement test
Ferrando et al. (2011)	290	11.53	Primary	47	Mixed	No	TEIQue	Teacher achievement rank
Hogan et al. (Female) (2010)	96	15.40	Secondary	100	Female	No	EQ-i	GPA
Hogan et al. (Male) (2010)	96	15.40	Secondary	0	Male	No	EQ-i	GPA
Izaguirre (2008)	199	20.70	Tertiary	55	Mixed	Yes	EQ-i	GPA
Jaeger (2003)	150	28.00	Tertiary	62	Mixed	No	EQ-i	Assignment grade

Study	N	Average Age	Academic Level	% Female	Gender	Transition	Trait EI Measure	Type of achievement index
Jordan et al. (Female) (2010)	37	12.03	Secondary	100	Female	No	EQ-i	Average grades
Jordan et al. (Male) (2010)	49	12.08	Secondary	0	Male	No	EQ-i	Average grades
Laborde et al. (2010)	219	19.50	Tertiary	23	Mixed	Yes	TEIQue	Assignment grade
Lui (2009)	108	17.71	Secondary	100	Female	No	EQ-i	GPA
Martin (2010)	170	11.50	Primary	54	Mixed	No	EQ-i	Achievement test
Mavroveli & Sánchez-Ruiz (2011)	114	8.50	Primary	51	Mixed	No	TEIQue	Key Stage 1 results
Mavroveli et al. (Female) (2008)	69	11.23	Secondary	100	Female	No	TEIQue	Key Stage 2 results
Mavroveli et al. (Male) (2008)	70	11.23	Secondary	0	Male	No	TEIQue	Key Stage 2 results

Study	N	Average Age	Academic Level	% Female	Gender	Transition	Trait EI Measure	Type of achievement index
Mavroveli et al. (2009)	140	9.26	Primary	45	Mixed	No	TEIQue	Teacher assessment results
Newsome et al. (2000)	160	21.00	Tertiary	66	Mixed	No	EQ-i	GPA
R. O'Connor & Little (2003)	90	19.25	Tertiary	41	Mixed	Yes	EQ-i	GPA
Ogundokun & Adeyemo (2010)	1563	15.96	Secondary	47	Mixed	No	EQBI	Researcher achievement test
Olson (2008)	74	18.85	Tertiary	60	Mixed	Yes	EQ-i	GPA
Parker, Creque et al. (Female) (2004)	363	16.16	Secondary	100	Female	No	EQ-i	GPA
Parker, Creque et al. (Male) (2004)	304	16.21	Secondary	0	Male	No	EQ-i	GPA

Study	N	Average Age	Academic Level	% Female	Gender	Transition	Trait EI Measure	Type of achievement index
Parker, Summerfeldt et al. (Female) (2004)	294	19.34	Tertiary	100	Female	Yes	EQ-i	GPA
Parker, Summerfeldt et al. (Male) (2004)	78	19.34	Tertiary	0	Male	Yes	EQ-i	GPA
Petrides et al. (2004)	650	16.50	Secondary	48	Mixed	No	TEIQue	GCSE marks
Pishghadam (2009)	508	21.30	Tertiary	74	Mixed	No	EQ-i	GPA
Qualter et al. (Female) (2012)	214	15.83	Secondary	100	Female	No	EQ-i	GCSE marks
Qualter et al. (Male) (2012)	197	15.83	Secondary	0	Male	No	EQ-i	GCSE marks
Radford (2010)	115	22.63	Tertiary	85	Mixed	No	TEIQue	GPA
Rankin (2009)	138	24.70	Tertiary	90	Mixed	No	SEIS	Assignment grade

Study	N	Average Age	Academic Level	% Female	Gender	Transition	Trait EI Measure	Type of achievement index
Rodeiro et al. (2012)	874	16.35	Secondary	51	Mixed	No	TEIQue	Mean GCSE score
Saklofske et al. (2012)	163	20.03	Tertiary	78	Mixed	No	EQ-i	Average grades
Schutte et al. (1998)	63	18.89	Tertiary	52	Mixed	Yes	SEIS	GPA
Shipley et al. (2010)	169	26.97	Tertiary	48	Mixed	No	TEIQue	Self-report GPA
Song et al., (2010) (Study 1)	222	21.30	Tertiary	47	Mixed	No	WLEIS	GPA
Song et al., (2010) (Study 2)	124	21.00	Tertiary	61	Mixed	No	WLEIS	Subject attainment
Tok & Morali (2009)	295	23.20	Tertiary	38	Mixed	No	SEIS	GPA
Walsh-Portillo (2011)	82	20.50	Tertiary	59	Mixed	No	EQ-i	GPA

Note. Multiple = Multiple measures of lower-order TEI facets from several domain-specific instruments; ASUEIT = Adolescent Swinburne University Emotional Intelligence Test (Luebbers, Downey, & Stough, 2007); EQBI = Emotional Intelligence Behaviour Inventory; WLEIS = Wong and Law Emotional Intelligence Scale.

5.3.3.1 University transition status. University transition status was coded as a dichotomous variable with the categories transition versus no transition. Although some studies did not investigate TEI in the university transition context per se (e.g., R. O'Connor & Little, 2003), these studies provided sufficient information in their sample descriptions to infer that most participants would have commenced a normative university transition during the study. A total of eight studies were coded as having a university transition (see Table 5.1).

5.3.3.2 Gender. Each study was coded for the gender of participants using two approaches. First, gender was coded as a categorical variable with three levels (mixed, male and female). As most studies did not, however, report relevant effect size and variance data for males and females separately, gender was also coded as the percentage (%) of female participants in each independent sample to increase statistical power associated with the test of its moderating effect (Valentine, DuBois, & Cooper, 2004).

5.3.3.3 Age. Age was coded as a continuous variable using the sample average age of participants. Where only class intervals for age were reported (e.g., Colston, 2008; Drati, 2010; Radford, 2010; Shipley et al., 2010), sample average age was estimated using Equation 5.1 as follows:

$$\bar{x} = \frac{\sum(fx)}{\sum(f)} \tag{5.1}$$

where $\bar{x}$ is the estimated mean, f is the frequency of each interval and x is the midpoint of each interval. Only a few studies neither reported the mean age of participants nor sufficient information to reconstruct the mean age (e.g., Barisonek, 2005; Jaeger, 2003; Song et al., 2010 [Study 2]). In these cases, sample average age was imputed based on mean ages in other studies that included students at a similar academic level (Poropat, 2009, 2011).

5.3.3.4 Academic level. Academic level was coded as a categorical variable with three levels (primary, secondary, or tertiary). In total, there were six samples from the primary level, 17 secondary level samples and 25 samples from the tertiary level, with aggregate samples of 758, 5188 and 4346 for the academic levels, respectively.

5.3.3.5 Measurement instrument. Operationalization instrument was coded as a categorical variable with the following three levels: TEIQue, EQ-i, or SEIS. Variants of these measures, such as youth and child forms, were also coded consistent with these categories

because domain coverage across variants belonging to the same family of instruments is comparable (Bar-On, 1997; Parker et al., 2011; Petrides, 2009; Schutte et al., 1998). For example, studies using the TEIQue-Adolescent Form (TEIQue-AF) and the EQ-i: Youth Version (EQ-i: YV) were coded as TEIQue and EQ-i, respectively. Only the Bar-On EQ-i, SEIS and TEIQue families of instruments were included in the omnibus test of the moderating effect of operationalization measure because these instruments are used in multiple measurements of TEI across the primary studies included in this quantitative synthesis.

5.3.4 Meta-Analytic Procedure

The present meta-analysis was conducted in accordance with the meta-analytic protocol outlined by Borenstein, Hedges, Higgins, and Rothstein (2009). This procedure involves the synthesis of Fisher's *r*-to-*z*-transformed effect sizes weighted by the inverse of the studies' sampling variance (Hedges & Olkin, 1985). Although the meta-analysis was performed using the Fisher's *z* transformed values, the summary effect was converted back to a correlation coefficient for interpretation and presentation (Borenstein et al., 2009). All analyses, including estimation of the summary effect, construction of 95% confidence bounds around the point estimate and moderator analyses, were performed using Comprehensive Meta-Analysis (Version 2.2.064; 1998–2005). The null hypothesis (H_0) that the mean effect size is zero, under the random-effect model, was rejected if the 95% confidence limit did not contain zero (Borenstein et al., 2009). The sections below elucidate the effect size metric and statistical model(s) used in this meta-analysis as well as procedures for testing moderating effects, statistically correcting effects for measurement unreliability, and addressing the issue of publication bias.

5.3.4.1 Effect size. In this meta-analytic review, correlation was selected as the metric of effect size because most primary studies provided correlations between measures of TEI and academic performance. Correlation indexes the magnitude and direction of the relationship between two variables (J. Cohen, Cohen, West, & Aiken, 2003). For instance, if a study yielded $r = .10$ for the correlation between TEI and academic performance, this would be interpreted as a modest positive association between the constructs in accordance with J. Cohen's (1988) conventions for small, medium and large effects. Similarly, $r = .30$ and $r = .50$ would be interpreted as moderate and large positive associations, respectively (J. Cohen, 1988). Two studies did not, however, report bivariate correlations. Petrides et al.

(2004) and Hogan et al. (2010) reported standardized regression coefficients (β) as indices of the effect of TEI on academic performance. In these cases, β was converted to r using Peterson and Brown's (2005) r imputation equation $r = .98\beta + .05\lambda$, where λ is an indicator variable equaling 1 when β is positive and 0 when β is negative. For instance, $\beta = .03$ would produce an imputed r of .08, while $\beta = -.03$ would yield an imputed r of –.03 (Peterson & Brown, 2005). Where studies reported correlations with multiple indices of achievement at similar levels of measurement aggregation (e.g., math and English subject scores), the effect size for a synthetic combined academic performance index was computed as the mean of the effect sizes for performance at lower levels of assessment aggregation (Borenstein et al., 2009; Poropat, 2009).

5.3.4.2 Statistical model. Meta-analyses can be performed using fixed-effect or random-effects models (Borenstein et al., 2009; Lipsey & Wilson, 2001). The fixed-effect model rests on the tenability of the assumption that all primary studies share a common, underlying effect size (Hedges & Vevea, 1998; Lipsey & Wilson, 2001). Effect-size variation is assumed to be the result of sampling error alone, and the summary effect is the estimate of this common effect size under the H_0 of no effect across primary studies (Borenstein et al., 2009). The random-effects model, contrariwise, assumes that the true effect size varies from study to study, and the summary effect is simply the mean of the sampling distribution of observed effect sizes under the H_0 that the mean effect is zero (Borenstein et al., 2009). When a random-effects model is posited, variation in observed effects is assumed to reflect both true variation in effect sizes and sampling error (Lipsey & Wilson, 2001). As observed by Borenstein et al. (2009), the random-effects model is more plausible because study design characteristics, such as participants, measures and interventions, are likely to differ across primary studies, thereby rendering untenable the assumption of a common effect size underlying the fixed-effect model. The random-effects model, however, often has insufficient statistical power to detect moderating effects, especially when sample sizes for tests of moderation are modest (Hedges & Vevea, 1998). Indeed, statistical power analyses have shown that, when testing for moderating influences, the random-effects model may overestimate error variance, leading to an increased risk of committing a Type II error, whereas the fixed-effect model may underestimate error variance (Overton, 1998). Given these methodological considerations, the meta-analysis was performed using random-effects weights; however, results under the fixed-effect model are also reported.

5.3.4.3 Tests of moderation. Under the random-effects model, the observed dispersion in effect sizes comprises both true between-studies variation and within-study error (Borenstein et al., 2009; Hedges & Olkin, 1985; Lipsey & Wilson, 2001). Homogeneity analysis is used in meta-analyses to test whether within-study error alone can sufficiently explain the variability in effect sizes. This analysis involves partitioning the total observed variance into (a) heterogeneity or true variation in effect sizes and (b) random error (Borenstein et al., 2009). The primary homogeneity test statistic, termed the *Q* statistic, follows a central χ^2 distribution under the H_0 with degrees of freedom (*df)* equal to the number of independent samples (*k*) minus one (Borenstein et al., 2009). A significant *Q* test indicates that sampling error alone cannot adequately explain the distribution of effect sizes.

In addition to reporting the *Q* statistic, which only addresses the significance of the test of heterogeneity, methodologists recommend reporting an index of the proportion of observed variance reflecting true heterogeneity in effects (Borenstein et al., 2009; Higgins & Thompson, 2002). Dissimilar to *Q*, the I^2 statistic permits quantification of heterogeneity as the proportion of true variance to total observed variation. Thus, a value of I^2 close to zero suggests that almost all of the observed variance is due to sampling error whereas I^2 values greater than 50% indicate that more than half of the observed variability between studies reflects systematic variation. Given a statistically significant *Q* test, and at least a moderate I^2 value (see Higgins, Thompson, Deeks, & Altman, 2003 for heuristics), the moderating effects of methodological and theoretical factors may be tested to examine potential sources of systematic variation in effect sizes.

In the present meta-analysis, tests of moderation were conducted using subgroup analysis and meta-regression. Subgroup analysis is the meta-analytic analogue to analysis of variance in primary studies and can be used to test moderation by categorical variables. Under the random effects model, subgroup analysis yields a *Q*-test of the H_0 that $\mu_a = \mu_b = \ldots \mu_n$ (Borenstein et al., 2009). If the *Q*-test of the null is significant, and the moderator consists of more than two levels, multiple pairwise comparisons with Bonferroni corrections may be performed to elucidate the moderating effects (Borenstein et al., 2009). Meta-regression is, similarly, the meta-analytic equivalent of regression analysis in primary studies and is typically used to examine the moderating effects of continuous or dummy-coded categorical variables (Borenstein et al., 2009). In meta-regression, the dependent variable is the summary effect, and the regression coefficient for the moderator variable quantifies the impact of the moderator on the focal relation.

5.3.4.4 Statistical corrections. Estimates of Cronbach's alpha were used wherever available to correct observed correlations for attenuation. If studies failed to report coefficient alpha or any cognate index of reliability, internal consistency estimates were obtained from technical manuals and validation studies for the relevant TEI operationalization vehicles. Three studies (Barchard, 2003; Izaguirre, 2008; Saklofske et al., 2012) reported sufficient data to estimate total TEI scale internal reliability as a linear composite of its constituent subscales using standard formulas provided by Horst (1966). In one study (Petrides et al., 2004), the effect size was estimated based on latent variables in the covariance structure analysis framework, thereby removing the need to conduct a reliability correction.

Only two studies reported estimates of Cronbach's alpha for academic performance (Di Fabio & Palazzeschi, 2009; Martin, 2010). In other cases, where GPA was the index of performance, estimates of Cronbach's alpha reported by Bacon and Bean (2006) were used to correct GPA. For studies that relied on GCSE results, these scores were corrected using estimates of alpha obtained from Bramley and Dhawan (2010), who provided reliability data from high-stakes assessments. In studies that used Key Stage National Curriculum Testing results as proxies for achievement, best available estimates of alpha obtained from Opposs and He (2011) were used. Where single levels of assessment were used to index academic performance (e.g., examinations or specific assessment results), the most appropriate estimate reported by Chamorro-Premuzic, Furnham, and Ackerman (2006) was used. Two studies used self-reported academic achievement to index performance. In these studies, the achievement indices were corrected using Kuncel et al.'s (2005) estimate of score reliability for self-estimated GPA.

5.3.4.5 Publication bias. Publication bias refers to the greater likelihood of the publication of studies that report significant results. It follows that any bias in the scientific literature is likely to be reflected in any meta-analysis because published studies are more likely to be included in a meta-analysis (Dickersin, 2005; Rothstein, Sutton, & Borenstein, 2005). This bias may result in the increased risk of committing a Type I error and overestimation of the summary effect in the meta-analysis (Richardson et al., 2012).

Five procedures were implemented to address the problem of publication bias in the present meta-analysis. First, the funnel plot of effect size by standard error was visually inspected to identify evidence of publication bias (Borenstein et al., 2009). The symmetrical distribution of observed effects about the summary effect is indicative of the absence of

publications bias. Second, in addition to visual inspection of the funnel plot, Egger's test of the intercept was used for statistical testing of asymmetry (Egger, Smith, Schneider, & Minder, 1997). For Egger's test, precision, taken as the inverse of the standard error, is used to predict the standardized effect size estimate. The intercept from this linear regression equation is used to index bias. An intercept that is significantly different from zero is indicative of publication bias. Third, Rosenthal's (1979) Fail-safe *N* was calculated, which estimates the number of missing studies averaging null effects required to render the cumulative effect statistically non-significant. Fourth, Orwin's (1983) Fail-safe *N* was also computed because of the known limitations of Rosenthal's formula. Contrary to Rosenthal's Fail-safe *N*, which centers on the statistical significance of the summary effect, Orwin's approach allows the researcher to estimate the number of missing studies required to reduce the summary effect to a value below an effect size of substantive importance. In the present meta-analysis, J. Cohen's (1988) threshold for a modest effect ($r = .10$) was considered the smallest effect size of substantive importance, below which any summary effect would be considered trivial. Finally, Duval and Tweedie's (2000) "trim-and-fill" procedure was implemented in which (a) the number of studies that may be missing due to publication bias is estimated, and (b) the missing studies are then imputed and the summary effect recalculated. This procedure provides a method for assessing the impact of bias on the summary effect as well as a best estimate of the unbiased summary effect.

5.4 Results

5.4.1 Preliminary Diagnostic Analysis

Before conducting analyses of effect sizes, a preliminary meta-regression using method of moments estimation (Lipsey & Wilson, 2001) was performed to examine the moderating influence of predictor and criterion errors of measurement on the summary effect. The estimated effect size in Fisher's *z* metric was regressed on a surrogate index of the impact of predictor and criterion unreliability on the observed correlations, referred to as a compound artifact multiplier (Borenstein et al., 2009). This index can be computed using Equation 5.2 provided by Borenstein et al (2009):

$$a = \frac{r}{r^u} \tag{5.2}$$

where a is the artifact multiplier, r is the attenuated correlation and r^{μ} is the unattenuated correlation corrected for predictor and criterion unreliability using standard formulas presented in Murphy and Davidshofer (1988). The artifact multiplier exerted a statistically significant moderating influence on the summary effect, $Q(1) = 4.85$, $p = .03$, $b = –0.90$, 95% CI [–1.70, –.10], such that every one unit increase in the artifact multiplier predicted a decrease of 0.90 units in the summary effect size. This finding supports the correction of observed correlations for attenuation to avoid negatively biasing the summary effect (Hunter & Schmidt, 2004).

Also, preceding the conduct of the primary synthesis, obtained effect sizes were scrutinized for the presence of outliers. Effect size outliers were identified as values located more than 3.29 standard deviations from the mean effect size consistent with recommendations provided by Tabachnick and Fidell (2007). This preliminary analysis revealed that only one effect size met this criterion (Ogundokun & Adeyemo, 2010) ($z = 3.89$, $p < .001$). All other effect sizes were no greater than one standard deviation from the summary effect. Given the extreme deviance of the outlying effect size, the study from which it was drawn was excluded from the primary synthesis. Following the exclusion of the anomalous primary study, 47 independent samples provided estimates of correlations between TEI and academic performance, with a cumulative N of approximately 8730.

5.4.2 The Relationship of TEI with Academic Performance

A meta-analysis with random-effects weights was conducted to estimate the mean correlation between TEI and academic performance. As shown in the forest plot of the distribution of effect sizes in Figure 5.1, 45 of the 47 correlations were positive. The two coefficients that were negative were trivial and showed a good deal of imprecision as indicated by wide confidence bounds. The inverse-variance weighted mean corrected correlation between TEI and academic performance was in the expected direction and of the predicted magnitude under the random-effects model (see Table 5.2). In terms of J. Cohen's (1988) guidelines for small, medium and large effects, the summary effect can be seen as a modest-to-moderate-sized effect. The 95% confidence interval for the summary effect was $.20 \pm .04$. As the confidence interval did not include zero, the H_0 that the mean effect is zero can be rejected.

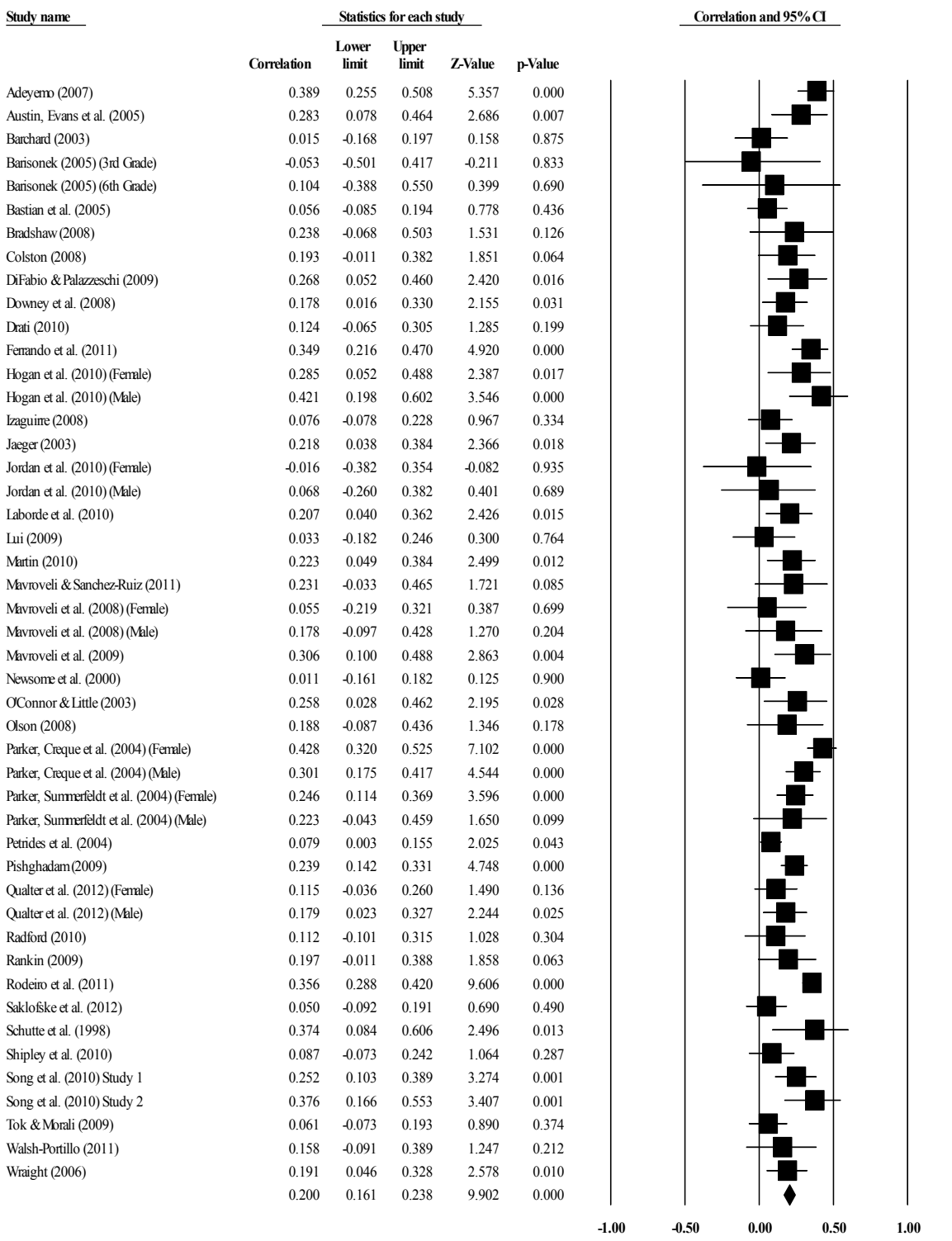

Figure 5.1. Forest plot of the association between TEI and academic performance under the random effects model. Effect size is given as the correlation coefficient with 95% confidence intervals. The summary effect is shown by the solid diamond at the bottom of the plot.

Table 5.2

Inverse Variance Weighted Mean Attenuated and Unattenuated Correlations between TEI and Academic Performance

		95% CI					95% CI	
Effect	RE Estimate	LB	UB	Q	I^2	FE Estimate	LB	UB
$r^{unattenuated}$	.20	.16	.24	107.01	57.01%	.21	.18	.23
r	.17	.14	.21	101.57	54.71%	.19	.17	.21

Note. RE = random effects; FE = fixed effect; $r^{unattenuated}$ = Inverse-variance weighted mean corrected correlation; r = Inverse-variance weighted mean correlation; CI = Confidence interval; LB = Lower bound; UB = Upper bound; Q = Cochran's measure of homogeneity; I^2 = Higgins and Thompson's (2002) measure of heterogeneity. All estimates of $r^{unattenuated}$, r and Q are significant at $p < .001$.

When tested using the fixed-effect assumptions, the point estimate of the effect size only increased marginally (+ .01). The confidence limits for this summary effect were slightly narrower, as expected, than those produced under the random-effects model (see Table 5.2), suggesting only mildly better precision in the estimate of the mean effect when between-studies dispersion was fixed to zero. Importantly, the convergence of results under the random-effects and fixed-effect models supports the rejection of the H_0 of no statistically significant relation between TEI and achievement.

5.4.3 Presence and Impact of Publication Bias

Inspection of the funnel plot of the standard error by effect sizes revealed relative symmetry of the observed effects about the summary effect, which is suggestive of the absence of publication bias (see Figure 5.2). In addition, Egger's test of the intercept was not statistically significant, $\beta_0 = -.049$, $t(45) = 0.84$, $p > .05$, 95% CI [–1.66, 0.69], providing further evidence of the absence of publication bias.

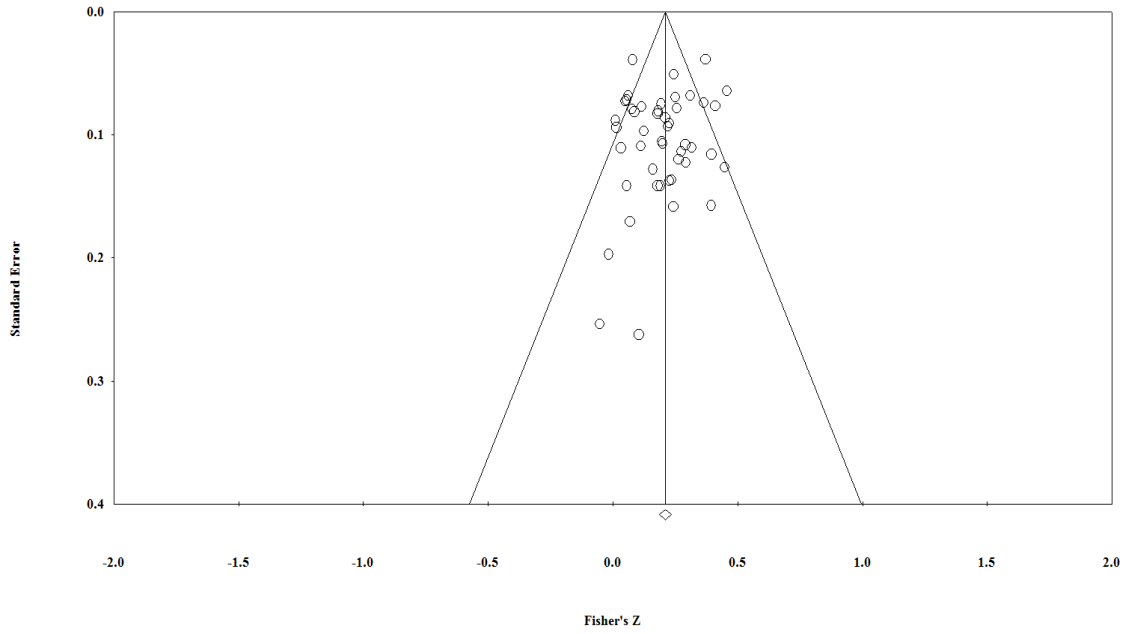

Figure 5.2. Funnel plot of the standard error by effect size in Fisher's *z* metric.

Rosenthal (1979) and Orwin's (1983) fail-safe *Ns* were computed to examine whether the entire summary effect obtained was an artifact of publication bias. Rosenthal's Fail-safe *N* was 2746, suggesting that nearly 3000 missing studies, averaging null effects, would be needed to render the cumulative effect statistically non-significant at the .05 level.

Additionally, Orwin's Fail-safe *N* was 63, which suggests that approximately 60 missing studies with mean null effects would be needed to reduce the observed summary effect to a value below J. Cohen's (1988) threshold for a small effect (i.e., $r < .10$).

Finally, Duval and Tweedie's (2000) trim and fill procedure was used to quantify the impact of any publication bias on the summary effect. Under the random effects model, when searching for missing studies to the left of the mean effect size (i.e., missing studies with effects smaller than the summary value), the trim and fill procedure resulted in no imputed missing studies and no adjustment to the observed summary effect. When searching for missing studies to the right of the summary effect (i.e., missing studies with effects larger than the observed summary effect), the trim and fill analysis led to the imputation of only two missing studies (see Figure 5.3). There were only negligible changes in the point estimate and confidence limit for the summary relation (< .004), suggesting that publication bias may not be a major source of confounding in the present meta-analysis.

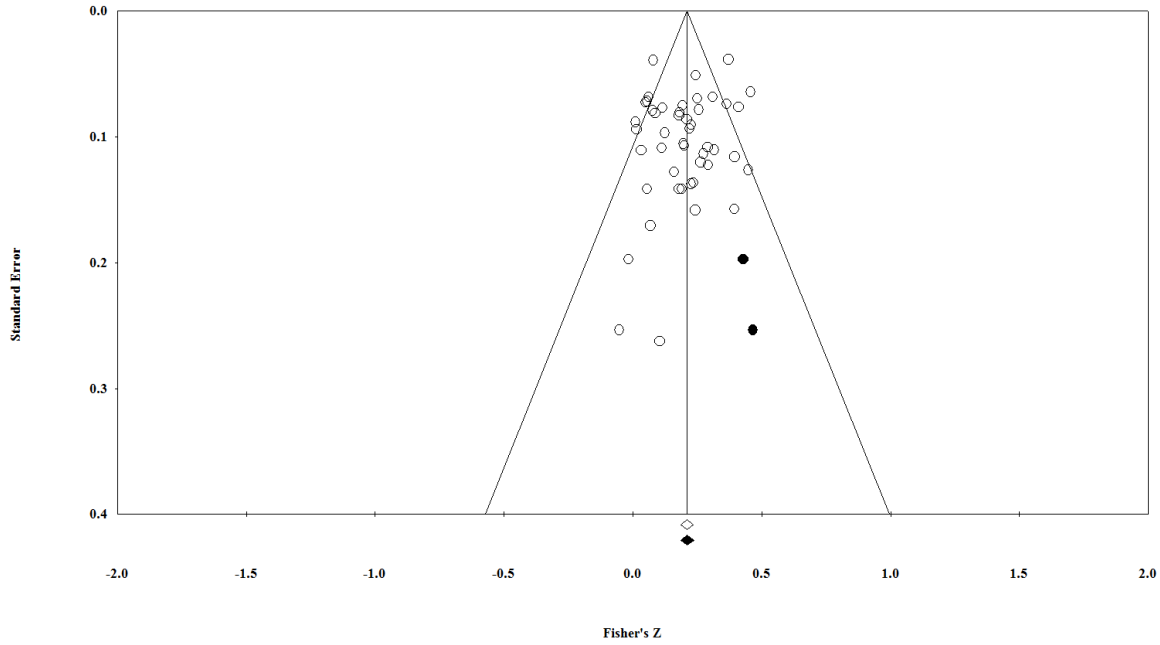

Figure 5.3. Funnel plot with imputed effect sizes to the right of the mean under the random effects model using Duval and Tweedie's (2000) trim and fill procedure. *Note*. Filled circles denote imputed effect sizes.

The conduct of the trim and fill analysis under fixed-effect assumptions resulted in similar findings. When looking for missing studies to the left of the mean effect, the trim and fill analysis did not lead to the imputation of missing studies or the adjustment of the summary

effect. When looking for missing studies to the right of the mean effect, the trim and fill procedure led to the imputation of five missing studies (see Figure 5.4). The adjusted point estimate following imputation of the missing studies was, however, only marginally stronger (.01) than the effect size obtained under the initial fixed-effect analysis.

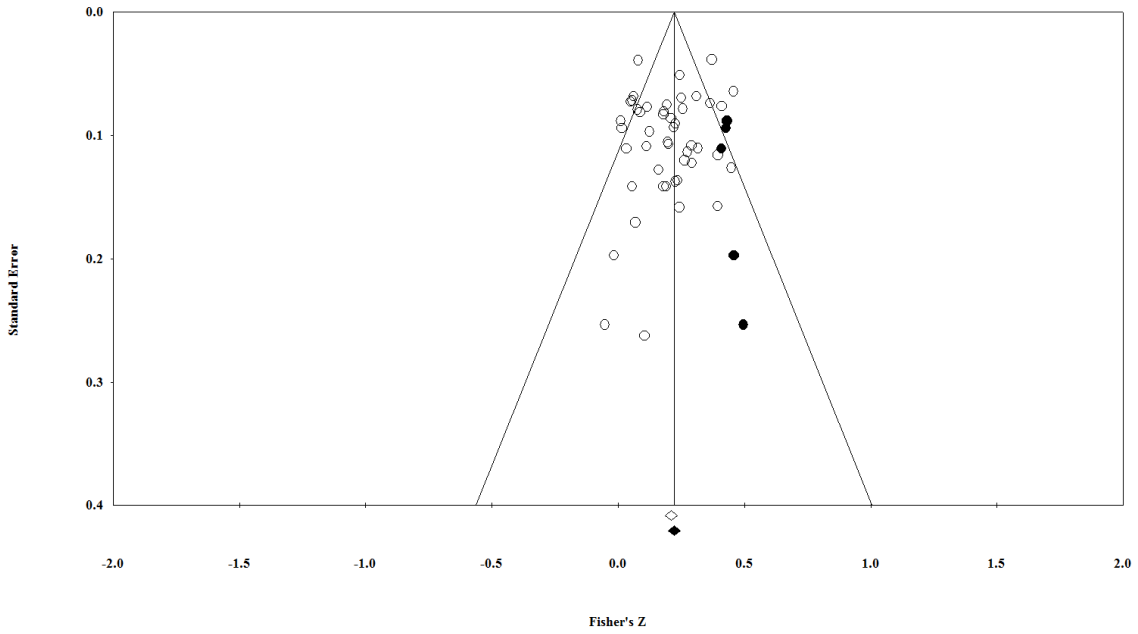

Figure 5.4. Funnel plot with imputed effect sizes to the right of the mean under the fixed effect model using Duval and Tweedie's (2000) trim and fill procedure. *Note*. Filled circles denote imputed effect sizes.

5.4.4 Homogeneity Analysis

Homogeneity analysis was performed to determine the statistical significance and proportion of observed variability in effect sizes due to systematic between-samples variation. The test for homogeneity of effect sizes was statistically significant, $Q(46, k = 47) = 107.01$, $p < .001$, indicating that within study error alone could not sufficiently explain the observed variability in effect sizes. In addition, the I^2 value of 57% suggests that more than half of the observed variation between samples was due to systematic between-samples variability, which is indicative of moderate heterogeneity (Higgins et al., 2003). Taken together, these homogeneity statistics indicate the presence of moderators of the relation of TEI with academic performance. Consistent with these results, the moderating effects of transition status, gender, age, academic level, and TEI measure were tested using subgroup analysis and meta-regression.

5.4.5 Moderators of Effect Size

5.4.5.1 Transition status. The test of the moderating influence of transition status was conducted using subgroup analysis. For transition status with two levels (transition versus no transition), the test of moderation was not significant under the random-effects model, $Q(1, k = 47) = 0.19$, $p > .05$. The test of moderation by transition status based on fixed-effect assumptions was also not significant, $Q(1, k = 47) = 0.04$, $p > .05$. Taken together, these findings suggest that there were no significant differences between effect sizes for studies using participants experiencing a normative university transition versus studies with no such transitions.

5.4.5.2 Gender. The potential moderating effect of gender on the TEI-academic performance relation was investigated using subgroup analysis and meta-regression. The use of meta-regression with % of females as a predictor of the summary effect was designed to increase statistical power associated with this test of moderation (see Section 5.3.3.2). Subgroup analysis yielded a non-significant moderating effect of gender on effect size under the random-effects model, $Q(2, k = 47) = 1.52$, $p > .05$, indicating that there were no significant differences among effect sizes for male, female and mixed samples. When gender was operationalized continuously as the % of females in each independent sample, meta-regression with method of moments estimation, under the random-effects model, also revealed no significant moderating effect of gender on the summary effect, $Q(1, 45) = 0.59$, $p > .05$.

The moderating influence of gender on the summary relation was also examined under the fixed-effect model. In this fixed-effect analysis, gender was not significantly associated with effect size using subgroup analysis, $Q(2, k = 47) = 3.03$, $p > .05$. Meta-regression also yielded a non-significant moderating effect of gender on the effect size, $Q(1, 45) = 0.40$, $p > .05$.

5.4.5.3 Age. The test of the moderating influence of age on the TEI-achievement relation was conducted using meta-regression under both the random-effects and fixed-effect models. In the random-effects analysis, meta-regression with method of moments estimation revealed that sample average age was not a statistically significant moderator of the mean effect, $Q(1, 46) = 1.11$, $p > .05$. Under the fixed-effect model, however, meta-regression yielded a significant moderating effect of age on the summary effect, $Q(1, 46) = 5.58$, $p < .05$, $b = –0.01$, 95% CI [–0.01, –0.001] such that, for every one year decrease in sample average age,

the summary effect was predicted to increase by 0.01 units. This result indicates that the relation of TEI with academic performance strengthens as a function of decreasing age.

5.4.5.4 Academic level. Subgroup analysis was conducted to examine the moderating effect of educational level on the TEI-academic performance relation. The omnibus test of the moderating effect of academic level was not significant under the random-effects model, $Q(2, k = 47) = 3.98$, $p > .05$. In the fixed-effect analysis, however, the test of moderation was statistically significant, $Q(2, k = 47) = 6.94$, $p < .05$, indicating that there were statistically significant differences among effects sizes across the educational levels. Specifically, under the fixed effect model, the one *df* pairwise comparison of primary-level with tertiary-level reached significance, $Q(1, k = 31) = 4.46$, $p < .05$, indicating that the summary effect was statistically significantly stronger at the primary level of education ($r^{unattenuated} = 0.28$) than in tertiary samples ($r^{unattenuated} = 0.17$). This result is consistent with the finding that the TEI-academic performance association strengthened as a function of decreasing age.

5.4.5.5 TEI measure. Subgroup analysis was used to examine the potential moderating influence of TEI operationalization vehicle on the relation of TEI with academic performance. This omnibus test of moderation was not significant under the random-effects model, $Q(2, k = 43) = 0.09$, $p > .05$. The test of moderation was also not significant in the fixed-effect analysis, $Q(2, k = 43) = 0.49$, $p > .05$. These results indicate that there were no significant differences among effect sizes for studies measuring TEI using the TEIQue, EQ-i or SEIS.

5.5 Discussion of Results

This meta-analysis of 47 independent effect sizes based on data from approximately 8700 participants has provided the first comprehensive quantitative review of the relationship between TEI and academic performance. The central research issues explored in the review concern the validity of TEI for predicting achievement and the moderating influence of university transition status on the summary effect. In addition to these primary issues, the meta-analysis also examined a number of supplementary research issues, including the moderating effects of gender, age, academic level, and TEI measure on the summary relation. Although only tangential to the present research, the investigation of these supplementary issues was considered crucial to the advancement of scientific knowledge on the role of affective personality traits in achievement settings. Given inconsistent findings on the TEI-

achievement link in the psychological literature, it was reasoned that the data obtained from this meta-analysis would serve to (a) clarify the relationship between TEI and academic performance and (b) potentially reinforce the present model specifications linking TEI with first semester achievement during the university transition with which the present research is centrally concerned.

5.5.1 The TEI-Achievement Relationship

The present meta-analysis has served to clarify the validity of TEI for predicting academic performance amid divergent theoretical positions concerning the link. On the one hand, an extant postulation of TEI theory is that the affective construct should be orthogonal or only trivially related to academic achievement (Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011); on the other hand, some theorists have argued that TEI is likely to be associated with achievement under stressful conditions. These divergent theoretical positions notwithstanding, based on the extensive review of literature in Chapter Four, it was expected that TEI would be positively associated with academic achievement. In line with this prediction, the meta-analysis yielded a favorable validity coefficient (r = .20) for TEI. The magnitude of the summary relation between TEI and academic performance exceeds J. Cohen's (1988) threshold of r = .10 for a modest effect and approaches the threshold of r = .30 for a moderate effect. The strength of this validity coefficient is remarkable because the TEI construct was not initially hypothesized to statistically predict cognitive-loaded variables and their proxies, such as academic performance (Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011; Petrides et al., 2004). Indeed, this mean effect size for the TEI-academic performance relation not only exceeds effects obtained for extraversion, neuroticism, agreeableness and openness but also approaches the effects observed for conscientiousness in comparable meta-analytic designs (e.g., Poropat, 2009; 2011; Richardson et al., 2012). Overall, the magnitude and direction of the effect size indicate that high TEI may confer a modest yet important advantage in academic evaluation settings.

Although it has become axiomatic that correlation does not imply causal direction, the finding of a positive and non-trivial summary association constitutes important evidence in establishing the causal ordering of TEI and achievement. Aside from the case in which suppression masks a significant association (MacKinnon, Krull, & Lockwood, 2000), and given sufficient statistical power, the finding of a zero or near-zero association between two variables is generally indicative of the absence of causation (Lyubomirsky et al., 2005). Thus,

the finding of a significant, positive summary relation between TEI and achievement is crucial to the present research to the extent that it is consistent with the propositions about the directional relations implied by the present model specifications. It should be noted that the finding of a null association would not have completely invalidated the present model specifications on the grounds that significant direct or indirect effects can emerge in the presence of even null total effects given unexpected inconsistent mediation, which is a type of suppressor effect (MacKinnon et al., 2000; Rucker et al., 2011); however, a null finding may have been viewed as a major challenge to the plausibility of the conceptual specifications.

5.5.2 Moderation by University Transition Status

In the present meta-analysis, university transition status was expected to moderate the summary relation between TEI and academic achievement, such that the expected positive association increases in magnitude during periods of transition. The finding of a stronger validity coefficient for the TEI-achievement relationship in university transition samples, like the result of a positive summary relation, would also lend weight to the present model specifications in which TEI is predicted to associate with achievement during the university transition. Inconsistent with this moderator hypothesis, transition status did not exert a statistically significant moderating effect on the weighted mean association of TEI with achievement. This is a surprising finding because, theoretically, TEI is postulated to exert its most beneficial effects on academic outcomes under stressful conditions (Mikolajczak et al., 2009; Parker, Summerfeldt et al., 2004; Petrides et al., 2004; Saklofske et al., 2012). Indeed, the university transition is known to be typically stressful (Brissette et al., 2002), involving exposure to numerous, and oftentimes novel, stressors, such as greater academic demands (Arthur & Hiebert, 1996; Credé & Niehorster, 2012), increased time pressure (Park & Adler, 2003), and a new social structure (Petruzzello & Motl, 2006). The failure to manage these stressors and adjust to the university environment is believed to lead to several deleterious outcomes, including academic failure (Credé & Niehorster, 2012).

As data for university transition samples are necessarily derived from a population of tertiary students, one explanation for this unexpected finding may be range restriction at tertiary levels of education. Range restriction occurs in study designs when the variance of a variable is artificially reduced due to preselection or censoring (Hunter, Schmidt, & Le, 2006; Le & Schmidt, 2006). Although compulsory education at the primary and secondary levels

serves to reduce selection bias in estimates of academic performance (Poropat, 2009), the deflationary effects of range restriction on variability in observed validities emerges as a critical source of artifactual variance in post-compulsory education samples (Aguinis, Sturman, & Pierce, 2008; Hunter et al., 2006; Poropat, 2009). This is because only data for a restricted, incumbent sample is available to estimate unrestricted population parameters (Hunter et al., 2006). Selection ratios at tertiary education levels may range from 10% to 40%, depending on the provider, which represents extreme to moderate restriction of range, where only the top 10% – 40% of population scores are available (Aguinis et al., 2008). This restriction of range can result in downwardly biased estimates of validities in the unrestricted population (Le & Schmidt, 2006). Such restriction of range may have spuriously deflated the associations of TEI with academic performance in all eight studies at the transition level of the omnibus test of moderation, thereby resulting in the failure of the test of moderation to detect the posited beneficial effects of TEI on academic performance in samples of students commencing normative university transitions.

5.5.3 Supplementary Research Issues

In addition to investigating the summary relation of TEI with academic performance and the moderating effect of university transition status on the link, the present meta-analysis investigated several supplementary research issues. These include the moderating influence of gender, age, academic level, and TEI measure on the TEI-achievement link. The results of these supplementary analyses are discussed below.

5.5.3.1 The moderating role of gender. Tests of moderation using subgroup analysis and meta-regression converged to suggest that there were no gender differences in the summary relation between TEI and academic performance. This result should not, however, be construed as indicative of the absence of gender effects. Instead the moderating role of gender in the association between TEI and achievement may assume prominence at lower-levels of conceptual aggregation in both predictor and criterion. In the present meta-analysis, the focus was on assessing the validity of TEI for predicting academic performance at the highest levels of aggregation consistent with the broader aims of the present research. This assessment of global constructs, which necessarily involves the aggregation of lower-order constituent factors, may have masked subtle gender influences on the relation. However, the dearth of primary studies investigating the role of primary-level TEI dispositions in academic performance prevented the conduct of any quantitative synthesis at lower-levels of

measurement aggregation. Future studies seeking to achieve a more refined understanding of the role of TEI in academic performance are, thus, likely to benefit from investigations of the effects of TEI lower-level dispositions on academic performance, thereby encouraging the generation of specific predictions on gender differences in the effects of TEI.

5.5.3.2 The moderating roles of academic level and age. Moderator analysis revealed that the summary relation between TEI and academic achievement was influenced by both academic level and age. Academic level was found to exert a statistically significant moderating effect on the mean effect size, such that the summary effect was stronger in primary samples than in tertiary samples. Age, likewise, moderated the inverse-variance weighted mean correlation of TEI with academic performance, such that every one year increase in sample average age predicted a 0.01 decrease in the summary effect. Theoretically, these are plausible moderating effects because socially adaptive responding, which may advantage those high on TEI in collaborative academic settings, is more likely to be advantageous at lower levels of education as learning is typically more collaborative (H. J. Eysenck & Cookson, 1969; Poropat, 2011). In these collaborative academic settings, it may be that dispositional emotion expressivity and perception among those high on TEI regulates interpersonal relationships in ways that enhance students' ability to work together by sustaining the flow of emotion-based information between social partners (Shiota et al., 2004). Disruptions to the normal exchange of emotion-related information, triggered by deficits in expressivity or perception typical of low trait, may result in situationally-inappropriate and socially-discordant responses that threaten the academic collaboration (Keltner & Kring, 1998).

Although the preceding account provides a compelling theoretical explanation for the moderating effects of age and academic level on the TEI-achievement link, these effects may be confounded with the influence of two methodological artifacts. First, we cannot rule out the possibility that the increase in the magnitude of the summary effect as a function of decreasing age and academic level was due to the confounding of TEI effects with the effects of verbal ability (Davies, Stankov, & Roberts, 1998; Mavroveli et al., 2008; Mavroveli & Sánchez-Ruiz, 2011). At secondary and tertiary levels, it is likely that most students possess sufficiently developed verbal skills to understand TEI items notwithstanding their underlying latent academic performance levels. Contrariwise, at the primary level, those high on verbal ability, who are also presumably higher achievers (Gustafsson & Balke, 1993; Vanderwood, McGrew, Flanagan, & Keith, 2002), may be better able to decode the most socially desirable

responses relative to students with lower verbal skills, thereby spuriously inflating estimates of the association of TEI with academic performance (Mavroveli et al., 2008; Mavroveli & Sánchez-Ruiz, 2011). Indeed, in a factor-analytic investigation of the location of TEI in cognitive ability factor space, Davies et al. (1998) found that four of seven TEI measures had non-trivial loadings on a higher-order verbal ability factor. Future studies on the role of TEI in academic performance in child samples must control for the potential confounding effects of verbal ability in their study designs to disentangle TEI effects from the potentially confounding influence of verbal ability.

The moderating effects of age and academic level may also be attributed to the confounding effects of increasing range restriction at higher levels of education. As mentioned above, typically, tertiary education providers restrict entry into higher degree programs on the basis of prior achievement or performance on achievement tests, which results in range restriction in tertiary samples (Hunter et al., 2006; Jensen, 1980; Le & Schmidt, 2006). This restriction of range in university samples may have reduced the magnitude of observed correlations reported in these studies included in this meta-analysis, thereby resulting in a downwardly biased estimate of the summary effect at the tertiary level. Indeed, the present meta-analytic review revealed that the inverse-variance weighted mean correlation between TEI and academic performance was significantly stronger at the primary level than tertiary level. Comparable attenuation of correlations of the FFM dimensions and intelligence with academic performance in tertiary samples has been found in the individual differences literature (Poropat, 2009). Despite the possibility that these methodological factors may explain the moderating effects of age and academic level, the results of these moderator analyses provide profitable directions for developing a more comprehensive understanding of the relation of TEI with academic performance.

5.5.3.3 The moderating role of TEI measurement instrument. As TEI instruments vary widely in their coverage of the TEI content domain (see Petrides, 2009 for a review), the present meta-analysis tested the potential methodological moderation of the summary relation between TEI and achievement by TEI measure. The test of moderation using subgroup analysis revealed that TEI measurement instruments did not differ significantly with respect to the magnitude of their effects on academic performance. This is a surprising finding because the measures included in the omnibus test of the moderating effect of instrument provide heterogeneous coverage of the TEI content domain (Perez et al., 2005; Petrides,

2009). This heterogeneity is statistically manifested as only about 25% overlapping variance among the measures' global scores (Petrides, 2009). For example, the TEIQue (Petrides, 2009) provides comprehensive coverage of the TEI content domain through operationalization of core TEI facets, ranging from self-motivation to emotion regulation. Contrariwise, both the EQ-i and SEIS are limited in their range and depth of coverage of the TEI content domain, omitting key TEI primary-level facets (Petrides, 2009; Petrides & Furnham, 2001).

One explanation for the absence of a statistically significant moderating effect of instrument centers on some measures' coverage of dispositions unrelated to affective personality. For instance, the Bar-On EQ-i (Bar-On, 1997) includes lower-level facets, such as independence and self-actualization, which have no clear affective basis and lie outside the conceptual domain of TEI (Petrides, 2009). The EQ-i self-actualization and independence facets, which refer to individual differences in the realization of potential capacities and self-direction in thoughts and actions, respectively, may, however, explain unique variation in academic performance (Zimmerman, 1990), thereby inflating the association of TEI, as measured by the EQ-i, with academic performance.

5.5.4 Limitations

Several limitations to this review merit attention as they serve to guide the appropriate interpretation of these meta-analytic results. First, although parsimony was preserved via the examination of the TEI-academic performance link at the highest level of conceptual aggregation, the analysis of global TEI may have masked both the specific effects of TEI primary-level facets on academic achievement and refined moderating influences on the summary effect. For instance, subtle moderating effects of gender on the relation of TEI with achievement at lower levels of measurement aggregation (e.g., TEI facet level) may have been concealed by the aggregation of lower-order constituent TEI facets. Admittedly, however, the focus of the present research is on the validity of global TEI for predicting achievement. Furthermore, the paucity of primary studies investigating the role of primary-level TEI dispositions in academic performance disallowed any synthesis of effect sizes at lower levels of aggregation. Researchers aiming to develop a more comprehensive understanding of the role of TEI in academic performance, including potential moderators of the relation, might profitably consider the influence of lower-order affective personality traits on academic performance.

A second, related, limitation was the inability to test for the potential moderating influence of index of achievement (e.g., GPA vs. standardized achievement tests) on the TEI-academic performance relationship. This test of moderation has potentially important theoretical and methodological implications. For instance, theoretically, it may be that TEI is more strongly implicated in cumulative performance (e.g., GPA, overall grades) than single-occasion achievement tests because lower-order traits, such as self-motivation and self-control, involving goal-approach, temptation-avoidance and impulse inhibition, sustain academic efforts towards long-term achievement (Duckworth et al., 2012; Duckworth & Seligman, 2006). However, the dearth of studies investigating the ways in which TEI is differentially implicated in discrete achievement outcomes, as well as the aggregation of multiple dependent achievement indices, precluded the conduct of this test. This is an area in the TEI literature that requires substantial theoretical and empirical elaboration.

Of greater methodological interest is the test of moderation to determine whether TEI is more strongly implicated in self-report than objective indices of performance due to common-method bias. Certainly, this methodological problem is not isolated to the TEI field and concerns nearly all research situations where the potential for artifactual covariance between predictor and criterion is generated by the same participants providing responses using common methods (e.g., self-report) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). This is a crucial methodological question for the validity of TEI; however, with only two studies reporting self-estimated indices of achievement, it is likely that any test of moderation would have been underpowered and misleading (Hedges & Pigott, 2004).

A third limitation of this meta-analytic study concerns the absence of statistical control for the effects of restriction of range. As discussed above, tertiary education providers typically limit access to higher education on the basis of previous achievement and intelligence assessments, potentially generating range restriction in academic performance scores (Hunter et al., 2006; Le & Schmidt, 2006; Poropat, 2009). The difficulty for investigators is the possession of data for only a restricted sample but the estimation of parameters of an unrestricted population (Hunter et al., 2006; Le & Schmidt, 2006). This restriction of range can result in downwardly biased estimates of validities in the unrestricted population (Le & Schmidt, 2006). In the present meta-analytic design, the effects of range restriction could not be accurately estimated because of the dearth of population estimates of variability in both predictor and criterion. The failure to account for the effects of restriction of range may have

attenuated the correlations between TEI and academic performance at the tertiary level, thereby potentially biasing not only the summary effect but also the tests of moderation for academic level, age and transition status.

A fourth limitation concerns the lack of statistical control for verbal ability in this meta-analysis. Although the potential confounding of TEI with verbal ability in the prediction of academic performance in child samples presents a notable danger to the validity of the affective construct, only few researchers have signaled the importance of implementing statistical controls to avoid such confounding (Mavroveli & Sánchez-Ruiz, 2011). In this meta-analysis, the significant moderating effects of age and academic level on the summary effect must be interpreted with caution as the increase in the magnitude of the summary effects as function of decreasing age and academic level may have been due to the confounding of TEI effects with the effects of verbal ability (Davies et al., 1998; Mavroveli & Sánchez-Ruiz, 2011). As discussed in Section 5.5.3.2, it is likely that most students at secondary and tertiary levels have adequately developed verbal skills to comprehend TEI items regardless of their latent academic performance levels. On the contrary, younger children at primary levels of education, who are high on verbal ability, and presumably high achievers, may be better able to decode the most socially desirable TEI responses as compared with their lower ability counterparts. This may have served to spuriously inflate the estimate of the summary effect at the primary academic level.

Another limitation of this meta-analysis concerns the possibility of publication bias generated by shortcomings in the search strategy. Publication bias refers to the greater likelihood that studies with statistically significant results will be published, and thus the published research will be systematically under-representative of the breadth of studies actually conducted (Borenstein et al., 2009). This systematic bias may carry over to meta-analyses to the extent that these syntheses rely on published data. Although efforts were made to contact scholars in the field to obtain any relevant data overlooked in the initial search, the search strategy did not include contacting relevant electronic listserves (e.g., EMONET), which may have resulted in the provision of additional unpublished data, and thus raises concerns about publication bias. It should be noted, however, that unpublished studies comprised 30% of the final body of literature subjected to meta-analysis in this review. Indeed, converging evidence from multiple procedures for detecting the presence and assessing the impact of publication bias, including (a) visual inspection of the funnel plot of

observed effects by standard errors, (b) Egger's test of the intercept, (c) Rosenthal (1979) and Orwin's (1983) Fail-safe *N*s, and (d) Duval and Tweedie's (2000), suggests that publication bias is unlikely to be a source of major confounding in the present meta-analysis.

Yet another limitation was the inability to test for other theoretically plausible moderation effects, such as the TEI × general ability interaction, in the prediction of academic performance. An emerging theoretical position on the role of TEI in academic functioning concerns the postulated protective role of TEI in academic evaluation settings (Petrides et al., 2004). From this standpoint, TEI is expected to exert stronger effects on academic outcomes—relative to its direct effect—under conditions of low cognitive ability (Ferrando et al., 2011; Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011; Petrides et al., 2004). Indeed, under this buffering hypothesis, TEI is conceptualized as a protective factor that exerts a "psychologically stabilizing" influence when the demands of the environment, such as academic examination or assessment settings, exceed the cognitive resources of the individual (Petrides et al., 2004, p. 84; see also Petrides, 2011). To the extent that this interaction term explains variation in academic performance, the results reported here may be underestimates of the relation of TEI with academic performance. This is because even substantial nonlinear effects may not be sufficiently represented by simple linear equations (Aiken & West, 1991). Future investigators are encouraged to consider interaction effects in their theoretical accounts of the role of TEI in academic performance.

The statistical significance of tests of moderation under only the fixed-effect model represents a final limitation that merits consideration. In the present meta-analysis, the moderating effects of age and academic level only reached significance under the fixed-effect model. Monte Carlo simulations investigating the performance of meta-analytic models under various assumption violations have shown that, when conducting tests of moderation, results are more likely to reach significance by chance under the fixed-effect model because this model underestimates sampling error variance, leading to inflation of Type 1 error rates, particularly when fixed-effect assumptions have been violated (Overton, 1998). Contrariwise, under the random-effects model, which substantially overestimates error variance, a statistically significant moderating effect is likely to suggest true moderation of the summary effect (Overton, 1998). Caution is urged in the interpretation of results obtained under the fixed-effect analysis, especially with respect to the generalizability of these findings. Extrapolations based on the fixed-effect analysis should be restricted to studies with

contextual or study design conditions approximating those in which the primary studies included in this meta-analysis were conducted (Overton, 1998). This limits the generalizability of results to studies investigating the relation of TEI, operationalized via self-report instruments, with academic performance, at the highest levels of conceptual aggregation.

5.5.5 Summary of Results

To the author's knowledge, this meta-analysis has provided the first quantitative review of the association between TEI and academic performance. The meta-analysis yielded robust evidence of near-moderate validity of TEI for predicting achievement, and served to clarify the TEI-achievement link. The available data are thus inconsistent with the existing theoretical view that TEI should show a null or near-null relation to cognitive-loaded outcomes, such as academic performance (Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011). On the contrary, the data accord with the review of literature in Chapter Four proposing theoretical links between TEI and achievement. Certainly, a construct reflecting individual differences in dispositional optimism, self-motivation, self-control, and emotion regulation should not be theoretically expected to show null relations with achievement outcomes. Overall, the finding of a positive validity coefficient constitutes encouraging, albeit tentative, evidence for the contribution of TEI to academic performance. It is hoped that this synthesis of prior research provides a basis for more focused research into the role of TEI in achievement, such as the processes that intervene in a temporal chain linking TEI and achievement, which is the focus of the present research.

The result of a favorable, near-moderate validity coefficient notwithstanding, tests of moderation revealed significant moderating influences of age and academic level on the summary effect. These findings of significant moderation suggest that researchers must consider specific population characteristics in advancing theoretical predictions on the role of TEI in achievement. The amount of heterogeneity detected between samples, and the finding of only two moderating effects under the fixed-effect model, indicate that there are likely to be further significant moderators of the summary effect. Further insights into the role of TEI in academic performance are likely to emerge from rigorous theoretical considerations of the non-linear effects of TEI on achievement. Additionally, a more refined understanding of the TEI-achievement link will necessitate examination of the indirect relations between the constructs. Indeed, the present research is centrally concerned with examining the indirect or

mediating processes through which TEI is associated with achievement during the university transition.

In addition to clarifying the validity of TEI for predicting academic performance, the meta-analytic results reinforce the present model specifications with which the present research is primarily concerned. Although the model specifications are informed by extensive theoretical considerations and prior research, the presence of inconsistent findings on the TEI-achievement link, which have been construed as indicative of the absence of any effect (Mavroveli & Sánchez-Ruiz, 2011), may have been viewed prima facie as a major challenge to the plausibility of the specifications. Thus, the finding of a near-moderate positive summary relation between TEI and achievement, based on the synthesis of approximately 15 years of research, serves to reinforce the model specifications and support their empirical testing in a sample of incoming undergraduates. The method and results of the empirical tests of these conceptual models are reported in Chapter Seven. Prior to reporting these empirical tests, the method and results of a preliminary Monte Carlo simulation study, conducted to determine *N* requirements for the target mediation model, are reported in the next chapter.

Chapter Six

A Monte Carlo Simulation Study of Sample Size Requirements for the Target Conceptual Model

The present chapter reports the methods and results of a preliminary Monte Carlo study designed to evaluate *N* requirements for the target mediation model. A crucial aspect in the design of any study using complex structural equations analyses is the determination of minimum *N* (N_{min}) to achieve an adequate probability (typically .80) (J. Cohen, 1992a) to reject a false H_0. The failure to obtain a sufficiently large sample may compromise the detection of real effects or, in statistical terms, inflate Type II error rates (J. Cohen, 1992b). An insufficient sample may also lead to biases in parameter estimates, standard errors and corresponding confidence limits (Wolf, Harrington, Clark, & Miller, 2013). Notwithstanding the centrality of *N* determination to study designs, applied researchers seldom consider N_{min} and corresponding statistical power to obtain unbiased estimates and detect real effects beyond limited and often erroneous heuristics.

Although rules of thumb continue to be used in the design of studies, they have limited applied utility. Common heuristics for applications of structural equation modeling (SEM) in the social and behavioral sciences include (a) a minimum of 200 cases (Hoogland & Boomsma, 1998), (b) at least 10 cases per observed indicator (Nunnally, 1967), (c) a minimum of five cases per freely estimated model parameter, which rises to at least 15 cases if data are found to violate the multivariate normality assumption (Bentler & Chou, 1987), and (d) even 20 cases per freely estimated parameter (Tanaka, 1987). The prevalence of these common heuristics has led some researchers to recommend rejecting for publication SEM articles reporting samples of fewer than 200 subjects except where the population is restricted (P. Barrett, 2007). These heuristics or rules of thumb are, however, limited by their generalizability to specific study and data conditions (L. K. Muthén & Muthén, 2002). Indeed, the required *N* for any given study is dependent on several factors, including the reliability of variables (Gerbing & Anderson, 1985; L. K. Muthén & Muthén, 2002), the degree and pattern of missing data (L. K. Muthén & Muthén, 2002; Wolf et al., 2013), the magnitude of associations between the variables (Gerbing & Anderson, 1985; L. K. Muthén & Muthén, 2002; Velicer & Fava, 1998), model complexity (Jackson, 2003; H. W. Marsh, Balla, & McDonald, 1988; H. W. Marsh & Hau, 1999), the type and degree of model

misspecification (Myers, Ahn, & Jin, 2011), and estimation procedure (Powell & Schafer, 2001).

The primary aim of the study reported in this chapter is to evaluate N_{min} requirements for the target conceptual model of interest in the current research using sophisticated Monte Carlo methods. The Monte Carlo approach provides a mechanism for the determination of N_{min} that accounts for various data and model contingencies, thereby redressing the limitations of general heuristics (L. K. Muthén & Muthén, 2002; Wolf et al., 2013). It should be noted that only the target conceptual model is under scrutiny in the present Monte Carlo study. This is because the alternative conceptual models specified are nested submodels of the more complex target specification, and the N_{min} determined for target model will thus be adequate for the alternative parametric structures. In the course of discussing the results of the present Monte Carlo study, an integrative framework for the conduct of N_{min} planning based on these simulation methods is advanced.

6.1 Statistical Power and Sample Size: A Brief Overview

Statistical power is the probability of rejecting a false H_0. It is equivalent to one minus the probability of a Type II error (β) where this beta error refers to the conditional probability of failing to reject the H_0 when it is false (J. Cohen, 1992a). Statistical power is contingent on three parameters implicated in statistical inference: (a) the nominal significance criterion or alpha level (α) for any given statistical test; (b) the population effect size reflecting the alternate hypothesis (H_1); (c) the N for any given statistical test (J. Cohen, 1988, 1992a). For example, for the test of the H_0 that the product moment correlation (r) is equal to zero, given the population effect size of $r = .40$ at $\alpha = .05$, when $N = 25$, the power of the statistical test is .53. When $N = 50$, maintaining the population r and α, power is .84. At $\alpha = .01$, given $r = .40$ and $N = 50$, power is .63. Finally, when the population $r = .10$, given $\alpha = .05$ and $N = 50$, power is .11 (see J. Cohen, 1988 for more detailed information about the mathematical relationship among these parameters). More precisely, then, statistical power is the probability of rejecting the H_0 given α, the population effect size and N (J. Cohen, 1992a).

Statistical power analysis is an important consideration in social and behavioral sciences research. A good deal of research depends on the formulation and empirical testing of hypotheses that the researcher has generated on the basis of theory and prior research. Empirical significance tests of these hypotheses that are underpowered may be of limited use

and even misleading to the extent that they cannot reliably detect a real nonzero parameter value. Furthermore, statistical power analysis is a crucial component of research design. Given a specified α and expected effect size, one of the primary functions of statistical power analysis is to estimate required *N* to achieve an adequate level of power to conduct planned hypothesis tests (T. Lee, Cai, & MacCallum, 2012). Indeed, increasingly, grant awarding and ethics bodies require the conduct of a priori power analysis and *N* determination or, at the very least, a justification of *N*, because a too large or too small sample may be unethical and wasteful (Thoemmes, MacKinnon, & Reiser, 2010). Power analysis and *N* considerations may be even more important in the design of SEM studies where several parameters are typically estimated and tested simultaneously.

6.2 Approaches to Sample Size Estimation in the Mean and Covariance Structure Framework

Over the past three decades, aside from rules of thumb, three major approaches to power analysis and *N* determination have been proposed in the SEM literature: (a) the Satorra-Saris (Satorra & Saris, 1985) method based on parametric misspecification; (b) MacCallum, Browne, and Sugawara's (1996) approach based on overall model fit; and (c) the Monte Carlo approach (e.g., L. K. Muthén & Muthén, 2002; Thoemmes et al., 2010; Wolf et al., 2013). The first two approaches to *N* determination and power analysis are briefly overviewed as a precursor to explicating the Monte Carlo formulation, which is used to evaluate *N* requirements and statistical power for the target mediation model in the present investigation.

Satorra and Saris (1985) proposed a method for estimating required *N* and calculating statistical power based on parametric misspecification of the hypothesized model. This procedure uses an approximate non-centrality parameter (NCP) λ (not to be confused with a factor loading in LISREL notation), indexing the amount of model misspecification, and corresponding noncentral χ^2 distribution to calculate the probability of detecting a false null parameter (typically H_0: $b_i = 0$) under the assumption that the parameter value contained in the alterative model is true in the population. For the purposes of N_{min} determination and power analysis, the parametric structure of a restricted model in specified under the H_0 in the first instance. Let $\Sigma_0(\theta)$ denote the covariance structure of this restricted model where θ represents a $q \times 1$ vector of model parameters. A second, unrestricted, model is then specified under the alternative hypothesis (H_1). This unrestricted H_1 model is identical to the restricted

model specified under the null with the exception that it contains a $p \times 1$ vector of additional model parameters. Let the covariance structure of this model be denoted by $\Sigma_1(\theta_1)$.

In the Satorra and Saris method (1985), the investigator must provide approximate population values for the parameters contained in θ_1 under the H_1. These values are typically obtained from previous research or estimated based on theory. From these approximate parameter values for the alternate (true) model, a covariance matrix $\tilde{\Sigma}_1$ is generated. The restricted model, containing only a subset of the parameters contained in θ_1, is then fitted to $\tilde{\Sigma}_1$. Typically, the H_0 model is specified by constraining to zero (or some other value of substantive interest) the parameters contained in the $p \times 1$ vector of additional model parameters for which the investigator wishes to obtain estimates of power. The discrepancy function value, $\hat{F}_1$, obtained from fitting $\Sigma_0(\theta)$ to $\tilde{\Sigma}_1$ can then be used to compute an approximate λ as shown in Equation 6.1:

$$\lambda = (N-1)\hat{F}_1, \tag{6.1}$$

under the assumption that the alternate model is true. Once the NCP is obtained, power for a chosen α level (typically $\alpha = .05$ but not always) is calculated as the probability of obtaining a χ^2 value that is greater than the χ_c^2 under the noncentral χ^2 distribution given the NCP and *df* equal to the number of constrained parameter in θ. Required sample size can be estimated as the value that yields a sufficient degree of noncentrality given the model misspecification contained in H_0 to obtain an adequate level of power for tests of key parameters (see Satorra & Saris, 1985 for full details).

Although the Satorra-Saris (Satorra & Saris, 1985) method has several recognized advantages, not least of which is the ability to estimate N_{min} and power for tests of individual parameters (Hancock & French, 2013; T. Lee et al., 2012; Thoemmes et al., 2010), it is limited by three chief factors. First, the method cannot account for specific data contingencies that may impact sample requirements and power, such as the amount and pattern of missing data and reliability of variables (L. K. Muthén & Muthén, 2002; Wolf et al., 2013). To the extent that these data characteristics impose a burden on model estimation, N_{min} requirements and power may be under-and-over-estimated, respectively. Second, and especially relevant to the present investigation, is the difficulty in defining the NCP for the mediated effect. The NCP for the indirect effect can be computed by setting the $X \rightarrow M, \mathrm{M} \rightarrow Y$ or both

paths to zero. However, as noted by Thoemmes et al. (2010), if the sizes of the paths differ considerably, estimates of requisite *N* and concomitant power can vary substantially based on the magnitude of the paths. As discussed in the following section, the Monte Carlo procedure redresses this limitation to N_{min} estimation in the context of testing mediation hypotheses. Finally, the Satorra-Sarris method only addresses N_{min} estimation from a power analytic perspective. Statistical power should not be the only consideration in *N* planning. Indeed, accuracy of parameters and standard error estimates, the reliability of confidence intervals and solution propriety may also be influenced by *N* (Kelley & Maxwell, 2003; L. K. Muthén & Muthén, 2002; Wolf et al., 2013).

A second approach to estimating N_{min} and power for structural equation models is proposed by MacCallum et al. (1996). This approach also uses an approximate NCP to calculate the probability of rejecting a false H_0 of not-good model fit. However, dissimilar to the Satorra-Saris method (Satorra & Saris, 1985), which defines the NCP in terms of parametric misspecification between H_0 and H_1 models, the MacCallum et al. approach defines the NCP is terms of overall model misfit. Although, traditionally, data-model fit has been defined by the χ^2 fit function, *F*, because the metric of this discrepancy function is cumbersome, MacCallum et al. used the root mean square error of approximation (RMSEA) absolute fit index, which is linearly related to *F*, to test model fit hypotheses. In the framework of *N* planning, this method aims to determine N_{min} required to obtain a desired level of power to reject the H_0 of not-close ($RMSEA_0 \geq .05$) or not-acceptable fit ($RMSEA_0 \geq .08$) (see T. D. Little, 2013). Unlike the Satorra-Saris (Satorra & Saris, 1985) method, the specification of a population covariance structure is not required. Although this has been recognized as a benefit of the MacCallum et al. approach, inasmuch as less input information is required (T. Lee et al., 2012), it may paradoxically be its chief disadvantage. This limitation is considered in detail in the following discussion of the Monte Carlo approach to N_{min} estimation.

6.3 A Monte Carlo Framework for the Estimation of *N* and Power: Accuracy, Propriety and Power

Typically, Monte Carlo simulation studies in SEM research are conducted to evaluate the behavior of statistical estimators, test statistics and fit indices for mean and covariance structure models under various data and modeling conditions (e.g., missing data, non-normality, model misspecification, model complexity) (Bandalos & Leite, 2013; Boomsma,

2013; Hoogland & Boomsma, 1998; Paxton, Curran, Bollen, Kirby, & Chen, 2001). For example, investigators may be interested in the finite sample properties of asymptotic statistical tests or estimators or the robustness of parametric methods to violations of the multivariate normality assumption. A less widely known use of Monte Carlo studies is in the estimation of *N* requirements in planning applied research. The Monte Carlo empirical estimate of a random variable's sampling distribution can be used to estimate *N* and power in much the same way as it is used to investigate the behavior of statistical estimators and tests (L. K. Muthén & Muthén, 2002).

The Monte Carlo simulation procedure is straightforward and conducted in four phases (see L. K. Muthén & Muthén, 2002; Myers et al., 2011; Thoemmes et al., 2010; Wolf et al., 2013 for other summaries). First, a population of interest is simulated by generating a model with known population parameters. Typically, values for the population parameters are derived from extant theory and/or prior research. Second, from this simulated population, which is treated as a known truth, repeated random samples *k* of the same size *N* are drawn where *k* is some large value necessary to achieve stability of estimates (typically, $k = 1000 – 10000$) and *N* is the sample size of interest. Third, for each random sample, the statistics of interest are estimated by fitting the population model to each random sample. Finally, a sampling distribution for each resulting population parameter is generated from the estimates recovered across the random samples. This Monte Carlo empirical estimate of the sampling distribution of a parameter of interest is examined for insights into the quality of the parameter estimate, associated standard error and coverage under the conditions specified by the simulated population. For instance, to examine the degree of parameter estimate bias under, say, conditions of missing data using normal theory (NT) maximum likelihood (ML) estimation, the mean of the estimates across the *k* replications is compared to the initial population parameter value (specific formulae for the calculation of bias are presented below).

This basic Monte Carlo procedure can also be used to estimate requisite *N* and power for a study. In line with sampling theory, sample statistics are expected to vary around the true population parameter values due to random events. Following from this, the statistical significance of parameter estimates can be expected to vary from sample to sample. In the Monte Carlo experiment, for any non-zero parameter, with sufficient random draws from the known population, power can be estimated as the proportion of *k* random samples in which

the H_0 that the parameter equals zero is rejected at the nominal alpha level (typically, $\alpha = .05$) (L. K. Muthén & Muthén, 2002). To illustrate, suppose that a researcher is interested in determining requisite *N* for achieving adequate statistical power to reject a false H_0 that the intelligence-achievement correlation is equal to zero. Based on theory and prior research, the population value for this parameter is fixed to reflect a large-sized effect (i.e., $r = .50$). From this simulated population, 1,000 random samples of size $N = 150$ are drawn to estimate an empirical sampling distribution of the parameter. The parameter of interest reached statistical significance in 971 random samples of the 1,000 replications performed. Given that the population parameter is of a non-zero value, power is taken as the proportion of replications for which the H_0 is rejected. In this case, the statistical power to reject the H_0 that the intelligence-achievement correlation is significantly different from zero, given $N = 150$, a population effect size of $r = .50$ and $\alpha = .05$, is .971 (971/1,000). Thus, requisite *N* can be estimated a priori by observing power at a range of values for *N* given the expected population effect size and nominal significance criterion.

The Monte Carlo approach has several benefits for the estimation of requisite *N* in substantive research over heuristics and even other model-based approaches, such as the Satorra and Saris (1985) method based on parametric misspecification and the MacCallum et al. (1996) approach based on overall model fit. First, the Monte Carlo approach addresses *N* planning from the perspectives of parameter accuracy, solution propriety as well as statistical power (L. K. Muthén & Muthén, 2002). It is recognized that bias in parameter estimates and standard errors as well as model nonconvergence and inadmissibility can increase as a function of decreasing *N* (Gagné & Hancock, 2006; Wolf et al., 2013). It may be that the quality of the model solution and accuracy of parameter estimates and standard error informs N_{min} requirements as much as statistical power considerations. Second, by estimating an empirical sampling distribution of relevant statistics via repeated random draws from a defined population, the Monte Carlo approach facilitates the computation of a probability value reflecting the likelihood of observing a parameter that is significantly different from zero. This may be particularly advantageous in the estimation of requisite *N* to detect mediated and non-linear effects where the definition of a non-centrality parameter may be unclear under the Satorra-Saris approach (Thoemmes et al., 2010). Third, the Monte Carlo method focuses on estimating power for statistical tests of individual parameters as compared with overall model fit. Because it is entirely possible for a structural equation model to be adequately powered to detect appropriate data-model fit quite apart from the power of

individual statistical tests of model parameters (Satorra & Saris, 1985; MacCallum et al., 1996; Maxwell, 2004), it may be that a good-fitting model masks erroneous inferences about the statistical non-significance of parameters from underpowered tests. Finally, the Monte Carlo method can take into account several model and data characteristics, such as the reliability of variables, the degree and pattern of missing data, model misspecification and complexity, and estimation routines, which have been shown to influence required *N* (L. K. Muthén & Muthén, 2002; Myers et al., 2011; Wolf et al, 2013).

In the present study, a series of Monte Carlo simulations was performed to estimate *N* requirements for the target mediation model linking TEI and achievement during the university transition. Specifically, a 6 × 1 Monte Carlo experiment was conducted consisting of two between-subjects independent variables: (a) *N* with six levels; and (b) missing data with one pattern of missingness. The dependent variables in the study design were parameter estimate and standard error bias, coverage, statistical power and solution propriety. In total, there were six cells in this Monte Carlo design. The simulations were performed using the Monte Carlo utility in Mplus 6.12 (L. K. Muthén & Muthén, 1998–2010).

6.4 Method

6.4.1 Model Specification and Population Parameters

A population covariance matrix was generated for the target mediation model based on best available estimates of population parameters derived from theory and prior research. Population values for factor loadings, error variances, structural regression paths and disturbance variances were selected so that all variables were generated to have a mean of 0 and variance of 1. This is equivalent to standardizing the solution and facilitates the interpretability of the population values (L. K. Muthén & Muthén, 2002).

6.4.1.1 Measurement model parameters. For the peripheral measurement parameters in the population model (e.g., factor loadings [λ], error variances [θ]), population estimates of standardized λs were obtained from validation studies and technical manuals where possible. Where estimates of standardized loadings could not be directly obtained or computed based on existing data (e.g., covariance matrix), the square roots of known reliabilities (e.g., maximal reliability, Cronbach's alpha) were used as proxies for λ (Hancock, 2006; Hancock

& French, 2013). As the factor variances were fixed to 1.0 in the population model, θs for observed indicators were simply calculated as $1 - (\lambda^2)$.

For the Well-being, Self-control, Emotionality and Sociability indicators of latent TEI, population values of λ were estimated from an interrcorrelation matrix and standard deviations of these variables measured using the TEIQue as reported in Petrides (2009). Population values for the Self-motivation and Adaptability indicators of latent TEI were estimated as the square roots of internal consistency reliabilities (i.e., α) of these facet scores also obtained from Petrides (2009).[1]

Population estimates of λ for the observed indicators of latent perceived social support were obtained from a CFA test of the factorial structure of the Social Provisions Scale (SPS) reported in Cutrona and Russell (1987). Specifically, second-order factor loadings of the six social provisions on the higher-order support factor were used as population estimates.

For the observed indicators of latent engagement coping, population estimates of λ were derived from loadings of primary-control and secondary-control engagement factors on a second-order engagement coping factor obtained from Connor-Smith et al. (2000).

Population estimates of λ for the manifest indicators of latent academic adaptation were obtained from a factor analytic examination of the dimensionality of items of the Organization and Attention to Study (OAS) scale of the College Learning Effectiveness Inventory (CLEI) reported in Yeager (2009; see also Kim et al., 2010).

For latent social adaptation, population values of λ were estimated as the square roots of maximal reliability coefficients for the following three scales proposed to index the construct: (a) UCLA loneliness scale-8 (ULS-8) (Hays & DiMatteo, 1987); (b) Peer-Group Interactions (PGI) scale of the Institutional Integration Scales (IIS) (Pascarella & Terenzini, 1980); (c) Involvement with College Activity (ICA) scale of the CLEI (Kim et al., 2010). Maximal reliabilities of the three scales were computed using Equation 6.2 as follows:

[1] A full description of the observed measures used as indicators of the latent constructs is presented in Chapter Seven (Section 7.2.3).

$$H = \frac{\sum_{i=1}^{k}\left(\frac{\lambda_i^2}{1-\lambda_i^2}\right)}{1+\sum_{i=1}^{k}\left(\frac{\lambda_i^2}{1-\lambda_i^2}\right)} \tag{6.2}$$

where λ refers to the standardized factor loading of items on the scale factor (Hancock & Mueller, 2001). Item loadings for each of the three scales were obtained from factor analytic validation studies (see Kim et al., 2010; Pascarella & Terenzini, 1980; Wu & Yao, 2008; Yeager, 2009).

Population values of λ for indicators of latent psychological adaptation were obtained from a principal components analysis of the Warwick Edinburgh Mental Well-Being Scale (WEMWBS) in an Irish general sample (Lloyd & Devine, 2012). Although there are at least two studies reporting CFA data on the scale, these studies did not report specific λ values for the item-level indicators. Further, requests for these data from relevant authors were not heeded.

Given the specification of a second-order psychosocial adaptation factor, which is expected to account for the covariation between social and psychological adaptation consistent with the present conceptualization of university adjustment (see Chapter Three), population values for the these indicators were estimated as the square roots of maximal reliabilities of the constituent first order factors. These reliability coefficients were computed using the population estimates of λ for the first-order factor loadings specified above. In the analytic model of the Monte Carlo procedure, the loading of social adaptation on psychosocial adaptation ($\Gamma_{5,1}$) was fixed to a non-zero value reflecting reliability for model identification purposes.[2] Thus, estimates of statistical power for this parameter could not be obtained. The statistical test of this parameter is, however, likely to be adequately powered at the chosen *N* because it significantly exceeds the minimum effect size to be detected in absolute magnitude.

Finally, for the single indicator of first semester achievement, the population value of λ was estimated as the square root of the internal consistency reliability of freshman GPA

[2] Second-order structures with fewer than three indicators are not *just-identified* unless some constraint is imposed on the model (e.g., fixed factor loading) (Chen, West, & Sousa, 2006; L. K. Muthén, personal communication, 12 November, 2012).

reported in a validity study of university GPA (Bacon & Bean, 2006). It should be noted that statistical power estimates for this parameter at any given *N* could not be obtained as the parameter was fixed to a non-zero value reflecting reliability in the analytic model of the simulation for model identification purposes. The statistical test of this parameter is, however, likely to be sufficiently powered as it greatly exceeds in absolute magnitude the minimum effect size to be detected. The population measurement model, without factor covariances, is shown in Figure 6.1.[3]

[3] Population factor covariances values were not included in the measurement structure because estimated population values for the focal structural regression parameters were included in the population structural model, which is of primary interest in the present investigation.

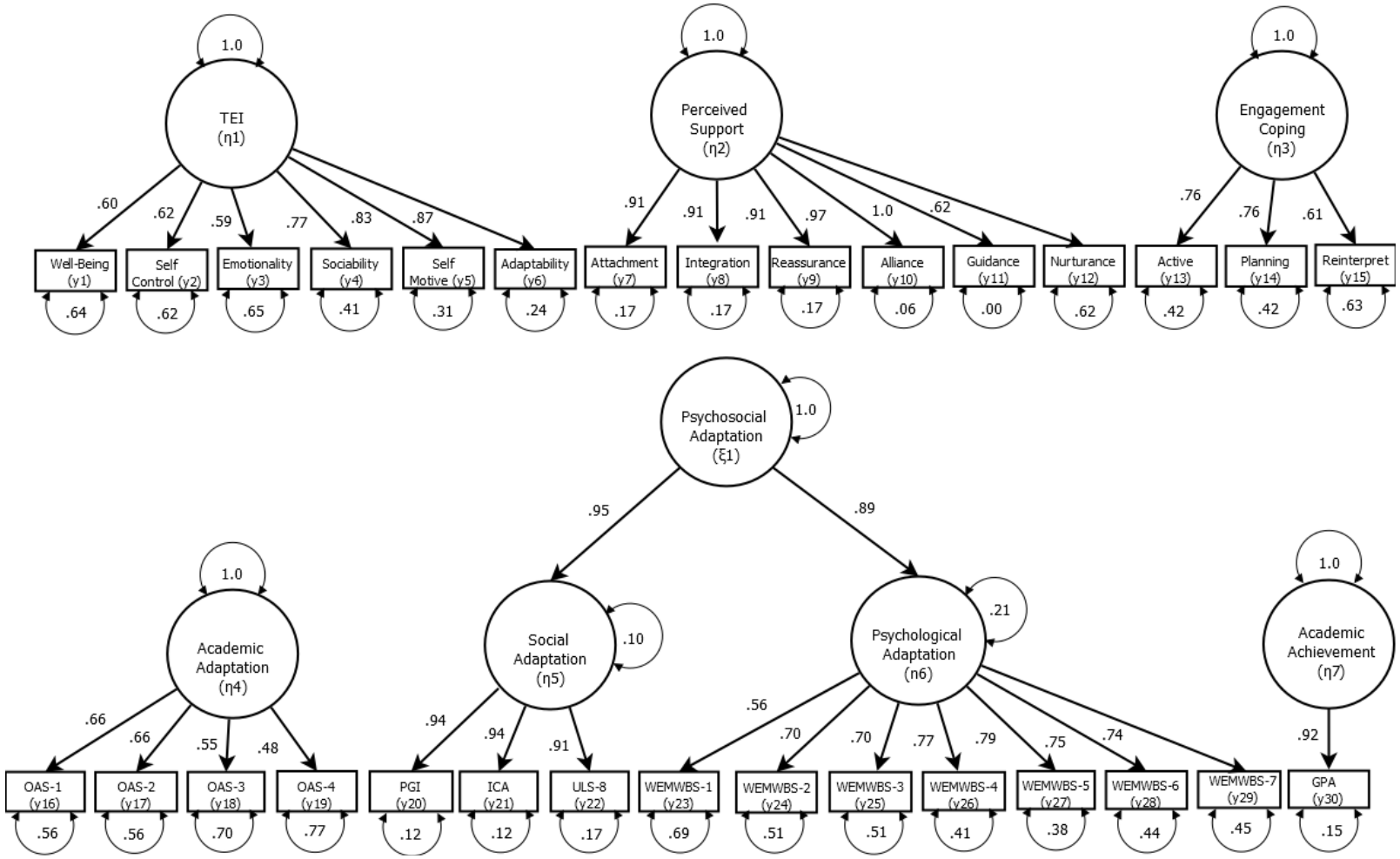

Figure 6.1. The population measurement model with estimates drawn from extant theory and empirical evidence. Self-Motive = Self-Motivation; Integration = Social Integration; Reassurance = Reassurance of Worth; Alliance = Reliable Alliance; Nurturance = Opportunity for Nurturance; Active = Active Coping; Reinterpret = Positive Reinterpretation.

6.4.1.2 Structural model parameters. For the focal structural parameters in the population model, population values for standardized regression paths from exogenous to endogenous variables (γ) and between endogenous variables (β) were estimated on the basis of the amount of variance explained in the relevant criterion (i.e., R^2) (Thoemmes et al., 2010; Wolf et al., 2013). These estimates were drawn wherever possible from meta-analytic reviews. Although meta-analytic summary effects (e.g., *rs*) may be overestimates of true population direct effects to the extent that they represent total effects, these coefficients were preferred to estimates drawn from single-studies due to their stability. Where summary effects from meta-analyses were not available, population estimates of regression paths were obtained from prior research with participants resembling, as far as possible, the sample of interest in the present study. Where even these estimates could not be obtained due to the paucity of research examining any given predictor-criterion relationship, J. Cohen's (1988) guidelines for R^2 effect-sizes of small (.02), medium (.13) and large (.26) magnitude were used to estimate population values for the structural paths guided by theoretical considerations in review of literature reported in Chapter Four. For all endogenous latent variables in the population structural model, disturbance variances were fixed such that the total variance of these variables was equal to one. The covariance algebra used to compute these disturbance variance terms is available in Appendix A.

The population estimate of $\gamma_{1,1}$ for the structural path from TEI to perceived social support was obtained from Kong et al. (2012a) who investigated the mediating role of perceived social support in the TEI-life satisfaction relationship in a sample of Chinese university students, controlling for errors of measurement.

For the path from TEI to engagement coping, the population estimate of $\gamma_{2,1}$ was obtained from Petrides, Perez-Gonzalez et al. (2007). These authors investigated the validity of TEI for predicting rational coping, which conceptually approximates engagement strategies, controlling for personality confounders (Petrides, Perez-Gonzalez et al., 2007).

The population value for the structural path from TEI to academic adaptation was more complicated to estimate because no studies had investigated the relationship of TEI with adjusting academically to the university transition at the time of designing this Monte Carlo study. On the basis of the theoretical arguments advanced in Chapter Four, TEI was expected to explain a moderate amount of variance in academic adaptation. Thus, J. Cohen's (1988)

heuristic for a moderate R^2 effect size (i.e., $R^2 = .13$) was used to compute the population value of $\gamma_{3,1}$ for the path from TEI to academic adaptation.

The population estimate of $\gamma_{4,1}$ for the direct relationship between TEI and psychosocial adaptation in the target model was obtained from the largest meta-analytic review of the TEI-well-being relation (Martins et al., 2010). The summary effect used as the population estimate of this structural path was based on the synthesis of 67 independent effect sizes.

For the direct path from TEI to academic achievement, the population estimate of $\gamma_{5,1}$ was obtained from the meta-analytic review reported in Chapter Five. Specifically, the population value was estimated as the summary relation between TEI and achievement based on data from only tertiary samples under the fixed-effect model.

The population value of $\beta_{4,1}$ for the structural path from perceived social support to psychosocial adaptation was estimated as the average of the correlations of perceived social support with social and psychological adaptation reported in a study of Canadian first year students adjusting to the university transition (Friedlander et al., 2007).

For the structural path from engagement coping to psychosocial adaptation, the population estimate of $\beta_{4,2}$ was obtained from a study by Aspinwall and Taylor (1992) who examined the direct association of active coping with subsequent adaptation to university, indexed, in part, by psychological and social well-being.

The population estimate of $\beta_{3,2}$ for the direct path from engagement coping to academic adaptation was obtained from Leong et al. (1997) in one of the few studies examining the role of coping in academic adaptation to the university transition.

Finally, population values for the paths from psychosocial and academic adaptation to academic achievement were estimated based on data from the largest meta-analytic review of the relations of university adaptation dimensions with freshman achievement (Credé & Niehorster, 2012). First, the population value of $\beta_{5,4}$ for the structural path from psychosocial adaptation to achievement was estimated as the average of the true-score correlations of psychological and social adjustment with freshman GPA obtained from Credé and Niehorster (2012). The population estimate of $\beta_{5,3}$ for the direct path from academic adaptation to achievement was taken as the true score correlation between academic adjustment and

freshman GPA reported in the same meta-analysis. The population structural model is shown in Figure 6.2.

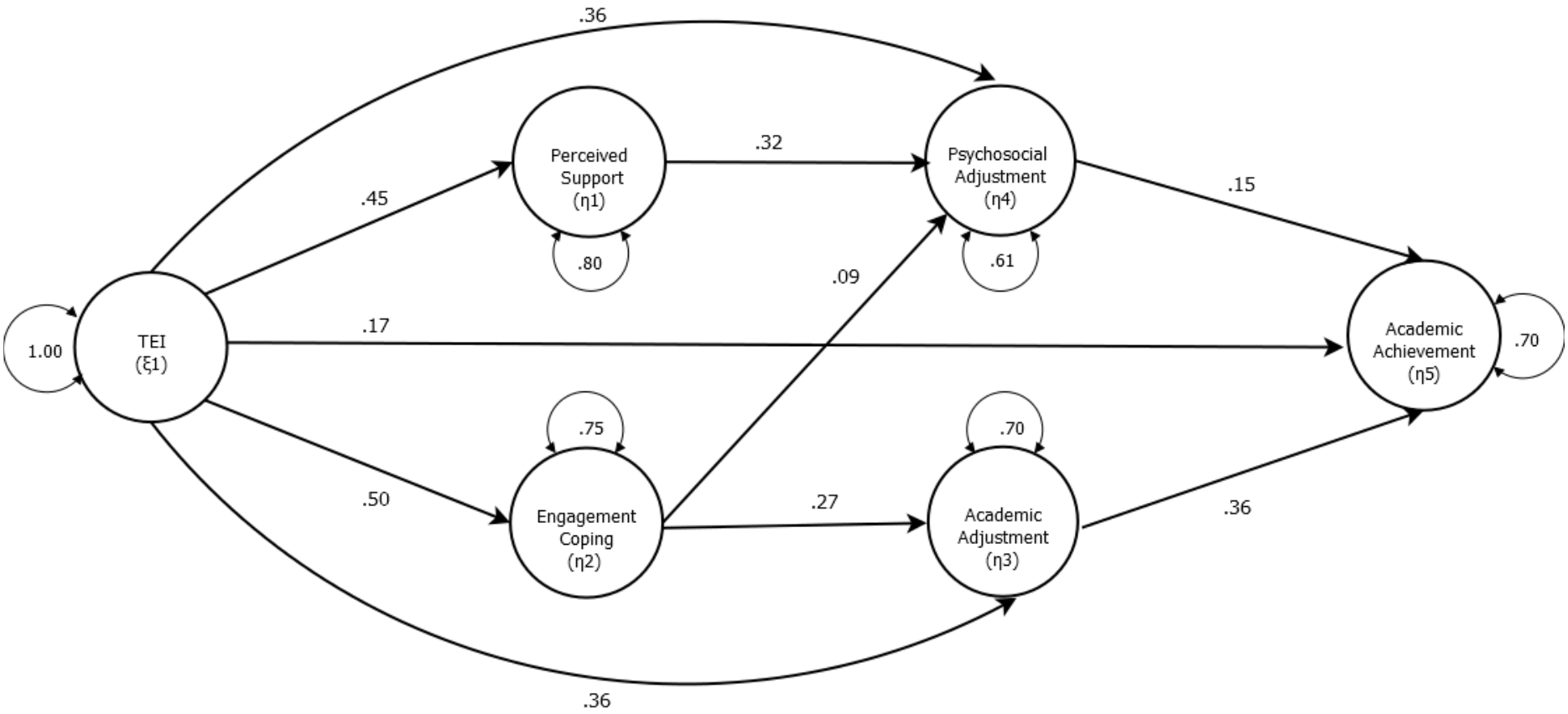

Figure 6.2. The population structural model with estimates drawn from extant theory and empirical evidence.

6.4.1.3 Indirect effects. The indirect effects in the Monte Carlo simulations were taken as the product of the standardized population structural coefficients implicated in the pathway (MacKinnon, Warsi, & Dwyer, 1995; Perera, 2013; Shrout & Bolger, 2002). For example, for the indirect association of TEI with psychosocial adaptation via perceived social support, the indirect effect was estimated as the product of $\gamma_{1,1}$ and $\beta_{4,1}$ (i.e., .45 × .32 = .14). For the three-path indirect effect of TEI on achievement via engagement coping and academic adaptation linked serially, the effect was taken as the product of $\gamma_{2,1}$, $\beta_{3,2}$, and $\beta_{5,3}$ (i.e., .50 × .27 × .36 = .05). Table 6.1 shows the population estimates of indirect effects quantified as the product of implicated structural path coefficients. This approach to defining indirect effects is preferred to the classical causal steps method (Baron & Kenny, 1986) because the effect is under direct empirical scrutiny rather than inferring statistical mediation from significance tests of constituent paths (Hayes, 2009; Perera, 2013; Rucker et al., 2011). (See Chapter Seven for further discussion.)

The statistical significance of the indirect effects in the simulations was evaluated using the Sobel (1982) product of coefficients test. The Sobel test is performed by dividing the indirect effect by its standard error, which produces a critical ratio or *z*-score that is compared to an approximate critical value from the standard normal distribution (e.g., $z = 1.96$ for a two-tailed significance test where $\alpha = .05$) to test the H_0 that the true indirect effect in the population is equal to zero.

Table 6.1

Population Indirect Effects Computed as the Product of Implicated Structural Path Coefficients

Parameter	Predictor		Mediators		Outcome	Population Effect
$\gamma_{3,1}\beta_{5,3}$	TEI	→	Academic adjustment	→	Achievement	.13
$\gamma_{4,1}\beta_{5,4}$	TEI	→	Psychosocial adjustment	→	Achievement	.05
$\gamma_{1,1}\beta_{4,1}$	TEI	→	Perceived support	→	Psychosocial Adjustment	.14
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	TEI	→	Perceived Support →Psychosocial adjustment	→	Achievement	.02
$\gamma_{2,1}\beta_{3,2}$	TEI	→	Engagement coping	→	Academic Adjustment	.14
$\gamma_{2,1}\beta_{4,2}$	TEI	→	Engagement coping	→	Psychosocial Adjustment	.05
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	TEI	→	Engagement coping →Academic adaptation	→	Achievement	.05
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	TEI	→	Engagement Coping → Psychosocial adjustment	→	Achievement	.01

The validity of the significance test of the indirect effect under the Sobel (1982) approach hinges on the tenability of the assumption that the sampling distribution of the indirect effect approximates normality under the H_0 (Perera, 2013; Preacher, Rucker, & Hayes, 2007). The indirect effect is, however, typically kurtotic and asymmetrical (viz., positively skewered), particularly in modest samples, which may yield underpowered tests of mediation and erroneous confidence bounds (Perera, 2013; Shrout & Bolger, 2002). Consequently, methodologists have advised against the statistical testing of the indirect effect using NT standard errors unless samples are large enough for the distribution of this effect to approximate normality (Mackinnon, Lockwood, Hoffman, West, & Sheets, 2002). Instead, bootstrapping provides an alternative, more powerful, method to assess indirect effects, which makes no assumptions about the sampling distribution of the indirect effect (Perera, 2013; Shrout & Bolger, 2002). Unfortunately, the bootstrap procedure is not currently available in the Mplus Monte Carlo utility or any other Monte Carlo utility to the author's knowledge (L. K. Muthén & Muthén, 1998–2010). Accordingly, significance tests of indirect effects were conducted using the Sobel approach in the simulations with the caveat that $N_{\min}$ for sufficient statistical power ($\pi = .80$) to reject the H_0 may be marginally overestimated

given that the bootstrap method is used to estimate and test indirect effects in the present empirical study (see Chapter Seven).

6.4.2 Conditions

6.4.2.1 Missing data. Missing data are a pervasive analytic issue in multiwave research, such as the present investigation. Missingness may be due to item non-response and/or survey attrition across waves of data collection (Jeličić, Phelps, & Lerner, 2009; Schlomer, Bauman, & Card, 2010). A good deal of recent evidence suggests that missing data have an impact on *N* requirements and power to detect real effects (Davey & Savla, 2009; Dolan, van der Sluis, & Grasman, 2005; L. K. Muthén & Muthén, 2002; Wolf et al., 2013). For instance, L. K. Muthén and Muthén (2002) demonstrated that *N* requirements for sufficient power ($\pi = .80$) to detect a moderate factor covariance in a two-factor congeneric CFA model increased by about 17% when substantial missingness (50%) was generated for half the observed variables assuming a missing completely at random (MCAR) missing data mechanism. Similarly, Wolf et al. (2013) found that, for a simple latent variable mediation model, *N* requirements for a minimum power of .80 to detect a moderate-sized mediated effect, with no systematic parameter or standard error bias in the solution, increased by approximately 44% after introducing moderate missingness (20%) across all observed variables. Thus, data in the present simulations were generated accounting for the amount and pattern of missingness expected based on prior research using comparable short-term multi-wave designs.

Missing data on the observed variables were generated such that the pattern of missingness reflected non-trivial attrition across time as is common in even short-term sequential studies. Let *T* denote a vector of missingness probabilities,

$$T = \left[\tau_1, \tau_2, \ldots \tau_i\right],$$

where τ_i is the probability of missingness at the i^{th} measurement occasion or time point. In the present simulations, probabilities of missingness were estimated as follows:

$$T = \left[.00_1,\ .25_2,\ .35_3,\ .05_4\right].$$

Thus, data were generated such that all subjects had complete data on the time one variables, 75% of subjects had data on the time two variables, 65% of subjects had data on the time three variables, and 95% of subjects had data on the time four outcome. This pattern

of attrition is typical of short-term multiwave studies with incoming undergraduates such as this one (see e.g., Aspinwall & Taylor, 1992; Chemers et al., 2001; Lidy & Kahn, 2006). Notably, as academic transcripts with first-semester GPA records would be obtained from the university registrar for the fourth wave of measurement, only modest missingness was expected at this time point (Chartrand, 1990). Finally, data were generated such that there were no covariate predictors of missingness, thereby assuming that the probabilities of missingness are independent of the data (L. K. Muthén & Muthén, 2002).

6.4.2.2 Sample size and replications. Six sample sizes, typical of empirical research in the social and behavioral sciences, were considered for the model: 200, 400, 600, 800, 1000, and 1200. The simulations commenced with the $N = 200$ run because this has been suggested as the minimum N for conducting SEM analyses (P. Barrett, 2007). It should be noted, however, that in this small sample condition (i.e., $N = 200$) model estimation may be particularly problematic because the df of the target model exceed the N (Yuan & Bentler, 1998). Finally, one thousand replications of the model within each design condition were conducted to achieve stability (Paxton et al., 2001).

6.4.3 Data analytic strategy

6.4.3.1 Model estimation. For all cells in the Monte Carlo experiment, ML was used to estimate solutions. In Mplus, the ML estimator implements the Full Information Maximum Likelihood (FIML) routine for handling missing data that are MCAR or missing at random (MAR) (Enders & Bandalos, 2001; L. K. Muthén & Muthén, 1998–2010). This estimation routine was considered appropriate for the present simulations because multivariate normal data were generated for a population with missing data reflecting subject attrition over time.

6.4.3.2 Criteria for evaluating sample size requirements. Five criteria were used to determine minimum N requirements for the target mediation model to achieve sufficient statistical power while maintaining minimal bias, adequate coverage and solution propriety. First, the analysis could yield up to only 5% of convergence failures or improper solutions per run because a greater percentage of non-convergent or inadmissible solutions suggests that there is a non-trivial chance the model will fail to converge or converge to an inadmissible solution in the population (Myers et al., 2011).

Second, relative parameter estimate bias could not exceed 10% for any factor loading or structural regression parameter across the design cells (Flora & Curran, 2004). Relative bias

greater than 10% is suggestive of substantial bias (Curran, West, & Finch, 1996; B. Muthén, Kaplan, & Hollis, 1987). Relative parameter estimate bias was computed as the mean deviation of the sample estimate from its population value relative to the true value as per Equation 6.3:

$$rBias\left(\hat{\theta}_i\right) = \sum_{j=i}^{nr}\left(\frac{\left(\hat{\theta}_{ij}-\theta_i\right)}{\theta_i}\right) / n_r, \tag{6.3}$$

where $\hat{\theta}_{ij}$ is the *j*th sample estimate of the *i*th true population parameter θ_i, and n_r is the number of replications in each design cell. The resulting bias value can be multiplied by 100 to obtain the percentage of sample bias.

Third, the degree of bias in standard errors of the parameters had to also be less than 10% (Flora & Curran, 2004; Hoogland & Boomsma, 1998). Similar to parameter estimate bias, relative standard error bias was calculated as the average deviation of the sample standard errors from the true population value relative to the true value as per Equation 6.4:

$$rBias\left(SE\left(\hat{\theta}_i\right)\right) = \sum_{j=i}^{nr}\left(\frac{SE\left(\hat{\theta}_i\right)_j - SE\left(\hat{\theta}_i\right)}{SE\left(\hat{\theta}_i\right)}\right) / n_r, \tag{6.4}$$

where $SE\left(\hat{\theta}_i\right)_j$ is the estimated standard error of $\hat{\theta}_i$ for the *j*th replication, and $SE\left(\hat{\theta}_i\right)$ is an estimate of the population standard error of $\hat{\theta}_i$ .Standard error bias can be expressed as a percentage by simply multiplying this quantity by 100.

Fourth, coverage of the factor loadings and structural parameters was specified to be at least 90% and ideally around 95% (Collins, Schafer, & Kam, 2001). Coverage refers to the proportion of sample replications for which the true population value is contained within the 100(1 – α)% confidence limits of a parameter estimate (L. K. Muthén & Muthén, 2002). In the present simulations, the significance criterion was set at α = .05.

Finally, statistical power had to be at least .80 (given α = .05) for all factor loadings, direct regression paths and mediated effects (J. Cohen, 1992a, 1992b). Any solution (and concomitant *N*) with even one parameter of interest falling below a power of .80 would be rejected in line with this criterion (Maxwell, 2004).

6.5 Results

6.5.1 Imperfect Samples

Imperfect samples refer to data sets that fail to converge or converge to inadmissible solutions (e.g., replications with Heywood cases) (Paxton et al., 2001). High proportions of non-convergent and inadmissible solutions are suggestive of terminal model-data problems. In the initial run with baseline N (i.e., $N = 200$) and $k = 1000$, 58% of the replications were inadmissible due to non-positive definite (NPD) θ matrices. These NPD residual covariance matrices were caused by the substantial factor loading of y11 on perceived social support ($\lambda_{11,2} = 1.0$), with zero error variance, which, because of sampling variability, may have taken on a standardized value greater than one and resulted in a negative residual variance for y11 across the inadmissible replications. The population value of $\lambda_{11,2}$ was thus reset to the value of the next highest loading on perceived social support ($\lambda_{10,2} = .97$, $\theta_{\delta 10} = .06$) to facilitate the generation of admissible replications while maintaining the indicator's substantial contribution to the factor.

After adjusting these population parameters, most inadmissible solutions appeared in the small sample condition (i.e., $N = 200$). Indeed, in this condition, 6.7% of the replications converged to inadmissible solutions. Consistent with criterion one, $N = 200$ was rejected as a possible requisite N on the basis of inadmissibility exceeding 5%. No further results are reported for the $N = 200$ condition, but bias, coverage and power results are presented in Appendix B for the interested reader. The remaining conditions had few imperfect samples, and the results of these runs are reported below. In all cases, the statistics computed were based on sample replications that converged to proper solutions.

6.5.2 Requisite Sample Size

Due to space considerations, parameter estimate and standard error biases, coverage and statistical power data for the measurement parameters (i.e., factor loadings) across the admissible Monte Carlo runs are omitted from the narrative. However, these data are available in Appendix C for the interested reader. Across these runs, bias, coverage and statistical power for the factor loadings were uniformly acceptable and thus the focus in the present section is on reporting results concerning the substantive direct and indirect structural paths.

6.5.2.1 *N* = 400 run. For the *N* = 400 run, the analytic model converged to an admissible solution in 988 of 1000 sample replications. Twelve replications produced inadmissible solutions due to NPD θ matrices involving the fixed, single indictor of academic performance (i.e., y30). The rate of improper solutions (1.2%) did not, however, exceed the cut-off criterion for an invalid run. Thus, results from the admissible sample replications were retained for further examination.

Parameter estimate and standard error biases, coverage and statistical power for the 10 estimated direct structural regression paths from the *N* = 400 run are shown in Table 6.2. Mean parameter estimates for the 10 direct paths across the 1000 replications were all within approximately 3.5% of the population parameter estimates. Indeed, for six of the direct paths, parameter estimate bias was less than 1%. Relative bias for standard error estimates was also trivial, ranging from –4.91% ($\gamma_{3,1}$) to 0.97% ($\beta_{3,2}$). Coverage rates exceeded 90% for all direct structural paths and reached the optimal level of 95% for nine of the ten structural parameters. Adequate statistical power (i.e., $\pi = .80$) to reject the H_0 that the structural regression paths are not significantly different from zero was observed for seven of the ten direct paths. Direct paths $\beta_{5,4}$ and $\gamma_{5,1}$ were moderately underpowered, and the statistical test of $\beta_{4,2}$ was substantially underpowered. Findings of these underpowered direct paths suggest that *N* = 400 may be insufficient for adequate power to detect smaller direct paths.

Table 6.2

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 400 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	0.42	–0.25	95.6	1.00
$\beta_{5,4}$	–2.40	–0.74	94.8	.59
$\gamma_{5,1}$	–1.53	–1.10	95.1	.55
$\beta_{3,2}$	–1.67	0.97	95.9	.84
$\gamma_{3,1}$	3.33	–4.91	95.1	.99
$\beta_{4,1}$	–0.32	0.00	95.3	1.00
$\beta_{4,2}$	0.78	–4.34	94.2	.28
$\gamma_{4,1}$	0.25	–0.44	95.3	1.00
$\gamma_{2,1}$	0.56	–1.00	95.6	1.00
$\gamma_{1,1}$	0.75	0.37	95.4	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Table 6.3 presents relative parameter estimate and standard error biases, coverage and statistical power for the eight indirect effects from the $N = 400$ run. Relative parameter estimate bias for seven of the eight mediated effects was trivial. Only the three-path indirect effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ was moderately biased; however, the value of relative bias was well below the recommended cut-off of 10% for substantial bias. Average standard error estimates for the mediated effects over the 1000 replications were all within 5% of the population standard errors. Coverage rates for the mediated effects were acceptable, ranging from 90% to 95%. Statistical power to detect the indirect effects in this run was adequate for only three of the eight statistical tests of mediation. Of the remaining five indirect effects, power to detect the three-path mediated effect $\gamma_{2,1}\beta_{3,2}\beta_{5,3}$ was only marginally below the .80 cut-off for acceptable power to reject a false H_0. On the contrary, statistical tests of the mediated effects $\gamma_{4,1}\beta_{5,4}$ and $\gamma_{1,1}\beta_{4,1}\beta_{5,4}$ and $\gamma_{2,1}\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ were moderately and substantially underpowered, respectively, with the test of $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ reaching a near-null level to reject the H_0 that the three-path mediated effect is equal to zero. This is not altogether surprising, however, as the product of three (and even two) paths can often take on very small values, thereby necessitating larger samples to detect true and important, albeit small, indirect effects (Thoemmes et al., 2010).

Table 6.3

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 400 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	3.77	–4.68	93.3	.97
$\gamma_{4,1}\beta_{5,4}$	–2.22	–2.60	94.2	.53
$\gamma_{1,1}\beta_{4,1}$	–0.21	0.00	94.5	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–4.09	0.96	94.1	.52
$\gamma_{2,1}\beta_{3,2}$	–1.33	–1.38	95.1	.83
$\gamma_{2,1}\beta_{4,2}$	0.67	–3.69	95.1	.27
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–2.04	–3.79	93.1	.73
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–4.62	90.1	.05

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Taken together, the results of this Monte Carlo run suggest that $N = 400$ may be inadequate for the target mediation model. Although parameter estimate and standard error biases and coverage rates for the estimated measurement and structural parameters were all

acceptable, and frequently optimal, with $N = 400$, statistical tests of three of the 10 estimated direct paths and five of the eight estimated mediated effects were underpowered. This raises the possibility of incurring too great a risk of committing Type II errors in the empirical tests of these constituent model parameters. Indeed, in one case the Type II error rate exceeded .90, which is suggestive of an extremely high probability of failing to reject a false H_0. Thus, N was increased to 600 cases in the subsequent Monte Carlo run.

6.5.2.2 *N* = 600 run. For the $N = 600$ run, the analytic model converged to an admissible solution in 999 of 1000 sample replications. Only one replication produced an inadmissible solution due to a NPD θ matrix involving the single indicator of achievement, which was fixed to a non-zero value reflecting the reliability of GPA for model identification purposes. The rate of inadmissible solutions (0.1%) did not exceed the threshold of 5% for an invalid run. Results from the 999 sample replications that converged to proper solutions were thus retained for further examination.

Relative parameter estimate and standard error biases, coverage rates and statistical power for the 10 direct structural regression paths from the $N = 600$ run are shown in Table 6.4. Parameter estimate bias in the structural regression paths was consistently trivial. Indeed, the largest observed relative bias value only marginally exceeded 2%. Average standard error estimates for the 10 direct structural paths across the 1000 replications were all within 10% of the population values. ML coverage rates for the 10 direct structural paths ranged from 93% to 96%, suggesting that the confidence intervals around the parameter estimates are likely to be reliable given $N = 600$ and a pattern of missingness reflecting non-trivial sample mortality over time. Notwithstanding a 50% increase in N (i.e., $N = 400$ to $N = 600$), statistical power was still insufficient to reject the false H_0 that the direct paths $\beta_{5,4}$, $\gamma_{5,1}$ and $\beta_{4,2}$ are equal to zero. In the case of $\beta_{4,2}$, the probability of a Type II error exceeded an exorbitant .60. These statistical power results suggest that even with a moderately large sample, power may be inadequate to detect small direct structural regression paths.

Table 6.4

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 600 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	0.50	–1.49	95.1	1.00
$\beta_{5,4}$	–1.33	–0.37	95.7	.78
$\gamma_{5,1}$	–1.41	0.00	94.7	.74
$\beta_{3,2}$	–0.85	–0.91	95.3	.96
$\gamma_{3,1}$	2.11	–7.94	93.1	1.00
$\beta_{4,1}$	–0.53	2.29	96.0	1.00
$\beta_{4,2}$	–1.56	–3.23	94.8	.39
$\gamma_{4,1}$	0.50	–2.96	94.5	1.00
$\gamma_{2,1}$	0.70	–2.07	94.9	1.00
$\gamma_{1,1}$	0.87	0.45	95.0	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Table 6.5 displays relative parameter estimate and standard error biases, coverage and statistical power for the eight indirect effects from the $N = 600$ run. Mean parameter estimates of the indirect effects across the 1000 replications were generally within about 3% of the population parameter values. As with the $N = 400$ run, the estimate of the three-path indirect effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ was moderately downwardly biased, though relative bias did not reach 10%. Average standard error estimates for the mediated effects were all within 10% of the population values, and coverage rates were uniformly above 90%. With $N = 600$, four of the eight mediated effects were adequately powered. Notably, statistical power to reject the false H_0 that the indirect effect $\gamma_{2,1}\beta_{3,2}\beta_{5,3}$ is equal to zero, which was inadequate in the $N = 400$ run ($\pi = .73$), increased by approximately 29% to an acceptable level with $N = 600$. Nevertheless, the statistical tests of four mediated effects in the target model were underpowered with $N = 600$, though power for the tests of $\gamma_{4,1}\beta_{5,4}$ and $\gamma_{1,1}\beta_{4,1}\beta_{5,4}$ approached acceptable levels. The statistical test of the three-path mediated effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ was still grossly underpowered, raising the possibility of a substantial Type II error rate ($\beta > .88$) in any empirical test of this parameter even with a moderately large *N*.

Table 6.5

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 600 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	2.62	–7.44	92.0	1.00
$\gamma_{4,1}\beta_{5,4}$	–0.93	–2.28	94.0	.75
$\gamma_{1,1}\beta_{4,1}$	0.14	1.75	95.3	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–3.18	1.18	95.0	.73
$\gamma_{2,1}\beta_{3,2}$	–0.37	–1.46	95.2	.96
$\gamma_{2,1}\beta_{4,2}$	–1.11	–3.16	95.2	.37
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–1.22	–1.79	93.7	.94
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–1.96	91.6	.12

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

The findings of this Monte Carlo run suggest that $N = 600$ may not be sufficient for the target mediation model. In general, little parameter estimate and standard error biases were observed for the measurement and structural parameters in the mediation model with $N = 600$. Furthermore, coverage rates across factor loading estimates, direct paths and mediated effects were uniformly acceptable. Taken together, these results suggest that there is sufficient precision in the estimates of substantive parameters and corresponding standard errors and confidence bounds when $N = 600$. Notwithstanding the acceptable precision in these estimates, the fifth criterion for determining N_{min} (i.e., sufficient statistical power) was not met. Indeed, statistical tests of three direct paths and four mediated effects were underpowered. On this basis, $N = 600$ was rejected as an N_{min} for the target mediation model. Thus, N was increased to 800 cases in the subsequent Monte Carlo run.

6.5.2.3 *N* = 800 run. For the $N = 800$ run, the analytic model converged in all 1000 sample replications. Furthermore, all replications produced proper solutions. Thus, results from all sample replications were retained for examining bias, coverage and statistical power for the substantive parameters of the target mediation model.

Table 6.6 displays relative parameter estimate and standard error biases, coverage and statistical power for the 10 direct structural paths from the $N = 800$ run. There was little bias observed in the direct structural regression model parameters with the highest relative bias value obtained only marginally exceeding an absolute value of 1.5%. In general, only little

bias was also observed in the standard error estimates of the direct structural model parameters. For nine of the 10 direct paths, standard error estimates were within about 3% of the population values. Only the mean standard error estimate of $\beta_{4,2}$ exceeded 5% bias, though this relative bias did not reach the threshold of 10% for substantial bias. Coverage rates were uniformly acceptable, and, for eight of the 10 estimated direct paths, these rates reached optimal levels. Finally, with $N = 800$, statistical power to reject the H_0 that the direct structural regression paths are not significantly different from zero was adequate for nine of the 10 statistical tests. Notably, the statistical tests of $\beta_{5,4}$ and $\gamma_{5,1}$, which were underpowered with $N = 600$, reached an adequate level of statistical power with $N = 800$. Notwithstanding these promising results, statistical power to detect that the direct path $\beta_{4,2}$ is significantly different from zero was substantially below the cut-off of .80 for acceptable power.

Table 6.6

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 800 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	0.42	–2.06	94.5	1.00
$\beta_{5,4}$	–1.53	0.00	95.5	.88
$\gamma_{5,1}$	–0.41	–2.73	94.6	.83
$\beta_{3,2}$	–0.19	0.46	95.4	.99
$\gamma_{3,1}$	1.29	–2.88	94.8	1.00
$\beta_{4,1}$	0.00	2.38	96.3	1.00
$\beta_{4,2}$	–0.22	–6.41	92.9	.49
$\gamma_{4,1}$	0.28	–3.41	94.3	1.00
$\gamma_{2,1}$	0.58	–1.21	95.5	1.00
$\gamma_{1,1}$	0.78	–0.26	95.9	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Table 6.7 presents relative parameter estimate and standard error biases, coverage rates and statistical power for the eight indirect effects from the $N = 800$ run. For seven of the eight estimated indirect effects, mean parameter estimates across the 1000 sample replications were within about 3% of the population values. Only the mean estimate of three-path indirect effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ exceeded a trivial level of bias, though this estimate was still within approximately 6% of the corresponding population value. Average standard error estimates of the indirect effects were uniformly within 10% of the population parameter values, and

coverage rates consistently exceeded 90%. Finally, with $N = 800$, there was sufficient statistical power to detect six of the eight estimated indirect effects. Notably, power for the statistical tests of the indirect effects $\gamma_{4,1}\beta_{5,4}$ and $\gamma_{1,1}\beta_{4,1}\beta_{5,4}$ increased by approximately 16% and 18%, respectively, as a result of the increase in N from 600 to 800. Two statistical tests of mediation, however, remained underpowered with $N = 800$. In both cases, Type II error rates exceeded 50%.

Table 6.7

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 800 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	1.54	–4.04	94.0	1.00
$\gamma_{4,1}\beta_{5,4}$	–1.48	–1.08	95.1	.87
$\gamma_{1,1}\beta_{4,1}$	0.69	–0.98	95.1	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–2.73	0.00	94.9	.86
$\gamma_{2,1}\beta_{3,2}$	0.22	–0.29	95.4	.99
$\gamma_{2,1}\beta_{4,2}$	0.00	–5.93	93.7	.49
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–0.61	0.00	94.5	.99
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–6.67	90.7	.24

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

The results of the present Monte Carlo run indicate that $N = 800$ may not be adequate for the target mediation model. With $N = 800$, parameter estimates and standard errors are unlikely to be substantially biased for the target model specification. Additionally, ML confidence intervals around the estimates of factor loadings, direct structural paths and indirect effects are likely to be reliable. At this sample, however, there was insufficient statistical power to detect one direct structural regression path and two mediated effects. Thus, the $N = 800$ solution did not satisfactorily meet the fifth criterion for N_{min} determination. The N was accordingly increased to 1000 cases for the subsequent Monte Carlo run.

6.5.2.4 *N* = 1000 run. For the $N = 1000$ run, the analytic model converged to an admissible solution in all 1000 sample replications. The 100% rate of convergent and admissible solutions meets the first criterion for evaluating N requirements. Results from all 1000 replications were thus examined for parameter estimate and standard error biases,

coverage rates and statistical power with respect to the estimated parameters of the target mediation model.

Table 6.8 shows relative parameter estimate and standard error biases, coverage and statistical power for the 10 direct structural regression paths from the $N = 1000$ run. In general, little bias was observed across the estimates of the direct structural regression parameters. Indeed, the most discrepant mean parameter estimate was within about 1.25% of its population value. Relative standard error biases were also consistently trivial, ranging from –3.94% to 2.07%. ML coverage rates were uniformly acceptable and often optimal, suggesting that the 95% confidence intervals around the mean direct structural regression paths are reliable when $N = 1000$. There was adequate power for statistical tests of nine of the 10 estimated direct structural regression paths. Notably, the direct path $\beta_{4,2}$ remained underpowered even with $N = 1000$.

Table 6.8

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 1000 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\beta_{5,3}$	0.42	–3.94	93.3	1.00
$\beta_{5,4}$	–1.13	–3.42	94.0	.93
$\gamma_{5,1}$	–0.88	–0.20	94.3	.90
$\beta_{3,2}$	–0.15	–1.35	94.6	1.00
$\gamma_{3,1}$	1.22	–1.63	94.8	1.00
$\beta_{4,1}$	0.06	–1.98	95.3	1.00
$\beta_{4,2}$	–0.89	–3.92	93.7	.56
$\gamma_{4,1}$	–0.25	–1.60	94.3	1.00
$\gamma_{2,1}$	0.58	–0.23	95.5	1.00
$\gamma_{1,1}$	0.60	2.07	95.1	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Relative parameter estimate and standard error biases, coverage and statistical power for the eight estimated indirect effects are shown in Table 6.9. In general, little bias in the indirect effects was observed with seven of the eight estimated mean parameters falling within about 2.5% of the population parameter values. Only the three-path mediated effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ showed relative bias greater than 5%, though this value did not greatly exceed the cut-off for substantial bias. Relative bias in the standard error estimates of the mediated

effects was likewise small with the majority of average standard errors within about 5% of the population standard errors. Coverage rates were consistently acceptable, ranging from 91% to 95%. As with the $N = 800$ run, six of the eight statistical test of mediation were adequately powered when $N = 1000$. Statistical power was, however, insufficient to detect the small indirect effects $\gamma_{2,1}\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$.

Table 6.9

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 1000 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	1.46	–4.18	94.3	1.00
$\gamma_{4,1}\beta_{5,4}$	–1.11	–2.37	94.2	.92
$\gamma_{1,1}\beta_{4,1}$	0.56	–3.23	95.3	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–2.27	–4.29	94.6	.92
$\gamma_{2,1}\beta_{3,2}$	0.30	–1.57	94.7	1.00
$\gamma_{2,1}\beta_{4,2}$	–0.67	–3.20	93.9	.56
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–0.41	–3.05	94.4	1.00
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–5.13	90.8	.33

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

The results of the present Monte Carlo run suggest that $N = 1000$ may not be a sufficient N_{min} for the target mediation model. Although parameter estimate and standard error biases and coverage rates for the estimated factor loadings, direct structural regression paths and mediated effects were uniformly acceptable, statistical tests of one direct regression path and two mediated effects were underpowered with $N = 1000$. In all three cases, the probability of rejecting the false H_0 that the direct and indirect paths are not equal to zero was well below the recommended cut-off of .80 for acceptable statistical power. This raises the possibility of incurring a non-trivial risk of committing Type II errors in the empirical tests of these model parameters. Thus, the $N = 1000$ solution did not satisfactorily meet the a priori power criterion for N_{min} requirements, and N was accordingly increased to 1200 in the subsequent Monte Carlo run.

6.5.2.5 *N* = 1200 run. In each of the 1000 sample replications, the analytic model converged to an admissible solution for the $N = 1200$ run. This perfect rate of convergent and admissible solutions is consistent with the first criterion for evaluating N requirements. Thus,

results for all 1000 sample replications were examined to determine parameter estimate and standard error biases, coverage rates and statistical power.

Table 6.10 displays parameter estimate and standard error biases, coverage and statistical power for the 10 estimated direct structural regression paths from the $N = 1200$ run. There was little bias in the direct structural model parameters with mean parameter estimates consistently within 1% of the population parameter values. Only one estimate of a direct structural model parameter exceeded 1% bias, though this mean estimate only mildly deviated from its population value. Relative bias in the standard error estimates was also trivial, with mean standard error estimates across the 1000 sample replications consistently within 5% of the population standard errors. Coverage rates for the 10 direct structural regression paths ranged from an acceptable 94% to an optimal 96%. Finally, with $N = 1200$, statistical power to detect the direct structural regression paths was adequate for nine of the 10 statistical tests. Although the increase in N by 200 cases resulted in a 12.8% increase in power to detect that $\beta_{4,2}$ is not equal to zero, the statistical test of this parameter remained underpowered with $N = 1200$.

Table 6.10

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 1200 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	0.05	–0.85	95.1	1.00
$\beta_{5,4}$	–0.20	0.26	95.3	.97
$\gamma_{5,1}$	–0.77	1.09	95.3	.95
$\beta_{3,2}$	–0.26	0.94	95.5	1.00
$\gamma_{3,1}$	0.81	–2.94	94.4	1.00
$\beta_{4,1}$	0.03	3.95	95.7	1.00
$\beta_{4,2}$	–1.89	–4.51	93.8	.64
$\gamma_{4,1}$	0.14	–2.97	94.7	1.00
$\gamma_{2,1}$	0.68	1.01	95.5	1.00
$\gamma_{1,1}$	0.58	–0.63	94.9	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

For the eight mediated effects from the $N = 1200$ run, relative parameter estimate and standard error biases, coverage and statistical power are shown in Table 6.11. Parameter estimate bias for seven of the eight mediated effects was trivial. Only the mean parameter

estimate of the small mediated effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ exceeded 5% relative bias, though this did not reach the threshold of 10% for problematic levels. Relative standard error bias for the mediated effects was uniformly trivial, with mean standard error estimates within 5% of the population standard errors. ML coverage rates for the mediated effects were uniformly above 90%. With $N = 1200$, six of the eight statistical tests of mediated effects were adequately powered. Statistical tests of both $\gamma_{2,1}\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ remained underpowered despite the increase in N of 200.

Table 6.11

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 1200 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	0.62	–2.34	93.7	1.00
$\gamma_{4,1}\beta_{5,4}$	–0.19	–0.66	95.7	.97
$\gamma_{1,1}\beta_{4,1}$	0.56	0.00	96.1	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–1.36	0.00	95.3	.97
$\gamma_{2,1}\beta_{3,2}$	0.30	1.06	95.7	1.00
$\gamma_{2,1}\beta_{4,2}$	–1.33	–3.96	94.1	.63
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–0.61	0.00	94.6	1.00
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–2.86	92.0	.48

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

The findings of this Monte Carlo run indicate that $N = 1200$ may not be sufficient for the target mediation model. Without exception, parameter estimate and standard error biases were within acceptable ranges for the estimated factor loadings, direct structural regression paths and mediated effects. Additionally, coverage rates across the estimated parameters were consistently acceptable and frequently optimal. Notwithstanding these results, which are suggestive of adequate precision in the estimates of model parameters, standard errors and 95% confidence bounds, statistical power did not reach adequate levels for one direct structural regression path and two mediated effects with $N = 1200$. On this basis, the $N = 1200$ solution was rejected as an N_{min} for the present investigation.

6.5.2.6 *N* = 1600 run. Given that all five a priori sample sizes did not yield sufficient statistical power, with three parameters still moderately-to-substantially underpowered, N was adjusted upwards by increments of 400 units of observation to meet the a prior criterion

of .80 statistical power across all parameters of the target mediation model. For the $N = 1600$ run, the analytic model converged to an admissible solution in each of the 1000 sample replications. Thus, results from all 1000 sample replications were retained and scrutinized for insights into parameter estimate and standard error biases, coverage rates and statistical power for the substantive parameters constituting the target mediation model.

Table 6.12 shows relative parameter estimate and standard error biases, coverage rates and statistical power for the 10 direct structural regression paths from the $N = 1600$ run. Mean estimates of the direct structural model parameters were consistently within 1% of the population parameter values. Relative bias in the average estimated standard errors across the 1000 replications was also non-problematic. Coverage rates for the10 direct structural regression parameters were uniformly acceptable and often optimal, suggesting a good deal of precision in the 95% confidence limits around the estimates of the direct paths. Finally, with $N = 1600$, nine of the 10 statistical tests of the direct structural regression paths were optimally powered. Only the statistical test of β_{42} was underpowered, though the probability of rejecting the false H_0 for this test approached the cut-off of .80 for acceptable power.

Table 6.12

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 1600 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\beta_{5,3}$	–0.17	–3.34	93.6	1.00
$\beta_{5,4}$	–0.40	3.07	94.9	.99
$\gamma_{5,1}$	–0.06	1.00	95.4	.99
$\beta_{3,2}$	–0.04	1.09	95.4	1.00
$\gamma_{3,1}$	0.67	–3.17	94.7	1.00
$\beta_{4,1}$	0.13	2.25	96.0	1.00
$\beta_{4,2}$	–0.57	–6.00	93.4	.75
$\gamma_{4,1}$	0.00	–4.51	94.4	1.00
$\gamma_{2,1}$	0.46	3.58	95.5	1.00
$\gamma_{1,1}$	0.49	1.49	95.2	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Relative parameter estimate and standard error biases, coverage rates and statistical power for the eight indirect effects from the $N = 1600$ run are shown in Table 6.13. All mean estimates of the indirect structural model parameters over the 1000 sample replications were

within 5% of the population parameter values. Relative bias in the estimated standard errors was also non-problematic, ranging from –5.65% to 2.36%. ML coverage rates for the indirect effects were uniformly acceptable and, for six of the eight mediated effects, coverage rates reached optimal levels. With $N = 1600$, there was sufficient statistical power to detect six of the eight mediated effects. Notwithstanding an increase in N of 400 units of observation, statistical tests of the small mediated effects $\gamma_{2,1}\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ remained underpowered, though the test of the H_0 for $\gamma_{2,1}\beta_{4,2}$ approached an acceptable level of power. Notably, the increase in N of 400 from the previous Monte Carlo run resulted in a 36.4% increase in power to detect the smallest indirect effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$, raising the possibility that a comparable increase in N to 2000 might lead to sufficient statistical power for the target mediation model.

Table 6.13

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 1600 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	0.31	–4.85	93.1	1.00
$\gamma_{4,1}\beta_{5,4}$	–0.56	2.36	95.4	.99
$\gamma_{1,1}\beta_{4,1}$	–0.56	1.43	95.6	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–1.82	1.92	95.6	.99
$\gamma_{2,1}\beta_{3,2}$	0.37	0.41	95.4	1.00
$\gamma_{2,1}\beta_{4,2}$	–0.44	–5.65	94.5	.75
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–0.82	–0.99	94.7	1.00
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–4.29	–3.33	93.6	.66

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

The results of the analysis of the present Monte Carlo run suggest that $N = 1600$ may not be an adequate minimum for the target mediation model. In general, there was little or no parameter estimate or standard error bias in the substantive measurement and structural model parameters. Furthermore, coverage rates were uniformly acceptable and often reached optimal levels. Although these results indicate that parameter estimates, standard errors and confidence bounds are generally accurate when $N = 1600$, statistical power was not uniformly adequate for the model parameters given the N. Statistical tests of the direct path $\beta_{4,2}$ and indirect paths $\gamma_{2,1}\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$ were underpowered. For the parameters $\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}$, this is unlikely to be a major concern because power is only marginally below .80 (<.05). For the three-path mediated effect $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$, however, statistical power is materially below the

recommended value, raising the possibility of incurring a non-trivial risk of committing a Type II error in any empirical test of the model. On this basis and consistent with criterion five for minimum *N* determination, the *N* = 1600 solution was rejected as an N_{min} for the present investigation. The *N* was thus increased to 2000 units of observation for the subsequent Monte Carlo run.

6.5.2.7 *N* = 2000 run. For the *N* = 2000 run, the analytic model converged to an admissible solution in each of the 1000 sample replications. This rate of convergence and admissibility meets the a priori criterion of no greater than 5% of imperfect samples. Results from all 1000 sample replications were thus examined for evidence of parameter estimate and standard error bias as well as to determine coverage rates and statistical power for the estimated parameters.

Table 6.14 shows relative parameter estimate and standard error biases, coverage rates and statistical power for the 10 direct structural regression paths from the *N* = 2000 run. Relative bias in the estimates of the direct structural model parameters was consistently trivial, ranging from –0.56% to 0.56%. In general, little or no bias in average estimates of standard errors for the direct structural paths was also observed, with only one estimate marginally exceeding the threshold of 5% for trivial bias. Coverage rates for the parameter estimates were uniformly acceptable, ranging from 93% to 96%. With *N* = 2000, all 10 statistical tests of the direct structural regression parameters were adequately powered. Notably, with the increase in *N* of 400 from the previous run (*N* = 1600), statistical power to detect $\beta_{4,2}$ increased by 13.4%, reaching acceptable levels to reject the false H_0 that $\beta_{4,2}$ is equal to zero.

Table 6.14

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 2000 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	0.00	5.47	93.6	1.00
$\beta_{5,4}$	0.20	–2.90	93.2	1.00
$\gamma_{5,1}$	–0.29	–2.70	94.6	1.00
$\beta_{3,2}$	–0.04	3.50	96.1	1.00
$\gamma_{3,1}$	0.56	–2.30	94.0	1.00
$\beta_{4,1}$	0.00	0.41	96.0	1.00
$\beta_{4,2}$	–0.56	–4.22	93.8	.86
$\gamma_{4,1}$	0.00	–4.42	93.6	1.00
$\gamma_{2,1}$	0.56	4.03	95.4	1.00
$\gamma_{1,1}$	0.44	1.67	96.0	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Table 6.15 displays relative parameter estimate and standard error biases, coverage rates and statistical power for the eight indirect effects from the *N* = 2000 run. Relative bias in the mean estimates of the indirect structural model parameters was uniformly trivial with all estimates within 5% of the population values. Bias in the average standard error estimates for the mediated effects was also trivial, ranging from –4.08% to 1.85%. In addition, ML coverage was consistently acceptable with rates ranging from 93% to 96%. With *N* = 2000, all eight statistical tests of the mediated effects were adequately powered. Importantly, the systematic increase in *N* from 1600 to 2000 resulted in 13.68% and 21.06% increases in statistical power to detect the mediated structural model parameters $\gamma_{2,1}\beta_{4,2}$ and $\gamma_{2,1}\beta_{4,2}\beta_{5,4}$, respectively, with statistical tests of both parameters, which were previously underpowered, reaching an acceptable level of statistical power.

Table 6.15

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 2000 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	0.23	–2.03	93.9	1.00
$\gamma_{4,1}\beta_{5,4}$	–0.37	–3.33	95.0	1.00
$\gamma_{1,1}\beta_{4,1}$	0.42	–1.55	96.2	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–1.82	–4.08	93.4	1.00
$\gamma_{2,1}\beta_{3,2}$	0.52	1.85	95.5	1.00
$\gamma_{2,1}\beta_{4,2}$	–0.22	–3.87	94.2	.86
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–0.41	–1.10	94.0	1.00
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–4.29	–3.70	92.6	.80

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Taken together, the results of the present simulation run suggest that $N = 2000$ is a sufficient N_{min} for the target mediation model. Across all substantive measurement and structural model parameters there was little bias observed in the mean parameter estimates and standard errors. Indeed, average estimates of parameters and standard errors over the 1000 replications were largely within 5% of the population values and never exceeded the threshold of 10% for problematic bias. In addition, for all factor loadings, direct structural regression paths and indirect effects, coverage rates were above 90% and frequently reached optimal levels. Finally, with $N = 2000$, statistical power was uniformly adequate and reached unity for the majority of estimated parameters. On the basis of the five criteria used for evaluating N_{min} requirements, an N of 2000 was chosen as the requisite minimum for the target mediation model.

6.6 Discussion of Results

The present Monte Carlo experiment served to evaluate N_{min} requirements for the target mediation model specified in Chapter Four. Specifically, a Monte Carlo study was conducted to estimate N_{min} to obtain not only accurate estimates of measurement and structural model parameters, standard errors and confidence bounds but also sufficient statistical power for the tests of the simultaneous equations constituting the target model. In the simulation, N was systematically increased from a baseline of 200 units of observation until desired levels of precision in model parameter estimation and statistical power were reached. Additionally, for

each Monte Carlo design cell, missing data on the observed variables were generated to reflect non-trivial sample mortality (i.e., attrition) across the planned waves of data collection, as should be expected in short-term multi-wave designs. The simulation yielded a robust estimate of requisite *N* given the (a) model specification, (b) estimated population effect sizes for each parameter, (c) nominal significance criterion ($\alpha = .05$), (d) desired level of power ($\pi = .80$), (e) the modeled pattern of missingness, and (f) the ML estimation routine assuming multivariate normality of the observed variables. In the paragraphs below, a discussion of the Monte Carlo results is provided.

The results of the baseline Monte Carlo run (i.e., $N = 200$) suggest that a small sample is unlikely to be adequate for the target mediation model and parameters therein. In this small sample condition, the analytic model failed to converge to admissible solutions in over 5% of the sample replications. This finding suggests that there is a non-trivial chance the target model will not converge to a proper solution in empirical testing under similar data and model conditions. This is, however, not entirely unexpected given the complexity of the model specification (Yuan & Bentler, 1998). This finding of non-trivial model inadmissibility rates in the small sample condition is consistent with the asymptotic theory underlying the SEM procedure. This statistical theory posits that model estimation performance can be enhanced with large sample sizes (Bentler & Chou, 1987; Gagné & Hancock, 2006; Hancock, 2001). Indeed, the simulation literature has consistently shown that models are more likely to converge to proper solutions with larger samples (Gagné & Hancock, 2006; Rhemtulla, Brosseau-Laird, & Savalei, 2012; Wolf et al., 2013). This result of non-trivial improper solution rates with $N = 200$ also suggests that applied researchers should reconsider the use of common heuristics, such as a minimum of 200 cases (see e.g., Anderson & Gerbing, 1984; P. Barrett, 2007), in determining minimum samples. Instead, a priori N_{min} calculations should center on the data and model conditions specific to each empirical study.

The results of the simulation study indicate that a moderate-sized sample may be sufficient for precision in the estimation of the model parameters, standard errors and confidence bounds but not adequate to achieve acceptable power to uniformly detect the structural model parameters estimated in the target mediation model. Little or no bias in the model parameters was observed across the admissible sample conditions for even moderate-sized samples (e.g., $N = 400$). Relative bias in the mean estimates of the standard errors for the estimated parameters was also generally small, and did not exceed 10% for any parameter across the

admissible sample sizes evaluated. Additionally, coverage rates were uniformly acceptable for all admissible samples, suggesting that, given the specific data contingencies and model specification, the 95% confidence intervals around the parameter estimates are likely to be reliable at even moderate-sized samples.

Notwithstanding this evidence for the tenability of a moderate-sized sample for the target mediation model, statistical power for several tests of parameters in the structural model was inadequate at moderate and even larger samples. For instance, with $N = 400$, statistical tests of three direct structural regression paths and five mediated effects were underpowered. Even when the analytic model was estimated with $N = 1000$, statistical power to reject the false H_0 that one small direct path and two small mediated effects are equal to zero was insufficient. These results suggest that, even with moderately large samples, given the model specification, estimation routine, effect size estimates, nominal significance criterion, and desired level of power, there is a non-trivial risk of committing Type II errors, especially with respect to tests of small structural parameters. For the present target model specification, the simulation suggested that an N_{min} of 2000 was required for acceptable accuracy in the estimates of model parameters, standard errors and confidence intervals as well as sufficient statistical power. This N_{min} substantially exceeds common heuristics used in the design of SEM studies, suggesting that these rules of thumb may be grossly incorrect in empirical testing contexts (MacCallum, Widaman, Zhang, & Hong, 1999; Wolf et al., 2013).

The N_{min} for the target mediation model derived from the Monte Carlo experiment also substantially exceeds estimates derived from the widely-used MacCallum et al. (1996) model-based approach to a priori sample determination. As briefly mentioned above, the MacCallum et al. approach centers on determining N_{min} to obtain adequate statistical power to test either (a) the H_0 of not-close (or not-acceptable fit) fit or (b) the H_0 of close fit (or acceptable fit). As the logic of the former test is more defensible with respect to traditional statistical power analysis and hypothesis testing (i.e., statistical power is the probability of rejecting a false H_0 rather than accepting it) (Hancock, 2006; Hancock & French, 2013), only power for the test of the not-close (and not-acceptable) fit hypothesis will be discussed here. For the target mediation model with 394 *df*, given close population data-model fit (i.e., RMSEA = .04), to achieve a .80 probability of rejecting the false H_0 of *not-close* fit (i.e., $\text{RMSEA}_0 \geq .05$), 293 units of observation are required. Under the test of *not-acceptable* fit, 222 cases are required to obtain adequate statistical power to reject the false H_0 of

unacceptable data-model fit (i.e., $RMSEA_0 \geq .08$) in favor of acceptable data-model fit (i.e., RMSEA = .07; see Appendix D for computational details of these N_{min} analyses). These estimates of N_{min} obtained from the tests of the not-close and not-acceptable fit hypotheses constitute only 15% and 11%, respectively, of the absolute value of N_{min} estimated from the Monte Carlo procedure.

The discrepancy in the estimates of N_{min} obtained from the MacCallum et al. (1996) approach and the Monte Carlo procedure may be attributed to their divergent frameworks for *N* planning and power analysis. The MacCallum et al. method is centrally concerned with estimating N_{min} for tests of overall data-model fit. On the contrary, the Monte Carlo approach focuses on determining $N_{\min}$ for tests of specific model parameters (e.g., indirect paths) as well as precision in the estimates of these parameters, their standard errors and confidence bounds (L. K. Muthén & Muthén, 2002; Wolf et al., 2013). Dissimilar to the Monte Carlo method, the model-based approach requires no a priori information about population parameter values because it defines H_1 in terms of a specified degree of fit in the population rather than specific parameter values (MacCallum et al., 1996). Although this is, prima facie, an advantage in the conduct of a priori sample determination, especially when there is little information about specific population parameter values, it may paradoxically be a shortcoming of the approach and the source of the disjuncture between the divergent N_{min} estimates obtained from the two methods. Indeed, though the investigator may be confident about the estimated *N* to reject a false H_0 containing model unacceptability, he or she may not know whether specific tests of parameters in the model are sufficiently powered. This is because obtaining sufficient power to reject the H_0 of not-close or not-acceptable fit does not guarantee that statistical tests of constituent paths are adequately powered (Maxwell, 2004; Thoemmes et al., 2010). Future investigators are strongly urged to consider N_{min} requirements from both overall model-fit and parameter testing perspectives. Achieving sufficient power to reject a false H_0 of unacceptable model fit is of limited scientific utility if statistical tests of key parameters are untrustworthy.

It is noteworthy that the estimates of N_{min} based on the overall model-fit approach approximate the sample condition ($N = 200$) in the simulation that generated the highest number of inadmissible solutions. This is an alarming finding, raising the possibility that, given the present model specification, reliance on the overall model fit approach to determining $N_{\min}$ may result in inadmissible solutions in empirical testing contexts. To

examine this possibility, the simulation was re-run with samples of 222 and 293 units of observation to determine the rate of non-convergence and inadmissibility for these samples. These Monte Carlo runs resulted in 5% and 2.9% of inadmissible solutions, respectively (see Appendix E for results of these Monte Carlo runs). The former result indicates that there is a non-trivial risk that the analytic model will converge to an inadmissible solution when estimated with a sample believed to yield sufficient statistical power to reject a false H_0 of unacceptable fit based on the MacCallum et al. (1996) procedure. Indeed, this overall model data-model fit approach may routinely yield erroneous estimates of N_{min} because it does not provide a way for modeling specific data and model characteristics, such as missing data and small expected effects sizes (e.g., mediated effects), which may impose greater N demands (L. K. Muthén & Muthén, 2002; Thoemmes et al., 2010; Wolfet al., 2013). Investigators are cautioned against limiting their attention to global model-data fit in determining sample requirements, especially in empirical contexts where small, yet substantively important, effects, such as indirect effects, are predicted and the data are expected to be imperfect (e.g., presence of missing data).

The results of the simulation also suggest that investigators need to be cognizant of N_{min} requirements for adequate solution propriety and precision in the estimation of model parameters, standard errors and confidence bounds quite apart from only statistical power considerations. This represents a paradigmatic shift of focus in a priori N_{min} determination from a power analytic perspective exclusively, as espoused in the classical hypothesis testing paradigm, to a consideration of N_{min} to optimize solution quality and enhance parameter, standard error and confidence interval estimation as well as achieve sufficient statistical power. This inclusive approach to N planning, emphasizing *accuracy*, *propriety* and *power* (APP), is an extension of the AIPE method espoused by Kelley and Maxwell (2003; see also Kelley, Maxwell, & Raush, 2003; Maxwell, Kelley, & Rausch, 2008) in a multiple regression framework. Approaching N planning from the APP perspective may lead to the generation of optimal study designs in which there is adequate power to reject the false null of no effect for some minimally important parameter while also obtaining a proper solution containing accurate parameter estimates, standard error and confidence bounds.

As illustrated in the present study, the APP approach to N_{min} estimation can be conducted in a general Monte Carlo framework that also accounts for complex data and model characteristics. Given the general accessibility of Monte Carlo methods in several user-

friendly commercial statistical software programs (e.g., EQS; Mplus), the onus is on investigators to conduct rigorous *N* planning analyses in line with the APP approach to optimize study designs and potentially improve study inferences. Furthermore, given the ease of extending the APP approach to other applications of the general linear model, the possibility of the conduct of N_{min} estimation using Monte Carlo methods in the design of every confirmatory empirical study is submitted for consideration. Certainly, the utility of the APP framework is less clear where the domain of research is underdeveloped or the study is strictly exploratory. What is clear, however, is that investigators should avoid the use of common heuristics as a basis for establishing guidelines for requisite *N* in covariance and mean structure modeling as these typically lack validity (MacCallum et al., 1999; Wolf et al., 2013).

The simulation study also demonstrates the importance of considering the minimally important effect in the estimation of N_{min} (Harris & Quade, 1992; Wolf et al., 2013). Whereas most of the large-and-medium-sized factor loadings and direct structural regression parameters were estimated with adequate power and precision with even a moderate sample in the simulation (N= 400), much larger samples were required to obtain satisfactory power for the mediated paths and small direct structural paths. Indeed, in this moderate sample condition, power was adequate for only three of the eight statistical tests of indirect paths. Furthermore, three small direct structural regression paths were underpowered at this sample size. For the smallest effect under scrutiny in the mediation model ($\gamma_{2,1}\beta_{4,2}\beta_{5,4}$), the simulation suggests that a total sample size of at least 2000 cases is required to obtain sufficient power to detect the small mediated effect. The failure to attend to the absolute magnitude of the smallest effect in a model estimating simultaneous equations may result in the estimation of N_{min} that is downwardly biased and inadequate (Wolf et al., 2013). Future investigators are well advised to consider the minimally important effect size in *N* planning.

This basic criterion of the minimally important effect is assumed in the APP framework and is especially important when testing mediation hypotheses. In empirical tests of multistage mediation models, such as the present conceptual models, often the smallest effects of interest are the mediated paths, which, by virtue of their mathematical derivation as the product of coefficients (Perera, 2013), are smaller than their component direct paths (Thoemmes et al., 2010). As the number of paths constituting the mediated effect increases, the product term of the indirect path can become increasingly small and difficult to detect (A.

B. Taylor, MacKinnon, & Tein, 2008; Thoemmes et al., 2010). Researchers testing mediation hypotheses should not assume the sufficiency of a given sample on the basis of adequate projected power and precision for direct structural paths. Instead, investigators examining complex, multi-path mediated relations are encouraged to estimate N_{min} from the APP perspective where the input mediation parameters for the simulation are taken as the product of the coefficients of the implicated direct paths (Perera, 2013; Thoemmes et al., 2010). It should be noted that the N_{min} estimated for the target mediation model in the present simulation is likely to be modestly overestimated because the typically underpowered Sobel (1982) test was used to estimate the indirect paths in the Monte Carlo study whereas the more powerful bootstrap approach is used for the empirical tests of mediation (see Chapter Seven).

It is acknowledged that the N_{min} required for adequate model precision, propriety and power is seldom observed in psychoeducational research and may exceed the available resources of this single, largely unfunded, researcher. A cursory review of a random sample of 20 articles drawn from volumes 52 and 53 of the reputable periodical *Personality and Individual Differences*, in which most TEI research is published, reveals that the mean *N* of studies using comparable mediation designs is 429 (see Appendix F for studies included in this review). The requisite *N* for the target mediation obtained from the simulation is more than four times this figure. Moreover, removing the two extreme outlying sample sizes from this data set ($N = 1557$ and 1190) yields a readjusted mean of 324 cases. Even with a meticulously planned data collection protocol, the demand for *N* based on the simulation may be beyond the investigator's resources. Notwithstanding this projected limitation, the Monte Carlo estimate of N_{min} provides a useful maximal value that serves as a basis from which to gauge the propriety of the empirical solution, the accuracy of parameter estimates, standard errors and confidence bounds, and the power of the statistical tests of the estimated parameters. For instance, the failure to find a significant effect in a given sample can be attributed to (a) the absence of any real effect in the population or (b) inadequate statistical power to reject the H_0 (Altman & Bland, 1995). The Monte Carlo results, considered alone or together with findings obtained from any post-hoc APP simulation, may help to clarify this empirical finding of non-significance. In this regard, inferences drawn from the analytic results can be strengthened by the Monte Carlo findings.

6.6.1 Summary

In summary, then, the present Monte Carlo study has systematically evaluated *N* requirements for the multistage mediation model of primary interest in the present research. Specifically, a Monte Carlo experiment was conducted to determine the N_{min} required to achieve optimal solution propriety, accuracy in estimation and sufficient statistical power for the target model. The simulation yielded a robust estimate of N_{min} ($N = 2000$) given the (a) model specification, (b) input population parameters obtained from the existing literature, (c) nominal significance criterion ($\alpha = .05$), (d) desired level of statistical power ($\pi = .80$), (e) modeled pattern of missingness reflecting non-trivial sample attrition, and (f) ML estimation routine. The simulation provided an encompassing approach to *N* planning for the mediation model, integrating AIPE (Kelley & Maxwell, 2003), model quality (Gagné & Hancock, 2006) and statistical power (J. Cohen, 1992a, 1992b) perspectives on estimating N_{min}. This approach redresses the limitations of overall-model fit and general heuristic approaches to N_{min} determination by individualizing *N* planning to the specific model of interest. Having determined the requisite *N* for the target mediation model, in the following chapter, the method and results of empirical tests of this target model and theoretically-plausible alternatives are reported.

Chapter Seven

Empirical Tests of the Conceptual Models

This chapter reports the methods and results of the empirical tests of the target and alternative conceptual models specified in Chapter Four. The hypothesized target model is one in which greater TEI prospectively predicts better first semester achievement during the university transition both directly and indirectly via (a) perceived social support and engagement coping and (b) academic and psychosocial adaptation linked serially in a sequence of temporally-related events. The model specification draws on multiple accounts of emotion, regulation and adaptation and is developed, in part, as a response to calls for greater conceptual integration concerning the ways in which people's personality, social-network characteristics and coping efforts operate together in a temporal chain of events leading to adaptation and achievement during stressful life events (Brissette et al., 2002). Specifically, the study reported in this chapter aimed to test the following 18 hypotheses implied by the target model specification:

- TEI directly and positively predicts first semester achievement (H_{DR1});
- TEI directly and positively predicts academic adaptation (H_{DR2});
- academic adaptation directly and positively predicts first semester achievement (H_{DR3});
- TEI directly and positively predicts psychosocial adaptation (H_{DR4});
- psychosocial adaptation directly and positively predicts first semester achievement (H_{DR5});
- TEI directly and positively predicts perceived social support (H_{DR6});
- perceived social support directly and positively predicts psychosocial adaptation (H_{DR7});
- TEI directly and positively predicts engagement coping (H_{DR8});
- engagement coping directly and positively predicts academic adaptation (H_{DR9});
- engagement coping directly and positively predicts psychosocial adaptation (H_{DR10});
- TEI is indirectly associated with first semester achievement through academic adaptation (H_{IR1});
- TEI is indirectly associated with first semester achievement through psychosocial adaptation (H_{IR2});

- TEI is indirectly associated with psychosocial adaption through perceived social support (H_{IR3});
- TEI is indirectly associated with first semester achievement via perceived social support and psychosocial adaptation linked serially in a three-path mediated sequence (H_{IR4});
- TEI is indirectly associated with academic adaptation through engagement coping (H_{IR5});
- TEI is indirectly associated with psychosocial adaptation via engagement coping (H_{IR6});
- TEI is indirectly associated with first semester achievement via engagement coping and academic adaptation linked serially in a three-path mediated sequence (H_{IR7}); and,
- TEI is indirectly associated with first semester achievement via engagement coping and psychosocial adaptation linked serially in a three-path mediated sequence (H_{IR8}).

In addition to empirically testing these hypotheses implied by the target structural model, the present study investigated alternative specifications as well as the dimensionality of university adaptation. This study investigated three alternative model specifications that provide competing accounts of the links among TEI, perceived social support, engagement coping, adaptation and achievement. The first alternative model is one in which the direct relation of TEI with first semester achievement is fixed to zero. This model specification implies complete mediation of the TEI-achievement link via the serially-linked proximal and distal mediators. The second and third alternative models specify null direct relations of TEI with psychosocial and academic adaptation, respectively, assuming complete mediation of the TEI-adaptation links via the proximal mediators. Finally, the present study examined the hierarchical, multidimensional structure of university adaptation in line with the formulation of adjustment advanced in Chapter Three.

7.1 Method

This section provides an overview of the participants used in this study, including a description of the institution from which the participants were drawn, participant eligibility criteria, and a summary of the sample demographics. This section also presents an outline of the study procedure, a description of the instrumentation used to measure the theoretical constructs included in the conceptual models, and an overview of the data analytic strategies.

7.1.1 Participants

Participants were incoming undergraduates from a large metropolitan university in eastern Australia. As at 2013, total student enrolments were approximately 35,000 of which about 20,000 were undergraduate students, with incoming students constituting approximately 25% of the total undergraduate population. Of these roughly 5000 students, about 90% were full-time students, approximately 80% were domestic students, and 65% were recent school leavers (defined as students < 21 years at enrolment).[4] The institution typically attracts some of the highest achieving school leavers. The university comprises seven faculties, including (a) Arts and Social Sciences, (b) Business, (c) Engineering and Information Technology, (d) Health, (e) Law, (f) Science, and (g) Design, Architecture and Building. For the present study, permission was granted to conduct voluntary data collection with first year students from five of the seven faculties.

Respondents had to meet strict eligibility criteria to participate in this study. First, participants were required to be full-time undergraduate students in their first semester of university study. Second, participants had to be domestic students. Finally, participants were required to be recent school leavers, defined as those less than 21 years at enrolment. The final eligibility criterion was derived from the institution's definition of mature-entry students as those aged ≥ to 21 years at the time of matriculation. These eligibility criteria were imposed because the focus of the present investigation is on the adaptation experiences and achievement outcomes of traditional Australian undergraduates during the university transition. There is an ample body of transition and retention literature suggesting that part-time, international and mature-age students differentially adjust to the university transition (see e.g., Bean & Metzner, 1985; Chartrand, 1992; Kaczmarek, Matlock, Merta, Ames, & Ross, 1994). The inclusion of these groups may present a source of confounding that obscures or complicates the interpretation of results.

Data were collected from 498 participants. Of this initial sample, 28 (5.6%) participants were excluded following eligibility screening. Fifteen students were found to be in their second year of study following the inspection of academic transcripts and were excluded. Academic transcripts also revealed that eight participants were part-time students and were omitted. A further five participants reported dates of birth that indicated that they were ≥ 21

[4] Note: These are approximate figures computed with assistance from the university registrar. The institution in which this research was conducted does not have a genuine count of first-year students, which complicated these computations.

years at the time of enrolment and were excluded from the dataset. Of the 470 eligible participants, 33.0% (n = 155) were matriculated in science and mathematics degree programs, 28.7% (n = 135) were enrolled in business degrees, 17% (n = 80) were enrolled in arts and communication degree programs, 12.3% (n = 58) were matriculated in nursing and midwifery degree programs, 7.2% (n = 34) were enrolled in engineering and information technology programs, and 1.3% (n = 6) were enrolled in education degrees. Two participants did not report their degree program. The mean age of the participants was 17.78 (SD = .72; range 16 – 20 years), and 61.7% of the sample was female. The reduced N of 470 constitutes approximately 15% of the available first year cohort. Although this figure may seem low, it is typical of response rates for comparable university samples using a web-based data collection protocol (Sax, Gilmartin, & Bryant, 2003). The N does, however, raise concerns about statistical power for tests of individual model parameters given the results of the Monte Carlo simulation reported in Chapter Six. Thus, post-hoc analyses using Monte Carlo methods within the APP framework were conducted to examine statistical power and the quality of the model solution, parameter estimates and standard errors for the preferred solution (see Section 7.3.3).

7.1.2 Procedure

One week prior to and during the first week of a first semester incoming undergraduates were enlisted to participate in a multiwave study on adjusting to university. The following three recruitment strategies were used to enlist participants: the distribution of flyers at orientation social events; instructor announcements at 25 first year coursework lectures; and electronic notices posted on first year virtual learning environments. Students were advised that they would be contributing to a study on the "adjustment experiences of new undergraduates" and that participation required (a) the provision of consent to partake in the research and obtain official first semester academic transcripts and (b) the completion of three online batteries of questionnaires at three occasions over the autumn semester. Informed consent was obtained via students' endorsement of an "I consent" radio button embedded in the initial online battery, which was preceded by a comprehensive participant information notice (see Appendix G). In line with the ethics of reciprocity (Grant & Sugarman, 2004), participants were compensated for their contribution to the study by way of entry into four lotteries to win prizes of modest value.

Data were collected in four waves consistent with the temporal ordering of constructs implied by the conceptual models. Time One (T1) data were collected during the first week of the first semester via a battery of online measures of TEI and the covariates (Week 1 of an 18-week semester). Four weeks later (Week 5; Time 2[T2]), electronic measures of perceived social support and engagement coping were completed by the same participants. At mid-semester (Week 9; Time [T3]), a third online battery of measures of the adjustment constructs was administered. Each of these occasions of measurement lasted one week to maximize response rates but avoid substantial confounding of the observed effects with the interval of measurement (T. D. Little, 2013; Selig, Preacher, & Little, 2012). Furthermore, within each of these occasions of measurement, the positioning of instruments was randomized to control for order effects. The final wave of measurement (Time 4[T4]) involved the retrieval of students' academic transcripts from the university registrar at the end of the first semester. The timing of the waves of measurement is considered suitable, ensuring that first year students had sufficient time to develop relationships, encounter normative university transition stressors and cope with these stressors towards adjusting to the initial period of transition (Brooks & DuBois, 1995; Cutrona, 1982; Halamandaris & Power, 1997; Shaver et al., 1985).

7.1.3 Measures

The constructs in this study were operationalized as latent variables with between three and seven manifest indicators. Thirty observed variables were included serving as effect indicators of the following seven latent constructs: TEI; perceived social support; engagement coping; academic adjustment; social adjustment; psychological adjustment; and academic achievement. In addition, observed measures of extraversion and neuroticism were modeled as statistical covariates. Indicators of the latent variables and statistical covariates are described below.

7.1.3.1 TEI. Latent TEI was indexed by six observed indicators drawn from the Trait Emotional Intelligence Questionnaire–short form (TEIQue–SF; see Appendix H) (Petrides, 2009). The TEIQue-SF comprises 30 items, responded to on a seven-point Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The TEIQue–SF was designed to provide a global index of TEI but can also be used to generate scores on the following four subscales: Emotionality; Sociability; Self-control; Well-being. These four subscale scores were used as manifest indicators of the latent TEI construct in the current study. Petrides

(2009) offers the important caveat that the subscale scores derived from the TEIQue-SF tend to have lower internal reliability than the full-form analogues by virtue of the limited number of items contained in each subscale. Because internal consistency is dependent on scale length, alpha coefficients in the region of .60 to .70 are respectable for limited-item measures (Carmines & Zeller, 1979). In the present sample, internal consistency reliabilities were adequate for the Well-being (α = .83), Self-control (α = .60), Emotionality (α = .62), and Sociability (α = .73) subscales. These alpha coefficients are consistent with internal reliabilities reported by Petrides (2009) and Petrides et al. (2010) in original validation work. Furthermore, adequate factorial, convergent and criterion validities have been established (Cooper & Petrides, 2010; Petrides, 2009; Petrides et al., 2010).

In addition to these indicators, Adaptability and Self-motivation indicators were constructed and used to index latent TEI consistent with TEI theory. For both the Self-motivation and Adaptability variables, one indicator per facet was constructed by aggregating the two items in the TEIQue-SF corresponding to each facet. Although Petrides (2009) suggests that the lowest level of analysis using the TEIQue-SF should be at the first-order factor level, the use of Adaptability and Self-motivation indicators was necessary to ensure adequate representation of the construct domain of TEI. The omission of these indicators would have resulted in only partial coverage of the TEI content domain. In the present sample, the alpha reliabilities for the Self-motivation (α = .79) and Adaptability (α = .59) indicators were acceptable notwithstanding the limited number of items in each testlet. Notably, for the Self-motivation indicator, coefficient alpha exceeded the internal consistency coefficient for the full-form analogue (α = .69), containing five times the number of items, reported in the original validation study (Petrides, 2009).

7.1.3.2 Covariates. The Big-Five Inventory (BFI; see Appendix H) (John, Donahue, & Kentle, 1991) was used to measure extraversion and neuroticism as observed statistical controls at T1. The BFI is a 44-item self-report inventory, rated on a five-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The inventory is designed to measure the five superordinate personality dimensions from the perspective of the five-factor theory of personality. The BFI yields factor scores for the five dimensions with higher scores reflecting higher levels of the personality trait. In the present study, the extraversion and neuroticism total scale scores were used as observed statistical covariates in the structural models. In the current sample, the internal consistencies for the Extraversion (α = .87) and Neuroticism (α = .84) scales were acceptable. These alpha coefficients approximate the

internal consistency reliabilities reported for these scales in studies with comparable student samples (e.g., Benet-Martínez & John, 1998; extraversion [α = .88]; neuroticism [α = .84]) (see also Noftle & Robins, 2007). Furthermore, three-month test-retest reliabilities are reported to be in the region of .80 – .90 for the scales (John, Naumann, & Soto, 2008), and convergent, divergent and external (e.g., via peer-ratings) validity have been established in multiple investigations (e.g., Gosling, Rentfrow, & Swan, 2003; John et al., 2008; Rammstedt & John, 2007).

7.1.3.3 Perceived social support. Latent perceived social support was indicated by the six subscales of the SPS (see Appendix H) (Cutrona & Russell, 1987). The SPS is a 24-item self-report inventory, rated on a 4-point Likert-type scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). The scale measures the extent to which respondents perceive their social relationships as providing social support. The SPS is designed to yield not only a global perceived social support score but also subscale scores on the following six social provision dimensions proposed by Weiss (1974): attachment; social integration; reassurance of worth; reliable alliance; guidance; opportunity for nurturance. In the current study, subscales scores for these dimensions were used as manifest indicators of the latent social support construct. Internal consistencies for the Attachment (α = .77), Social Integration (α = .74), Reassurance of Worth (α = .63), Reliable Alliance (α = .74), Guidance (α = .80), and Opportunity for Nurturance (α = .68) subscales were uniformly acceptable in the present sample given the limited subscale lengths (i.e., four items per subscale). These alpha reliabilities are consistent with internal reliabilities reported by Cutrona and Russell (1987) based on earlier work with a large sample of university students, teachers and nurses. In addition to adequate internal consistency, factorial, convergent and predictive validity have been demonstrated (Cutrona, 1984; Cutrona & Russell, 1987; Cutrona, Russell, & Rose, 1986; Russell, Altmaier, & Van Velzen, 1987). As the focus of this investigation is the university transition, participants were asked to "think about your current relationships with friends, particularly your university peer, lecturers, tutors, and family members over the first semester of university" in responding to the scale items.

7.1.3.4 Engagement coping. Latent engagement coping was indicated by three scales from the Coping Orientations to the Problems Experienced inventory (COPE; see Appendix H) (Carver, Scheier, & Weintraub, 1989). The full-form COPE is a 60-item self-report inventory that is responded to on a 4-point Likert-type scale ranging from 1 (*I haven't been*

doing this at all) to 4 (*I have been doing this a lot*). Respondents indicate the extent to which they have engaged in 15 ways of coping with stressful events during a period up to the present administration. In the current study, the four-item Active Coping, Planning and Positive Reinterpretation scales of the inventory served as observed indicators of latent engagement coping. This proposed latent structure of engagement coping is broadly consistent with the hierarchical model of coping discussed in the review of literature, incorporating primary-and-secondary-control engagement strategies (Carver & Connor-Smith, 2010; Connor-Smith et al., 2000; Connor-Smith & Flachsbart, 2007).

The psychometric properties of these COPE scales are robust. In the current sample, internal consistencies for the Active Coping ($\alpha = .77$), Planning ($\alpha = .80$) and Positive Reinterpretation ($\alpha = .74$) scales were acceptable. These alpha reliabilities approximate and sometimes exceed the internal consistencies reported in validation studies with university students (Carver et al., 1989; Active Coping [$\alpha = .62$]; Planning [$\alpha = .80$]; Positive Reinterpretation [$\alpha = .68$]; see also Sica, Novara, Dorz, & Sanavio, 1997). Furthermore, adequate factorial, concurrent, divergent, and criterion validity have been established (Brissette et al., 2002; Carver et al., 1989; Carver et al., 1993; Connor-Smith et al., 2000; Sica et al., 1997). As the context of this investigation is the adjustment of new undergraduates to the first semester of university, items were prefaced with directions asking participants to "think about experiences of stressors related to university life in the first semester, such as preparing for and taking examinations or quizzes, preparing for assessment tasks, tutorials and lectures, making friends, interacting with faculty, delivering oral presentations, and class participation".

7.1.3.5 Academic adjustment. Latent academic adjustment was indicated by four items from the OAS scale of the CLEI (Kim et al., 2010) (see Appendix H). The OAS scale consists of eight items that are rated on a five-point Likert-type scale ranging from 1 (*never*) to 5 (*always*). These items are designed to measure academic functioning in the university environment involving the extent to which respondents organize tasks and structure time to set goals, plan and attend to academic work. The scale provides a comprehensive operationalization of academic adjustment in line with the present conceptual formulation of university adaptation (see Chapter Three), tapping core attention, organization and academic-goal-related facets. In the current study, only four items, providing broad coverage of these facets, with uniformly moderate to strong factor loadings as reported in the original validation study (Kim et al., 2010), were used as manifest indicators of latent academic adjustment. The

use of a limited set of items was designed to reduce non-essential model complexity in the measurement structure, thereby minimizing the potential for any confounding of model complexity with model misfit. This is because model fit tends to decrease as the number of indicators per construct increases, even when a model is correctly specified (Kenny & McCoach, 2003; H. W. Marsh, Hau, Balla, & Grayson, 1998). Notably, the internal consistency reliability for the four-item composite in the present sample ($\alpha = .80$) approximates the alpha reliability found for the full scale in the original validation study using a comparable university sample ($\alpha = .81$) (Newton, Kim, Wilcox, & Beemer, 2008). Furthermore, adequate factorial and convergent validity have been established (Kim et al., 2010; Newton et al., 2008). In the current study, participants were asked to consider their university "experience over the past semester" in responding to the items to obtain a time-limited index of academic adjustment over the first semester extending to the present assessment.

7.1.3.6 Social adjustment. Latent social adjustment was estimated from the following three observed indicators reflecting cognitive, behavioral and affective dimensions of optimal social functioning in line with the present conceptualization of social adjustment (see Chapter Three): (a) the PGI subscale of the IIS (Pascarella & Terenzini, 1980) (see Appendix H); (b) the ICA scale of the CLEI (Kim et al., 2010) (see Appendix H); and (c) the ULS-8 (Hays & DiMatteo, 1987) (see Appendix H). Each of these instruments is described below.

The PGI subscale of the IIS is a seven-item self-report index measuring perceived quality of, and satisfaction with, peer relationships. The measure is predicated on Tinto's (1993) theory of persistence and is designed to partially operationalize Tinto's construct of social integration. Participants respond to the PGI items on a five-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In the present sample, Cronbach's alpha for the PGI subscale was .80. This internal consistency is comparable to the alpha reliability reported by Pascarella and Terenzini (1980; see also Terenzini, Lorang, & Pascarella, 1981) in the original validation study ($\alpha = .84$) as well as by French and Oakes (2004) in a more recent validation study ($\alpha = .84$). In addition to being sufficiently internally consistent, the scale has been shown to have factorial, discriminant and criterion validity (Pascarella & Terenzini, 1980, 1983; Terenzini et al., 1981). The cumulative scale score, calculated by summing scores on the seven items, served as the first indicator of latent social adjustment.

The ICA scale of the CLEI is a self-report instrument designed to measure participants' involvement in university organizations and activities. High scorers are typically involved in multiple organizations and often participate in formal and informal campus activities (Newton et al., 2008). The measure comprises nine items that are rated on a five-point Likert-type scale ranging from 1 (*never*) to 5 (*always*). The ICA has been shown to have high internal consistency and possess factorial and convergent validity (Newton et al., 2008). The internal consistency for the ICA scale in the present sample was acceptable ($\alpha = .82$) and virtually identical to the alpha reliabilities reported by Newton et al. (2008; $\alpha = .81$) and Kim et al. (2010; $\alpha = .79$) based on university validation samples. In the current study, the nine items comprising the ICA scale were prefaced with instructions asking respondents to think about the items as they apply to "your experience at university over the past semester" to obtain a time-limited index of university involvement during the first semester up to the present measurement. The total observed score for the ICA, computed by averaging scores on the nine test items, was used as the second observed indicator of latent social adjustment.

The ULS-8 served as the final manifest indicator of latent social adjustment. The ULS-8 is an eight-item self-report inventory, rated on a 4-point Likert-type scale ranging from 1 (*never*) to 4 (*always*). This short-form adaptation of Russell, Peplau and Cutrona's (1980) revised UCLA Loneliness Scale was derived from an exploratory factor analysis of the original 20 items and is designed to measure subjective feelings of loneliness (Hays & DiMatteo, 1987). The scale has been shown to have high internal consistency and good factorial, convergent and criterion validity (Hays & DiMatteo, 1987; Wu & Yao, 2008). In the present sample, Cronbach's alpha ($\alpha = .88$) for the ULS-8 exceeded the internal consistency reliability coefficient reported in the initial validation study ($\alpha = .84$) (Hays & DiMatteo, 1987). It should be noted that the conventional scoring procedure for the ULS-8 was reversed in the current study, such that higher scores reflected lower loneliness in line with the present formulation of latent social adjustment. As the context of the current study is the university transition, items were prefaced with direction asking students to consider the items as they relate to "your experience at university over the past semester".

Taken together, these three measures provide comprehensive coverage of the content domain of social adjustment consistent with the present conceptualization of university adaptation. The PGI scale was chosen to operationalize the perception of satisfying relations facet of social adjustment. The ICA scale was selected to tap the engagement with university

activity facet. Finally, the ULS-8 was administered to operationalize the low-loneliness facet of optimal social adaptation.

7.1.3.7 Psychological adjustment. Latent psychological adjustment was indicated by seven items from the WEMWBS (Stewart-Brown & Janmohamed, 2008) (see Appendix H). The WEMWBS is a 14-item self-report instrument designed to measure well-being from both SWB and PWB perspectives. Specifically, the scale is designed to appraise affective-emotional, cognitive-evaluative and optimal functioning aspects of well-being. Respondents rate the extent of their psychological functioning over the previous fortnight using a five-point Likert-type scale ranging from 1 (*none of the time*) to 5 (*all of the time*). In the current study, only seven items, which have been shown to be unidimensional indicators of psychological adaptation in Rasch analysis (Stewart-Brown et al., 2009), were used to index psychological adaptation to reduce non-essential complexity in the measurement model. These seven items have been found to correlate near unity with the full-form (ρ = .95) (Stewart-Brown et al., 2009), suggesting little loss in construct coverage resulting from item reduction. A comprehensive program of reliability and validity research has demonstrated that the scale is internally consistent and possesses good factorial and convergent validity (Clarke et al., 2011; Lloyd & Devine, 2012; Stewart-Brown & Janmohamed et al., 2008; Stewart-Brown et al., 2009; Tennant et al., 2007). In the present sample, Cronbach's alpha for the seven-item composite was acceptable (α = .84).

7.1.3.8 Psychosocial adjustment. In the current study, a second-order psychosocial adjustment factor was assumed to underlie the social and psychological adjustment constructs, reflecting generalized positive functioning across emotional and social domains. This is consistent with the present conceptualization of university adjustment in which psychological and social adjustment are posited to reflect a higher-order psychosocial adjustment construct (see Chapter Three). Thus, a second-order factor was specified in the measurement structure with the first order loadings of both social and psychological adjustment. This higher-order factor is designed to account for the presumed strong covariation between these constructs.

7.1.3.9 Academic achievement. Academic achievement was estimated as a pseudo latent variable from first semester GPA. First semester GPA reflects cumulative academic achievement across all units of study undertaken during the first semester of university.

At the institution in which data were collected, this overall achievement index is based on an interval-level 4-point scale, ranging 0.00 to 4.00, with higher values reflecting greater achievement. GPA is calculated using Equation 7.1 as follows:

$$\frac{[(GP_1 \times CP_1) + (GP_2 \times CP_2) + (GP_n \times CP_n)]}{(\sum CP)} \quad (7.1)$$

where *GP* is the grade point value of subject *n* and *CP* is the credit point value of subject *n*. For two students, an index of GPA based on all subjects undertaken in the first semester was not available on their transcripts. In these cases, GPA was computed from the available subject scores using Equation 7.1.

In the current study, first semester GPA was used as a single indicator of pseudo latent academic achievement with an a priori estimate of measurement error. For the dimensional indicator of achievement, the unstandardised error variance was fixed to some non-zero constant using Equation 7.2 as follows:

$$\theta_{\delta x} = s^2(X)(1-\rho) \quad (7.2)$$

where $s^2(X)$ is the observed variance of the measured indicator and ρ is the estimated reliability of the indicator (Brown, 2006). In the present study, the best available estimate of the reliability of first year GPA (i.e., $\alpha = .84$), obtained from Bacon and Bean (2006), was used as the estimate of ρ in solving the equation.

7.1.4 Analytic Strategy

Analyses in the current study were conducted in the following six stages: (a) preliminary diagnostic analysis; (b) primary statistical modeling, involving alternative models evaluation; (c) testing indirect relations; (d) conditioned model analysis; (e) post-hoc Monte Carlo analysis of solution propriety, parameter estimate and standard error bias, coverage and statistical power for the final solution; and (f) examination of the posited hierarchical, multidimensional structure of university adaptation.

7.1.4.1 Preliminary diagnostic analysis. In the first stage of the analytic strategy, diagnostic assessment of data assumptions and conditions was performed involving the (a) detection of univariate and multivariate outliers, (b) evaluation and treatment of missing data and (c) assessment of multivariate normality (McDonald & Ho, 2002). First, univariate

outliers were detected as observations with standardized scores (i.e., *z* scores) exceeding ±3.29 ($p < .001$) (Tabachnick & Fidell, 2007). Multivariate outliers were examined using the squared Mahalanobis distance (D^2) estimate, which is central χ^2 distributed with *df* equal to the number of observed variables, and a stringent alpha level ($p < .001$; Kline, 2011; Tabachnick & Fidell, 2007). In the present study, $D_c^{2}{}_{(32)} = 62.87$, $p < .001$.

Second, relations between observed variables and missing values were empirically assessed using R. J. A. Little's (1988) test of missingness, which statistically evaluates the tenability of the MCAR assumption underlying missing data. A sufficiently large probability value ($p > .05$) associated with this test is indicative of a pattern of missingness that is consistent with the MCAR mechanism (R. J. A .Little, 1988; Schlomer et al., 2010), thereby permitting the use of modern missing data techniques (e.g., FIML, multiple imputation) in handling missingness to obtain unbiased and efficient estimates (Baraldi & Enders, 2010; Jeličić et al., 2009; Schafer & Graham, 2002; Schlomer et al., 2010).

Finally, multivariate normality was evaluated using Mardia's (1970) normalized estimate of multivariate kurtosis and Yuan, Lambert and Fouladi's (2004) normalized coefficient of kurtosis—the latter of which is a more accurate index of multivariate kurtosis in the presence of missing data (Bentler & Wu, 2002). In large samples, both estimates are distributed as standard normal variates; thus, any value of these estimates exceeding ±3.29 provides evidence of non-trivial multivariate kurtosis. In addition, empirical significance tests of multivariate skewness, multivariate kurtosis and these third and fourth order moments in combination are reported, though these tests are sensitive to *N* (Jöreskog & Sörbom, 1996–2002).

7.1.4.2 Primary statistical analyses. The primary analyses in the present study involved CFA and SEM. These analyses were conducted in line with the two-step modeling approach recommended by Anderson and Gerbing (1988). In the first phase of two-step modeling, the hypothesized target structural regression model was specified as an eight-factor CFA model, with freely estimated covariances among the exogenous latent variables, to determine whether the measurement model fit the data. This initial measurement phase of two-step modeling ensures that any misfit in the model is attributable to only measurement model misspecification rather than misspecified structural model components (e.g., misspecified directional paths), thereby potentially minimizing any later interpretational confounding (Anderson & Gerbing, 1988). In the second phase of two-step modeling, the structural

regression portion of the latent variable model was evaluated along with the three theoretically plausible alternative specifications.

For all CFA and SEM analyses, the raw data were submitted to Mplus (version 6.12) (L. K. Muthén & Muthén, 1998–2010) and ML was tentatively chosen as the estimation method.[5] ML estimation is an iterative, mean and covariance structure estimation procedure yielding a set of parameter estimates that minimizes the discrepancy between the sample covariance matrix, S, and the model-implied matrix estimated from the obtained model parameters, $\Sigma(\theta)$. Under multivariate normality, a discrepancy function (*F*) is minimized so that the likelihood of the data given the model is maximized. Specifically, NT ML obtains model parameter estimates by minimizing the fit function shown in Equation 7.3:

$$F_{ML} = \ln|\Sigma(\theta)| - \ln|S| + \mathrm{Tr}(S\Sigma^{-1}(\theta)) - p \qquad (7.3)$$

where *ln* is the natural logarithm function, *Tr* is the matrix trace function (i.e., the diagonal elements summed) and *p* is the number of observed variables (Bollen, 1989). This estimation routine is suitable where there are at least five response categories for any given scale and category thresholds are approximately symmetrical (Dolan, 1994; Finney & DiStefano, 2006, 2013; Rhemtulla et al., 2012). Assuming multivariate normality, the ML estimator is asymptotically unbiased, consistent and efficient (Lei & Wu, 2012). Another desirable property of the ML estimator is that it links the minimum discrepancy function *F* to a model fit statistic T_{ML}, which is asymptotically χ^2 distributed with *df* equal to the number of non-redundant elements in S minus the number of freely estimated model parameters (Bentler & Bonett, 1980). This final feature of ML estimation provides a statistical basis for assessing model fit.

The evaluation of data-model fit has been a controversial issue in the SEM literature. This controversy has been the subject of several scientific articles; chief amongst these is a set of nine articles published in a Special Issue on SEM in *Personality and Individual Differences* (volume 42, issue 5). This controversy can be seen as a manifestation of the tension between two competing approaches to evaluating model fit and testing theory in the SEM framework (P. Barrett, 2007). One approach, hereafter termed the *exact-fit approach*, espouses strict

[5] At the time of the design of the data analytic strategy, the choice of NT ML estimation was provisional because it requires the assumption of a joint multivariate normal distribution of the observed variables (McDonald & Ho, 2002). Violation of the multivariate normality assumption would necessitate the use of a robust estimator (e.g., robust ML) to obtain unbiased $\chi 2$ test statistics, associated fit indices and standard errors. Evaluation of this data assumption is reported in Section 7.3.

adherence to the criterion of $\Sigma = \Sigma(\theta)$ (i.e., exact fit). This approach to model fit evaluation is typically operationalized via the χ^2 test in which retention of the H_0 is taken as evidence of the tenability of the hypothesized model (T. D. Little, 1997, 2013). A second, competing, approach, hereafter termed the *approximate fit approach*, seeks to quantify the extent of model approximation to the data (Bentler, 2007; T. D. Little, 2013). This approach is consistent with the long standing tradition in model evaluation suggesting that all parametric structures are imperfect to some degree and a reasonable approximation to real-world processes has much scientific value (Bentler, 2007; MacCallum, 2003; MacCallum & Austin, 2000). In applications of SEM, the approximate fit approach is operationalized through the evaluation of model fit using practical fit indices. These indices reflect goodness or badness of fit on a continuous scale rather than the binary form of model truth or falsity with which the exact fit approach is centrally concerned (West, Taylor, & Wu, 2012). The tenability of each approach to model evaluation may be profitably gauged with respect to their utility for theory testing and, more broadly, scientific inquiry.

Which of exact-fit or approximate-fit is the more useful concept for scientific inquiry? It is this question that needs to be asked (and answered) as a precursor to model evaluation in applications of SEM. As discussed above, the exact-fit approach operates under the stringent H_0 that the model perfectly reproduces the population mean and covariance structure (T. D. Little, 2013). It is, however, questionable whether the hypothesis $\Sigma = \Sigma(\theta)$ can ever be precisely correct for any overidentified, parsimonious and scientifically interesting model (Bentler, 2007; MacCallum et al., 1996). Indeed, all unsaturated models that seek to provide a parsimonious representation of real-world processes will be wrong to some extent, even in the population (MacCallum, 2003; MacCallum & Austin, 2000). This may particularly be the case for sizeable models with many *df* (Bentler, 2007). These models, although typically the most scientifically interesting, are the most likely to be misspecified and thus rejected under the χ^2 test of exact fit. For instance, in a model with 350 degrees of freedom, there are over 350 ways of misspecifying the model. Some of these misspecifications may be theoretically important in terms of the underlying population process (e.g., omission of a structural regression path); others may be more theoretically trivial (e.g., omission of an error covariance or indicator cross-loading) with the model substantively consistent with the underlying population process (Hancock & French, 2013). The exact fit approach is not sufficiently sensitive to detect these qualitative differences in model misspecification. Thus, this stringent approach may reject models that, though trivially misspecified, are reasonable

approximations to real-world processes (MacCallum et al., 1996). This undesirable property of the exact fit approach is compounded by the sensitivity of its statistical test to trivial misspecification when *N* is even moderately large (Bentler & Bonett, 1980; MacCallum et al., 1996; H. W. Marsh et al., 1988; West et al., 2012). Following from this, in practice, exact fit is likely to be an implausible and scientifically restrictive criterion for model retention, which may be at odds with the spirit of scientific inquiry.

Approximate model fit may be a more useful scientific concept for model evaluation and theory testing. As briefly mentioned above, the approximate fit approach to model evaluation is based on an implicit modeling rationale that acknowledges that models are simply approximations of real-world processes that generate the observed means, variances and covariances (Cudeck & Henly, 1991; T. D. Little, 2013; MacCallum, Widaman, Preacher, & Hong, 2001; West et al., 2012). Because there is no true model, and all models that seek to provide a parsimonious representation of population processes are wrong, even trivially so, a realistic expectation for the researcher is to specify a model that is not grossly erroneous, providing a reasonable approximation to real–world effects (MacCallum, 2003; MacCallum & Austin, 2000). This idea of approximation in scientific inquiry is not new. Indeed, there has been recognition of the role of approximations in the development of the exact sciences for many years (Mulaik, 2007; Niiniluoto, 1986; Ostrovsky, 2005). In discussing approximations, Mulaik (2007, p. 890) notes that "good initial approximations…were clues to scientists that they had stumbled on ideas worth pursuing further". In the context of theory testing, theoretical progress is achieved not by one-off tests of fidelity but by the accumulation of information from multiple approximations that serve as evidence for future theorizing. In this regard, progress in scientific activity may be considered a matter of cumulative and increasingly sophisticated approximations to the truth. On the basis of these arguments, model fit evaluation in the present research was conducted in line with the approximate fit approach.

The notion of scientific approximation has been operationalized in the SEM literature in terms of approximate or practical fit indices. These indices are proposed to address both the conceptual (i.e., exact fit criterion) and statistical (e.g., sensitivity to *N*) limitations of the likelihood ratio test (H. W. Marsh, Balla, & Hau, 1996; H. W. Marsh et al., 1988; West et al., 2012). In the present study, fit for the hypothesized model was assessed using the following three indices from the categories of absolute and comparative fit: the RMSEA; the

standardized root mean square residual (SRMR); and the comparative fit index (CFI).[6] Although the reporting of multiple approximate indices has sometimes, rather derisively, been taken as a sign that researchers do not know how to interpret them (McDonald & Ho, 2002), converging information from multiple approximate indices may more reliably point to acceptable or unacceptable models than a single index (Brown, 2006). The evaluation of model-data correspondence using the practical fit indices is, however, complicated by a lack of consensus in the SEM literature concerning a priori threshold values constituting acceptable fit (H. W. Marsh, Hau, & Wen, 2004).

Although there is little consensus and much controversy regarding proposed cut-off values for approximate fit indices (H. W. Marsh, Hau et al., 2004), the following rough guidelines for interpreting model-data fit, based on a synthesis of recommendations provided by Bentler (1990), Browne and Cudeck (1993), Hu and Bentler (1999), and H. W. Marsh, Hau, and Grayson (2005), were used to evaluate model fit in the current study. For the CFI, values greater than .90 and .95 typically reflect acceptable and very good fit to the data, respectively (Bentler, 1990; Hu & Bentler, 1999). A criterion of .08 or less for the SRMR has been proposed as indicative of good fit (Hu & Bentler, 1999). For the RMSEA, values less than .05 and .08 reflect close and acceptable fit to the data, respectively (Browne & Cudeck, 1993; H. W. Marsh et al., 2005). As well as reporting the RMSEA point estimate, the 90% confidence bound and statistical test of close fit (CFit) associated with the RMSEA are reported (Brown & Cudeck, 1993; MacCallum et al., 1996). It should be noted that the threshold values cited above are only approximate guidelines and should not be interpreted as golden rules (Markland, 2007; H. W, Marsh, Hau et al., 2004). Indeed, there is evidence that large models may fail to reach even the minimum standards of acceptable fit (Marsh et al., 1998; H. W. Marsh et al., 2005). Accordingly, to enhance the assessment of model acceptability, individual parameter estimates, standardized residuals and modification indices were evaluated to identify localized areas of misfit and solution impropriety (Bentler, 2007; McDonald & Ho, 2002; Tomarken & Waller, 2003). The χ^2 test statistic is also presented for informational purposes but was excluded from the assessment of model fit.

The second stage of the analytic protocol also involved alternative models evaluation. Specifically, three theoretically plausible alternative models were compared to the target

[6] Please note that Mplus computes the χ^2 test statistic as $(N)F_{ML}$ rather than the more routinely observed $(N-1)F_{ML}$ (Brown, 2006; Wang & Wang, 2012). Accordingly, fit indices involving the likelihood ratio statistic are computed in Mplus using $(N)F_{ML}$. In practice, this is unlikely to alter the fit indices to any considerable extent.

parametric structure to obtain the most substantively meaningful, yet parsimonious, representation of the population processes. These alternative model comparisons concerned the evaluation of fully versus partially mediated relations of TEI with the adaptation and achievement constructs (see Section 4.4 for a summary of the alternative models). In the current study, the χ^2 difference (χ^2_{diff}) test was tentatively chosen to statistically compare the nested models. A stringent alpha criterion was set ($p < .01$) for this test given its known sensitivity to N (MacCallum, Browne, & Cai, 2006; West et al., 2012). A χ^2_{diff} statistic exceeding the χ^2_c, with nominal alpha criterion and *df* equal to the number of constrained (or unconstrained) parameters involved in the nested comparison, constitutes a statistically significant decrement (or improvement) in fit. In the context of comparing more parsimonious alternative structures, a statistically significant χ^2_{diff} test indicates that differences in fit between nested models are sufficiently large to reject the more parsimonious model in favor of a less restrictive model. It should be noted that the choice of the NT ML-based χ^2_{diff} test was provisional at the time of the data-analytic design because the estimation routine requires the tenability of the assumption of multivariate normality (McDonald & Ho, 2002). Violation of this assumption can lead to biased χ^2 test statistics and, by implication, biased χ^2 difference tests (Chou, Bentler, & Satorra, 1991; Curran et al., 1996; Hu, Bentler, & Kano, 1992; West, Finch, & Curran, 1995).[7]

7.1.4.3 Testing indirect relations. In the third stage of the analytic protocol, empirical significance tests of indirect relations were conducted based on the final structural model retained in the primary modeling phase. Widely-used NT product of coefficients strategies, such as the Sobel test, for assessing indirect effects demand the tenability of the assumption that the sampling distribution of the indirect effect approximates normality under the H_0 (Perera, 2013; Preacher & Hayes, 2008). The indirect effect is, however, typically kurtotic and asymmetrical, namely positively skewed, particularly in modest samples, which yields low-powered tests of mediation (Hayes, 2009; Preacher & Hayes, 2004). Thus, it is necessary to refrain from using these NT tests of indirect effects. Bootstrapping provides an alternative method for assessing indirect effects that makes no distributional assumptions about the sampling distribution of the indirect effect (Perera, 2013).

[7] Bias in the χ^2 test statistic can be either upward or downward depending on the form of kurtosis present in the sample data (Yuan, Bentler, & Zhang, 2005). Inflation and attenuation of the χ^2 test statistic will invariably lead to bias in the $\chi 2_{diff}$ test.

An extensive body of recent methodological literature encourages the use of the bootstrap method for examining indirect effects (see e.g., Mallinckrodt, Abraham, Wei, & Russell, 2006; Perera, 2013; Preacher & Hayes, 2004; Preacher et al., 2007; Shrout & Bolger, 2002). Bootstrapping is a non-parametric resampling approach to estimating and testing effects which makes no distributional assumptions about the sample statistic and observations (Hayes, 2009; Preacher et al., 2007; Shrout & Bolger, 2002). Instead, the procedure infers the distributional properties of the sample statistic via the resampling of the empirical data (Perera, 2013). In the bootstrap procedure, the parent sample is considered to represent the population from which it was derived. The sampling distributions of tests and sample statistics are empirically determined by multiple resamples of equivalent size to the original sample indiscriminately drawn from the parent sample (Hayes, 2009; Preacher et al., 2007). For instance, in the framework of specific indirect effects, bootstrapping is conducted by arbitrarily drawing a large number of samples denoted k (typically between 1000 and 10000), with replacement, from the parent sample. The indirect effect ab is calculated in each of the k samples. The point estimate of the indirect effect is the mean ab value calculated over k samples (Preacher & Hayes, 2004).

In addition to generating a point estimate based on the empirical approximation of the sampling distribution of the statistic, the bootstrap procedure can produce $100(1 - \alpha)\%$ percentile and bias-corrected (BC) confidence intervals for ab (Hayes, 2009; Preacher et al., 2007). In terms of testing the null using the bootstrap procedure, the H_0 of no indirect effect is not supported at, for instance, $\alpha = .05$ if zero is not included in the lower and upper bounds of the 95% confidence interval. Any probability value can be set as $(100 - CI\%)/100$ to determine the desired level of significance. The BC bootstrap approach is widely recommended by methodologists because this resampling procedure not only directly tests mediation hypotheses but also has been shown in simulation studies to yield (a) unbiased confidence bounds, (b) greatest statistical power, and (c) the most accurate Type 1 error rates (MacKinnon, Lockwood, & Williams, 2004; J. Williams & MacKinnon, 2008).

Another consideration in the estimation and testing of indirect effects is the provision of effect sizes. Although promising effect size measures for quantifying indirect effects have been developed for single mediator models (e.g., κ^2, R^2_{Med}) (Fairchild, MacKinnon, Taborga, & Taylor, 2009; Preacher & Kelley, 2011), these indices have not been extended to the multiple mediator context. This complicates the communication of effect size for indirect

effects in multistage mediation models, such as the present parametric structures. One approach for expressing the size of indirect effects that can be used in the multiple mediation context, though not without its limitations, is the ratio of the specific indirect effect to the total effect knows as the proportion mediated (P_M), which is computed using Equation 7.4 as follows:

$$\hat{P}_M = \frac{(\hat{a}\hat{b})}{\hat{c}} \tag{7.4}$$

where a is the regression slope linking X to M, b is the conditional regression slope linking M to Y, and c is the total effect computed as the sum of indirect and the direct effects. The P_M can be easily extended to assess the proportion of the total effect that is attributable to individual mediational pathways by including the coefficient for the specific indirect effect in the numerator of Equation 7.4. Although theoretically informative, the P_M is statistically limited as an effect-size measure for mediation analysis. Under conditions of inconsistent mediation or empirical suppression (MacKinnon et al., 2000), P_M can exceed one, which violates its interpretation as a true proportion (MacKinnon, 2008; Preacher & Kelley, 2011; Shrout & Bolger, 2002). Following recommendations by Shrout and Bolger (2002), if marginal inconsistent mediation or empirical suppression is observed but not statistically significant, P_M is set at an upper bound of one.

7.1.4.4 Conditioned model analysis. In the fourth stage of the analytic protocol, a conditioned model analysis was conducted in which the covariates were included in the final model retained in the unconditioned analysis. These statistical covariates were included as manifest variables to assess the extent to which the relationships in latent space involving TEI are specific to TEI and not confounded with the effects of neuroticism and extraversion. The advantage of performing distinct unconditioned and conditioned analyses over a conditioned analysis alone is that it is possible to observe whether any relationships change markedly once the covariate effects are controlled (e.g., Elliott, McGregor, & Gable, 1999; T. D. Little, 2013). In the current study, covariate differences were controlled via the specification of direct paths from not only neuroticism and extraversion to TEI but also extraversion to social support, engagement coping and psychosocial adaptation, and neuroticism to psychosocial and academic adaptation. These regressions of the exogenous predictor and theoretically-relevant endogenous constructs on the covariates ensure full control of the covariate influences (T. D. Little, 2013; Little, Preacher, Selig, & Card, 2007). However, in line with

recent recommendations by T. D. Little (2013), clearly non-significant (i.e., $p > .10$) covariate effects were constrained to zero to avoid statistical over-control and model misspecification, which could lead to inaccurate estimates of the substantive paths in the model.

7.1.4.5 Post-hoc APP simulation. The fifth stage of the data analytic protocol involved the conduct of a post-hoc Monte Carlo experiment to evaluate (a) the propriety of the final unconditioned empirical solution, (b) the accuracy of parameter estimates, standard errors and confidence intervals and (c) the power of statistical tests of the estimated parameters. A population covariance matrix was generated based on the estimates of population parameters drawn from the final standardized empirical solution. The parameter estimates were chosen from the standardized solution to enhance the interpretability of the results (L. K. Muthén & Muthén, 2002). As in the a priori simulation, in the analytic model of the post-hoc Monte Carlo procedure, the loadings of social adaptation on psychosocial adjustment and GPA on achievement were fixed to their final model estimates for model identification purposes. Furthermore, in line with the a priori simulation and empirical study, indirect effects were computed as the product of implicated path coefficients (Perera, 2013); however, the statistical significance of these effects were evaluated using the Sobel product of coefficients test in this simulation as the bootstrap procedure in not available in the Mplus Monte Carlo utility (L. K. Muthén & Muthén, 1998-2010). Missing data on the manifest indicators were generated to reflect the proportion of missingness observed in the sample data (see Table 7.1). ML was used to estimate the Monte Carlo solution, which implements the FIML routine in the presence of data missing data and yields approximately unbiased and efficient estimates when data are MCAR or MAR. One thousand replications of the model were generated to achieve stability in the results (Paxton et al., 2001). In the current simulation, the evaluation of bias, coverage, solution propriety and statistical power was conducted in the APP framework using the five criteria outlined for estimating N_{min} in Chapter Six.

7.1.4.6 Subsidiary research issues: The dimensionality of university adaptation. In the final stage of the data analytic protocol, the structure of university adaptation was examined. Consistent with the present conceptualization of university adjustment, the adaptation process is posited to occur in three domains: academic adjustment; social adjustment; psychological adjustment. The social and psychological dimensions are proposed to define a higher-order psychosocial adjustment construct that reflects general functioning across social and

emotional domains. The academic and psychosocial dimensions are expected to be positively and moderately-to-strongly associated (see Chapter Three for an overview).

The test of this hierarchical, multidimensional structure was conducted using CFA. Specifically, a second-order model was postulated in which the first-order psychological and social adjustment factors were specified to load onto the higher-order psychosocial adjustment factor. Seven and three observed indicators, in turn, were predicted to define the psychological and social adjustment lower-order factors, respectively (see Section 7.2.6). As second-order models require at least four first-order factors to be statistically over-identified and thus testable in the absence of additional sample moments (Chen et al., 2006), without constraints, the present model, with only two higher-order loadings, is statistically under-identified. Thus, to generate sufficient *df* in the second-order portion of the model, the higher-order factor loadings and disturbance variances associated with the first-order factors were fixed to their standardized values obtained from the test of the broader eight-factor measurement structure in the primary data analyses, thereby yielding an over-identified structure that can be statistically tested. In line with the present conceptualization of university adjustment, academic adjustment was specified as a first-order factor in the CFA model with four lower-order loadings (see Section 7.2.3.5) and the academic and psychosocial adjustment factors were free to co-vary. Because the estimation of second-order structures can be computationally intensive (H. W. Marsh, 1990), to optimize the estimation process, estimates drawn from the test of the full eight-factor measurement model were used as start values for the freely estimated parameters in the adaptation CFA model. The evaluation of fit for this CFA model was conducted using the criteria outlined in Section 7.2.4.2.

7.2 Results

7.2.1 Preliminary results

7.2.1.1 Outliers. Univariate outliers were identified via inspection of standardized scores across all manifest indicators and covariates. Using a criterion of $z > \pm 3.29$, $p < .001$ (Tabachnick & Fidell, 2007), two cases with extremely low *z* scores on the indicator Well-being were found to be univariate outliers (z = –3.99, z = –3.38). Another case was identified as an outlier on the Self-control indicator (z = –3.45). Two cases had outlying scores on Reassurance of Worth (z = –3.59, z = –3.59), and one case was found be an outlier on the

Social Integration indicator (z = –3.98). A further two cases were identified as outliers on the observed variable Opportunity for Nurturance (z = –3.31, z = –3.31). All eight cases found to be univariate outliers were removed from the data set (Tabachnick & Fidell, 2007). After the deletion of these cases, squared Mahalanobis distance statistics for each case were computed to screen for multivariate outliers (Kline, 2011; Tabachnick & Fidell, 2007). Four additional cases were found to be multivariate outliers, exceeding $D^2_{c\,(32)} = 62.87$, $p < .001$,[8] and were removed from the data set, leaving 458 cases available for further analysis.

7.2.1.2 Missing data. As is commonplace in most multiwave designs (Enders, 2011), there was a moderate amount of missing data due primarily to participant attrition over the four waves of data collection. Between 0.66% and 27.95% of data were missing on the observed indicators across the entire data set (see Table 1). On average, 17.41% of each variable's data were missing across the observed indicators. Traditional or ad hoc routines for handling missing data (e.g., listwise or pairwise deletion and mean or regression imputation) have largely fallen out of favor in the methodological literature because they yield inefficient (i.e., low power) and biased parameter estimates (Baraldi & Enders, 2010; Enders, 2006, 2010, 2013 Enders & Bandalos, 2001; Jeličić et al., 2009; Wilkinson & Task Force on Statistical Inference, 1999). FIML (or direct ML or raw ML) has been recognized by methodologists as the "practical state of the art" missing data routine (Schafer & Graham, 2002, p. 173).

FIML is a direct model-based procedure for parameter estimation in the presence of missingness that uses all available case data. FIML estimates parameters on the basis of complete observations in combination with probable values of the missing data points given the observed data (Enders, 2001). In this regard, accuracy and precision of estimates are maximized by using all available data. It should be noted that FIML is not an imputation-based method per se; however, by virtue of including the vectors of partially completed data in the casewise likelihood functions that are summed across the sample, probable values for the missing data points are implied in the estimation of parameters (see Enders & Bandalos, 2001 for technical details). FIML produces approximately unbiased and efficient parameters estimates under the assumptions of MAR and MCAR (Enders & Bandalos, 2001). In the current study, R. J. A. Little's (1988) omnibus statistical test of the tenability of the MCAR assumption was not statistically significant, χ^2 (1196) = 1217.31, $p > .05$, suggesting a pattern

[8] D^2 values for the four multivariate outliers are as follows: $D^2_{(32)} = 63.46$, $p < .001$; $D^2_{(32)} = 69.19$, $p < .001$; $D^2_{(32)} = 63.46$, $p < .001$; $D^2_{(32)} = 66.80$, $p < .001$.

of non-systematic missingness that is consistent with the MCAR mechanism. Thus, the FIML routine for missing data was used for model estimation in the current study. Covariance coverage under the FIML routine ranged from 66% to 99%.

7.2.1.3 Multivariate normality. NT ML estimation makes the distributional assumption that the observed variables have a joint, multivariate normal distribution in the population (Bentler & Dudgeon, 1996; Bollen, 1989; McDonald & Ho, 2002). Violations of the multivariate normality assumption can result in biased χ^2 test statistics and standard errors, though parameters estimates remain relatively robust to nonnormality (Chou et al., 1991; Curran et al., 1996; Finch, West, & McKinnon, 1997; Hu et al., 1992; Yuan et al., 2005; see Finney & DiStefano, 2006, 2013 for reviews). In the current study, univariate skew and kurtosis values for the indicators did not exceed an absolute value of one (see Table 1), indicating a reasonable approximation to univariate normality for the observed variables (West et al., 1995). However, univariate normality is a necessary but not sufficient condition for multivariate normality (DeCarlo, 1997). In evaluating multivariate normality, Mardia's normalized multivariate kurtosis estimate of 13.14 and Yuan et al's (2004) normalized coefficient of multivariate kurtosis of 49.87 exceeded the recommended cut-off of 3.29 (Bentler & Wu, 2002). Empirical significance tests of multivariate normality also revealed statistical significant multivariate skewness ($z = 9.54$, $p < .001$) and multivariate kurtosis ($z = 7.86$, $p < .001$). Furthermore, the omnibus test for the third and fourth order moments in combination was statistically significant, χ^2 (2) = 152.74, $p < .001$. This converging evidence is suggestive of a joint distribution of the observed variables that departs from normality.

On the basis of these results from the tests of multivariate normality, robust maximum likelihood, operationalized as the MLR estimator in Mplus (L. K. Muthén & Muthén, 1998–2010), was used to estimate all CFA and SEM models excepting bootstrapped solutions for assessing indirect effects.[9] The MLR estimator was chosen in the current study because it produces standard errors and tests of model fit that are robust to non-normality while implementing the FIML routine for missing data (L. K. Muthén & Muthén, 1998–2010; Yuan & Bentler, 2000). Specifically, MLR standard errors are computed using a sandwich estimator based on a Huber-White algorithm (L. K. Muthén & Muthén, 1998–2010). Additionally, the MLR estimator yields an adjusted χ^2 test statistic that is asymptotically

[9] The bootstrap procedure for estimating and testing indirect effects is only available under NT ML estimation in Mplus (L. K. Muthén & Muthén, 1998–2010). In assessing indirect effects, the bootstrap procedure should be preferred to the Sobel test, which is computed under MLR estimation in Mplus, as standard errors are computed using the empirically derived bootstrap distribution.

equivalent to the Yuan-Bentler T_2* test statistic, comprising a correction for normality violations based on an estimated scaling correction factor that indexes the amount of non-normality in the observed data (L. K. Muthén & Muthén, 1998–2010; Yuan & Bentler, 2000). Under MLR estimation, associated model fit indices, based on the likelihood ratio test statistic, are also rescaled using the scaling correction factor. When testing relative fit across nested models, statistical comparisons were performed using the Satorra-Bentler scaled χ^2_{diff} test (TRd), which is appropriate for use with the MLR χ^2 (Satorra & Bentler, 2001, 2010). A conservative alpha criterion (< .01) was set for this test given its known sensitivity to *N* (T. D. Little, 2013; MacCallum et al., 2006).

Table 7.1

Descriptive Statistics, Percentage of Missing Data, and Skew and Kurtosis Values for the Observed Variables

Variable	M	SD	% Missing	Skew	Kurtosis
1. Well-being	5.39	1.03	2.18	–0.79	0.41
2. Self-control	4.41	0.91	1.31	–0.19	–0.29
3. Emotionality	4.97	0.83	1.09	–0.36	–0.22
4. Sociability	4.87	0.95	1.53	–0.24	–0.18
5. Self-motivation	4.42	1.43	0.66	–0.12	–0.76
6. Adaptability	5.18	1.19	0.66	–0.54	–0.09
7. Attachment	12.47	2.46	19.65	–0.41	–0.44
8. Integration	13.11	1.93	19.87	–0.47	0.20
9. Reassurance	12.39	1.67	19.43	–0.06	0.22
10. Alliance	13.25	2.06	19.65	–0.55	0.16
11. Guidance	13.07	2.26	19.87	–0.53	–0.03
12. Nurturance	11.41	2.13	20.31	–0.29	0.24
13. Active coping	9.73	2.71	21.40	0.27	–0.32
14. Planning	10.27	2.98	20.52	0.13	–0.71
15. Reinterpretation	11.58	2.66	19.87	–0.18	–0.70
16. OAS-1	3.08	1.01	25.55	–0.17	–0.46
17. OAS-2	2.88	1.03	25.55	0.03	–0.71
18. OAS-3	3.15	1.02	25.55	–0.17	–0.52
19. OAS-4	2.62	0.98	25.55	–0.01	–0.46
20. PGI	24.11	5.08	27.07	–0.16	–0.60
21. ICA	3.20	0.73	27.95	0.02	–0.25
22. ULS-8	24.33	5.13	27.29	–0.40	–0.69

23. WEMWBS-1	3.70	0.88	25.55	–0.39	–0.19
24. WEMWBS-2	3.38	0.89	25.55	–0.28	–0.38
25. WEMWBS-3	3.10	1.04	25.76	–0.26	–0.53
26. WEMWBS-4	3.41	0.90	25.55	–0.46	0.03
27. WEMWBS-5	3.43	0.82	25.98	–0.41	0.38
28. WEMWBS-6	3.50	0.93	25.76	–0.31	–0.24
29. WEMWBS-7	3.76	0.95	25.98	–0.67	0.28
30. GPA	2.67	0.73	2.40	–0.63	0.04
31. Extraversion	3.33	0.85	0.87	–0.27	–0.35
32. Neuroticism	2.93	0.77	1.31	0.05	–0.48

Note. % Missing = percentage of missing data; Integration = Social integration; Reassurance = Reassurance of worth; Alliance = Reliable alliance; Reinterpretation = Positive reinterpretation; OAS = Organization and Attention to Study scale; PGI = Peer-Group Interactions subscale; ICA = Involvement with College Activity scale; ULS-8 = UCLA Loneliness Scale-8; WEMWBS = Warwick Edinburgh Mental Well-Being scale. Means and standard deviations are FIML sample statistics.

7.2.1.4 Descriptives and correlations. The means and standard deviations of the 32 observed variables and their zero-order correlations are shown in Tables 7.1and 7.2, respectively. These estimates are sample statistics based on FIML estimation.[10] As shown in Table 7.2, 461 of the 496 estimated sample correlations were statistically significant at the $p < .05$ level or better. The six indicators of latent TEI were moderately-to-strongly correlated with each other, and, as expected, negatively and positively correlated with neuroticism and extraversion, respectively. In addition, these manifest indicators were generally moderately correlated with the indicators of latent social support, with the exception of the correlation between Self-control and Nurturance. All 18 correlations of the observed TEI indicators with the indicators of latent engagement coping were modest-to-moderate and statistically significant. Five of the six indicators of TEI were also statistically significantly associated with the OAS items, with Self-motivation showing the largest associations. Only the associations of the Sociability indicator with the indicators of academic adjustment were largely non-significant and near-zero. Notably, 58 of the 60 unique correlations of the TEI

[10] As there is little guidance in the SEM literature concerning the reporting of sample statistics (e.g., means, standard deviations and correlations) in the presence of missing data, the author deliberated on whether listwise-deleted means and standard deviations and pairwise-deleted correlations or FIML-based sample statistics should be reported. This initial deliberation resulted in an electronic mail exchange with C. K. Enders. After careful consideration, Enders and the author opted for reporting the FIML sample statistics as these are likely to be more useful for the reader in reproducing the study results (C. K. Enders, personal communication, 25 March, 2013).

indicators with the indicators of psychological and social adjustment reached statistical significance. The indicators of social and psychological adjustment were also generally moderately-to-strongly associated with each other. Finally, correlations of the TEI indicators with GPA were weak and generally statistically non-significant; however, this does not preclude the possibility of indirect associations (Rucker et al., 2011). Only the manifest indictors of academic adjustment were consistent correlates of GPA.

Table 7.2

Zero-Order Correlations for the 32 Observed Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Well-Being	–															
2. Self-control	.52	–														
3. Emotionality	.49	.33	–													
4. Sociability	.50	.38	.43	–												
5. Self-motivation	.48	.28	.31	.26	–											
6. Adaptability	.56	.57	.39	.38	.38	–										
7. Attachment	.45	.16	.44	.31	.27	.27	–									
8. Integration	.44	.22	.28	.26	.23	.29	.59	–								
9. Reassurance	.49	.30	.36	.37	.35	.32	.54	.54	–							
10. Alliance	.47	.22	.35	.30	.23	.32	.67	.62	.52	–						
11. Guidance	.49	.23	.40	.27	.21	.29	.72	.61	.53	.75	–					
12. Nurturance	.22	.07	.25	.28	.16	.12	.39	.31	.35	.32	.33	–				
13. Active	.38	.19	.32	.26	.36	.29	.28	.27	.39	.25	.31	.13	–			
14. Planning	.36	.13	.25	.20	.33	.22	.26	.27	.35	.27	.24	.12	.66	–		
15. Reinterpretation	.38	.15	.21	.18	.24	.25	.30	.29	.37	.28	.31	.19	.53	.59	–	
16. OAS-1	.27	.17	.14	.05	.41	.22	.18	.15	.28	.13	.16	.11	.41	.36	.25	–
17. OAS-2	.31	.14	.19	.12	.45	.21	.20	.19	.29	.21	.24	.14	.42	.41	.33	.71
18. OAS-3	.27	.15	.14	.08	.30	.11	.18	.14	.18	.15	.17	.09	.32	.32	.24	.58
19. OAS-4	.26	.27	.18	.03	.37	.26	.13	.04	.12	.10	.12	.03	.18	.13	.01	.47
20. PGI	.35	.16	.20	.21	.25	.31	.32	.42	.37	.35	.34	.19	.25	.19	.33	.09
21. ICA	.37	.19	.18	.17	.27	.34	.33	.44	.36	.33	.33	.19	.28	.29	.36	.21

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
22. ULS–8	.49	.30	.32	.30	.31	.43	.51	.48	.44	.47	.46	.31	.30	.24	.28	.19
23. WEMWBS–1	.51	.26	.15	.22	.26	.33	.22	.27	.31	.21	.29	.13	.27	.26	.38	.24
24. WEMWBS–2	.51	.27	.21	.23	.35	.36	.32	.31	.43	.34	.34	.19	.35	.30	.41	.36
25. WEMWBS–3	.37	.34	.09	.11	.07	.23	.18	.21	.25	.22	.24	.07	.13	.09	.22	.12
26. WEMWBS–4	.36	.29	.19	.21	.23	.30	.19	.13	.26	.20	.21	.14	.19	.18	.25	.19
27. WEMWBS–5	.45	.35	.22	.23	.30	.35	.17	.22	.37	.20	.21	.14	.28	.21	.27	.38
28. WEMWBS–6	.37	.19	.18	.22	.24	.33	.41	.42	.41	.39	.41	.23	.32	.25	.33	.19
29. WEMWBS–7	.36	.28	.17	.28	.32	.34	.25	.24	.30	.26	.27	.08	.22	.23	.19	.23
30. GPA	.06	.01	–.04	.02	.17	.03	.03	.10	.15	.07	.10	.08	.07	.10	.02	.32
31. Extraversion	.48	.23	.39	.59	.32	.37	.32	.28	.34	.29	.26	.23	.21	.21	.26	.05
32. Neuroticism	–.55	–.73	–.24	–.32	–.24	–.54	–.15	–.21	–.26	–.21	–.22	–.05	–.15	–.14	–.10	–.15

Variable	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
17. OAS-2	–															
18. OAS-3	.55	–														
19. OAS-4	.40	.34	–													
20. PGI	.21	.13	.07	–												
21. ICA	.30	.25	.07	.68	–											
22. ULS-8	.29	.20	.20	.64	.58	–										
23. WEMWBS–1	.31	.31	.21	.39	.44	.43	–									
24. WEMWBS–2	.38	.28	.33	.38	.39	.46	.65	–								
25. WEMWBS–3	.13	.21	.17	.21	.28	.31	.49	.43	–							
26. WEMWBS–4	.26	.27	.24	.27	.35	.37	.41	.36	.40	–						
27. WEMWBS–5	.30	.37	.37	.27	.32	.32	.55	.49	.53	.55	–					
28. WEMWBS–6	.24	.23	.12	.61	.57	.65	.45	.42	.27	.38	.35	–				
29. WEMWBS–7	.29	.30	.22	.26	.28	.39	.45	.46	.31	.28	.44	.33	–			

Variable	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
30. GPA	.29	.20	.16	.13	.14	.06	.10	.15	.02	.12	.20	.10	.09	–		
31. Extraversion	.17	.07	.06	.39	.33	.45	.21	.25	.12	.23	.21	.30	.26	–.05	–	
32. Neuroticism	–.11	–.13	–.24	–.13	–.18	–.31	–.31	–.33	–.40	–.35	–.36	–.20	–.26	.01	–.29	–

Note. $N = 458$. Integration = Social integration; Reassurance = Reassurance of worth; Alliance = Reliable alliance; Reinterpretation = Positive reinterpretation; OAS = Organization and Attention to Study scale; PGI = Peer-Group Interactions subscale; ICA = Involvement with College Activity scale; ULS-8 = UCLA Loneliness Scale-8; WEMWBS = Warwick Edinburgh Mental Well-Being scale. Correlations are FIML sample statistics including covariates. Absolute values of correlations greater than .09 were significant at $p < .05$.

7.2.2 Primary Results

7.2.2.1 Measurement model. An initial eight-factor CFA measurement model was specified in which all latent variable covariances were freely estimated to evaluate the hypothesized factor structure of the thirty observed indicators. The test of this measurement model converged to an admissible solution and resulted in a marginally acceptable fit to the sample data (RMSEA = .06, CFI = .87; see Table 7.3). Inspection of the standardized residual variance-covariance matrix revealed areas of substantial localized strain in the solution. Specifically, the sample covariances of item six of the WEMWBS (WEMWBS-6) with all three indicators of social adjustment were not sufficiently accounted for by the model specification, suggesting a potential loading of this item on the social adjustment factor (i.e., $\lambda_{28,5}$). Modification indices (MIs) supported this initial diagnosis, showing a sizeable probable likelihood ratio statistic allowing for the free estimation of $\lambda_{28,5}$ (MI = 102.97, standardized expected parameter change [SEPC] = .83).

This is a plausible respecification due to the strong conceptual overlap between the content of WEMWBS-6 and the social adjustment construct (i.e., "I've been feeling close to other people" is likely to tap social adjustment, which is defined as positive social functioning involving, in part, perceptions of satisfying relations and low loneliness; see Chapter Three). Statistically, this is also an important respecification to avoid inflation of the covariance between social and psychological adjustment. Accordingly, the eight-factor model was refitted to the sample data freely estimating $\lambda_{28,5}$.[11] This respecification resulted in a statistically significant improvement in model fit (see Table 7.3; $\lambda_{28,5} = .70$, $p < .001$), though the overall model-data fit was still only minimally acceptable. Notably, following this respecification, the original loading of WEMWBS-6 on psychological adjustment was substantially reduced and non-significant ($\lambda_{28,6} = .10$, $p > .05$). In line with the principle of scientific parsimony, a third model was specified in which $\lambda_{28,6}$ was fixed to zero. This, more parsimonious, measurement structure did not result in a statistically significant decrement in fit and was retained for further analysis (see Table 7.3).

Further evaluation of localized areas of strain in the retained solution revealed that the sample covariance between the Adaptability and Self-control indicators was not adequately

[11] In the current study, post-hoc respecifications were conducted in a stepwise fashion with theoretical guidance to avoid capitalization on chance (Chou & Huh, 2012).

explained by the latent TEI factor. Inspection of MIs revealed that the overall fit of the model could be further improved by freely estimating an error covariance between these indicators ($\theta_{6,2}$; MI = 39.19, SEPC = .36). A method effect was inferred from this postulated residual covariance on the basis of constituent indicator items containing highly similar phrasing keyed in a negative direction (e.g., "I often find it difficult to adapt my life according to the circumstances", "I usually find it difficult to regulate my emotions"). It is widely recognized that the specification of residual covariances that represent non-random measurement error due to secondary method effects (e.g., indicators with highly similar wordings or content) is necessary to obtain a well-fitting parametric measurement structure that is not grossly misspecified and biased (Brown, 2003; Byrne, Shavelson, & Muthén, 1989; Floyd & Widaman, 1995; Gerbing & Anderson, 1984). Freely estimating this residual covariance resulted in a statistically significant improvement in the fit of the model to the data (see Table 7.3; $\theta_{6,2} = .32$, $p < .001$). The overall fit of this respecified model with one freely estimated error covariance was acceptable (RMSEA = .05, CFI = .90; see Table 3).

Table 7.3

Summary of Model-Data Fit for the Measurement Model

Model	MLR χ^2	*df*	TRd	Δ*df*	Sig.	RMSEA	90% CI	CFit	CFI	SRMR
Null model	5096.43	435								
Initial 8-factor model	991.13	389				.06	.05, .06	<.01	.87	.07
8-factor with $\lambda_{28,5}$ free	882.89	388	94.69	1	< .001	.05	.05, .06	.16	.89	.07
8-factor with $\lambda_{28,6}$ fixed to zero	885.47	389	2.62	1	>.05	.05	.05, .06	.16	.89	.07
8-factor with $\theta_{6,2}$ free	848.10	388	26.01	1	< .001	.05	.05, .06	.37	.90	.07
8-factor with $\theta_{20,21}$ free	828.42	387	19.06	1	<.001	.05	.05, .06	.51	.91	.07
8-factor with $\theta_{10,11}$	816.18	386	9.34	1	<.01	.05	.05, .05	.59	.91	.06

Note. N = 458. MLR = robust maximum likelihood estimation; TRd = Satorra-Bentler scaled χ^2 differences text; Δ*df* = degrees of freedom change; Sig = significance level associated with the TRd; RMSEA = root mean square error of approximation; 90% CI = confidence interval for the RMSEA; CFit = statistical test of close fit associated with the RMSEA; CFI = comparative fix index; SRMR = standardised root mean square residual.

Although the respecified eight-factor model with 388 *df* provided an acceptable fit to the data, fit diagnostics revealed evidence of potential residual covariances between (a) the ICA and PGI indicators of latent social adjustment and (b) the Guidance and Reliable Alliance indicators of latent perceived social support ($\theta_{20,21}$ MI = 21.04, SEPC = .38; $\theta_{10,11}$ MI = 14.35, SEPC = .33). These are also plausible model respecifications. The covariances between these indicators, which were unexplained by their respective factors, were likely due to secondary effects produced by constituent items with high content overlap ($\theta_{20,21}$: "I have friends here at school", "It has been difficult for me to meet and make friends with other students"; $\theta_{10,11}$: "There are people I can depend on to help me if I really need it", "There is a trustworthy person I could turn to for advice if I were having problems"). The stepwise specification of each residual covariance resulted in statistically significant improvements in fit for each specification at the stringent < .01 level or better (see Table 7.3; $\theta_{20,21}$ = .32, p <.001; $\theta_{10,11}$ = .27, p < .001). Further scrutiny of the MIs revealed that better overall model fit could be achieved through additional post-hoc model fitting; however, only the respecifications described above could be justified on a theoretical basis.

The final measurement model with 386 *df* provided an acceptable fit to the sample data (RMSEA = .05, CFI = .91; see Table 7.3). All 30 loadings of the manifest indicators on the seven first-order factors, including the respecified $\lambda_{28,5}$, were uniformly moderate to high (λs = .44 – .92; see Table 7.4) and statistically significant at p < .001, with an average standardized factor loading of .71. Further, in line with the current conceptualization of university adjustment (see Chapter Three), the loadings of the first-order adaptation factors on the second-order psychosocial adjustment factor were strong and virtually identical (see Table 7.4). Construct reliability coefficients, computed using Hancock and Mueller (2001) formula, were also uniformly high, ranging from .80 to .89 (see Table 7.4). Taken together, all latent variables appear to have been adequately measured by the manifest and higher-order indicators.

Table 7.4

Factor Loadings for the Lower and Higher Order Indicators

Latent variable and indicators	λ	λ_{cs}	*SE*[a]	95% CI[a]	
				LL	*UL*
TEI (*H* = .86) [b]					
Well-being	1.00[c]	.88	.02	.84	.92
Self-control	0.58	.57	.04	.50	.65
Emotionality	0.53	.58	.04	.50	.66
Sociability	0.60	.57	.04	.49	.65
Self-motivation	0.86	.55	.04	.47	.62
Adaptability	0.85	.64	.04	.57	.71
Perceived Social Support(*H* = .89)					
Attachment	1.00[c]	.82	.02	.78	.86
Social integration	0.71	.75	.03	.69	.80
Reassurance of worth	0.58	.69	.03	.63	.76
Reliable alliance	0.81	.79	.03	.74	.84
Guidance	0.92	.82	.02	.78	.87
Opportunity for Nurturance	0.47	.44	.05	.34	.54
Engagement Coping (*H* = .83)					
Active coping	1.00[c]	.80	.03	.73	.86
Planning	1.14	.82	.03	.76	.88
Positive Reinterpretation	0.86	.70	.04	.62	.78
Academic Adjustment (*H* = .86)					
OAS–1	1.00[c]	.85	.03	.79	.91
OAS–2	1.00	.83	.03	.78	.88
OAS–3	0.80	.67	.04	.60	.74
OAS–4	0.58	.51	.05	.41	.61
Social Adjustment (*H* = .87)					
PGI	1.00[c]	.75	.03	.68	.82
ICA	0.14	.71	.03	.64	.77
ULS-8	1.15	.85	.03	.80	.90
WEMWBS-6	0.19	.78	.03	.73	.83
Psychological Adjustment (*H* = .85)					
WEMWBS–1	1.00[c]	.78	.03	.73	.84
WEMWBS–2	0.99	.76	.04	.69	.83
WEMWBS–3	0.91	.60	.04	.51	.69
WEMWBS–4	0.77	.58	.06	.46	.70

WEMWBS–5	0.86	.72	.04	.65	.80
WEMWBS–7	0.82	.59	.04	.51	.67
Academic Achievement (H = .85)					
GPA	1.00[d]	.92	.01	.91	.93
Psychosocial Adjustment (H = .80)					
Social Adjustment	1.00[c]	.81	.05	.72	.90
Psychological Adjustment	0.18	.82	.05	.73	.92

Note. N = 458. CI = confidence interval; *LL* = lower limit; *UL* = upper limit; λ = unstandardized factor loading; λ_{cs} = completely standardized factor loading. [a] These values are based on standardized estimates. [b] H = Hancock and Mueller's (2001) maximal construct reliability coefficient. [c] These loadings were fixed to 1.00 to establish the metric of the latent variable and identify the model.[d] The unstandardized error variance of the dimensional GPA indicator was fixed to a non-zero value reflecting an a priori estimate of measurement error. All factor loadings are significant at $p < .001$.

As shown in Table 7.5, all 15 correlations among the latent variables were in the predicted directions, though three did not reach statistical significance at $p < .05$. TEI was positively and strongly associated with perceived social support, engagement coping and psychosocial adjustment and moderately associated with academic adjustment. The association between TEI and academic achievement was considerably weaker and non-significant. The correlations of the proximal mediators with the distal mediators were statistically significant, and, consistent with the present conceptualization of university adjustment, the distal mediators were strongly related to each other. Finally, both adaptation constructs were statistically significantly associated with academic achievement at the latent bivariate level. Given the acceptable fit of the measurement model, the target and alternative structural models were tested.

Table 7.5

Model Estimated Correlations among the Latent Variables from the Final Measurement Solution

Latent variable	1	2	3	4	5	6
1. TEI	–					
2. Perceived support	.65**	–				
3. Engagement coping	.53**	.47**	–			
4. Academic adjustment	.42**	.30**	.53**	–		
5. Psychosocial adjustment	.77**	.70**	.54**	.52**	–	
6. Academic Achievement	.08	.12	.10	.39**	.21*	–

Note. $N = 458$. ** $p < .001$; * $p < .01$.

7.2.2.2 Structural models. The target structural model reflecting partial mediation was specified with direct paths from TEI to social support, engagement coping, academic and psychosocial adjustment, and academic achievement. Paths were also specified between the proximal and distal mediators and from the distal mediators to the achievement outcome (see Figure 4.9). In total, 10 direct structural regression paths were freely estimated. In addition, disturbance covariances for the endogenous proximal and distal mediators were estimated because it was assumed that (a) perceived social support and engagement coping and (b) academic and psychosocial adjustment share at least one omitted "cause" not specified in the present model (Kline, 2012). The test of this target model resulted in an acceptable fit to the sample data (RMSEA = .05, CFI = .91; see Table 7.6). Notably, this more restrictive structural model did not result in a statistically significant degradation in fit relative to the completely saturated structural solution (i.e., the final measurement model with all 15 covariances freely estimated), TRd (3) = 3.31, $p > .05$.

Although the target partial mediation model provided a reasonable fit to the data, the model was compared to a more parsimonious alternative parametric structure in which the direct relation between TEI and achievement was constrained to zero (AM1). Theoretically, this is an important model comparison because it enables the determination of whether a structural model specifying only indirect associations of TEI with academic achievement via the proximal and distal mediators provides a better, more parsimonious, account of the observed data relative to the less restrictive target solution with both direct and indirect associations. Support for the more restrictive model would be indicative of a fully mediated

relation of TEI with academic achievement (Holmbeck, 1997; James et al., 2006). The test of this constrained alternative model resulted in an acceptable fit to the data (RMSEA = .05, CFI = .91; see Table 7.6). Furthermore, a nested model comparison revealed that the alternative model did not result in a statistically significant decrement in fit relative to the more complex model using a stringent alpha criterion ($p < .01$; see Table 7.6). On the basis of these results, the more parsimonious alternative model, reflecting a fully-mediated relation between TEI and achievement, was retained for further analysis.

A second alternative model (AM2) was examined to determine whether the specification of a completely mediated TEI-psychosocial adjustment link provides a better, more parsimonious, fit to the observed variances and covariances than the retained model (AM1). In this model, the direct path from TEI to psychosocial adjustment was constrained to zero. This second alternative parametric structure also provided an acceptable fit to the sample data (RMSEA = .05, CFI = .91). Based on a nested model comparison, however, this model showed a statistically significant decrement in fit relative to the less restrictive model in which the direct path from TEI to psychosocial adjustment was freely estimated (see Table 7.6). Thus, the constrained AM2 solution was rejected in favor of the less restrictive AM1 model.

The fit of the retained AM1 solution was compared to a final, more restrictive, alternative model specifying a null direct path from TEI to academic adjustment (AM3). Theoretically, this is an important model comparison because it may clarify whether engagement coping partially or fully mediates the relation of TEI with academic adjustment. This more restrictive model was specified by constraining the direct path from TEI to academic adjustment to zero. Evaluation of the AM3 structural model resulted in acceptable overall data-model fit as shown in Table 7.6 (RMSEA = .05; CFI = .91). Notably, this more parsimonious model did not result in a statistically significant decrement in model fit relative to the more complex AM1 solution at the stringent $p < .01$ cut-off (see Table 7.6). On this basis, the constrained AM3 parametric structure, reflecting a fully-mediated association of TEI with academic adjustment, was retained for further analysis.

Table 7.6

Summary of Model-Data Fit Statistics for the Target and Alternate Structural Models

Model	MLR χ^2	*df*	TRd	Δ*df*	Sig.	RMSEA	90% CI	CFit	CFI	SRMR	Retained
Target model	819.23	389				.05	.04, .05	.61	.91	.06	
AM1 with γ_{51} constrained to zero	823.28	390	4.05	1	>.01	.05	.05, .05	.60	.91	.07	Yes
AM2 with γ_{41} constrained to zero	850.65	391	20.56	1	<.001	.05	.05, .05	.40	.91	.07	No
AM3 with γ_{31} constrained to zero	828.52	391	4.60	1	>.01	.05	.05, .05	.57	.91	.07	Yes
Final model with β_{54} constrained to zero	828.50	392	0.13	1	>.05	.05	.05, .05	.59	.91	.07	Yes

Note. $N = 458$. MLR = robust maximum likelihood estimation; TRd = Satorra-Bentler scaled x^2 differences text; Δ*df* = degrees of freedom change; Sig = significance level associated with the TRd; RMSEA = root mean square error of approximation; 90% CI = confidence interval for the RMSEA; CFit = statistical test of close fir associated with the RMSEA; CFI = comparative fix index; SRMR = standardised root mean residual.

In line with the basic tenets of the philosophy of science, which demand the most parsimonious, yet substantively meaningful, representation of the population processes, near-zero, non-significant paths were constrained to zero to obtain the final solution. Beyond the philosophical issues associated with scientific parsimony, obtaining the most parsimonious solution in which approximately null and non-significant parameters, possibly reflecting model misspecifications, are constrained to zero may result in greater precision and accuracy in parameter estimation (Bentler & Mooijaart, 1989; T. D. Little, 2013). In the retained AM3 solution, only one parameter met the criteria of near-zero and non-significant ($\beta_{5,4} = -.03$, $p > .05$). The model was refit to the sample data with the path from psychosocial adjustment to achievement ($\beta_{5,4}$) fixed to zero. Constraining this parameter did not result in a statistically significant decrement in the fit of the model (see Table 7.6) and the remaining substantive parameters remained unchanged. On this basis, the more parsimonious solution with 392 *df* was retained as the final structural model for interpretation and further mediational and conditioned analyses.

The final structural model with standardized path coefficients is displayed in Figure 7.1. No support was found for H_{DR1}, H_{DR2} and H_{DR5} as the structural models constraining to zero the paths from TEI to achievement and academic adjustment, and from psychosocial adjustment to achievement, did not result in statistically significant decrements in model fit relative to the more complex parametric structures in which these paths were freely estimated (see Table 7.6). Interestingly, when the direct path from TEI to achievement was freely estimated, the parameter assumed a modest negative, though non-significant, value ($\gamma_{5,1} = -.07$, $p > .05$), raising the possibility of inconsistent mediation or empirical suppression in the solution (MacKinnon et al., 2000; Shrout & Bolger, 2002). This possibility is considered in detail in the discussion. Inconsistent with H_{DR10}, the direct association between engagement coping at T2 and psychosocial adaptation at T3, though in the expected direction and of the predicted magnitude, did not reach statistical significance. This may, however, point to insufficient statistical power in the test of this parameter rather than a null effect in the population.[12] Support was found for H_{DR4}, H_{DR6}, and H_{DR8} as TEI was directly and prospectively associated with higher perceived social support, the greater use of engagement coping and better mid-semester psychosocial adjustment, respectively. Further, in line with H_{DR3}, better mid-semester academic adjustment was prospectively associated with higher

[12] Results from the post-hoc evaluation of parameter bias, solution propriety and statistical power in the APP framework using Monte Carlo methods are reported in Section 7.3.5.

freshman achievement. Support was also found for H_{DR7} and H_{DR9} as higher perceived social support and the greater use of engagement coping strategies were directly associated with better mid-semester psychosocial and academic adjustment, respectively. In the final model, TEI explained 42.6% and 30.1% of the variance in perceived social support and engagement coping, respectively. The model also accounted for 29.4%, 66.3% and 14.1% of the variance in academic adjustment, psychosocial adjustment and achievement, respectively.

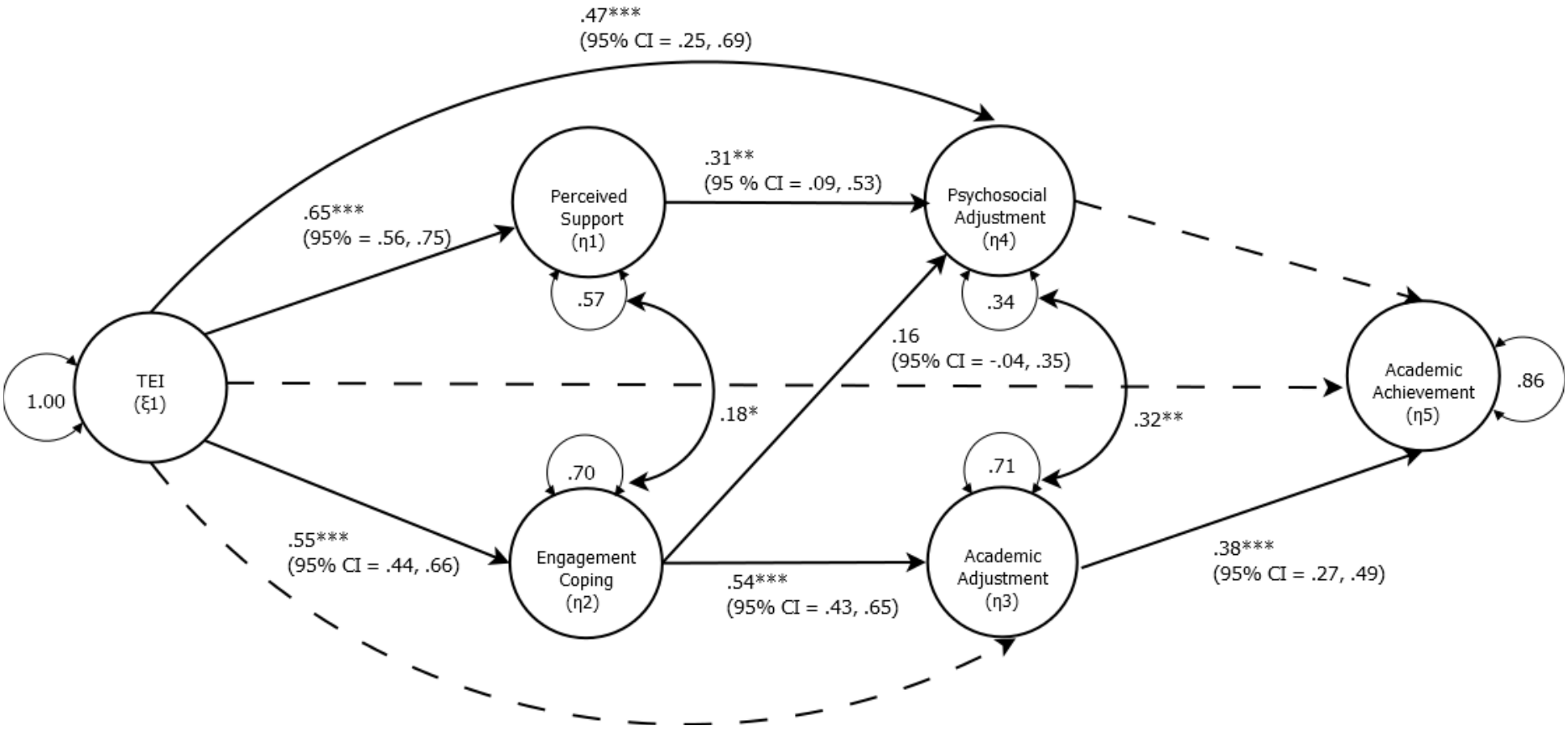

Figure 7.1. The final unconditioned structural model with standardized estimates and corresponding 95% confidence limits for the substantive structural paths. $N = 458$. The dashed lines indicate paths that were constrained to zero in the final solution. CI = confidence interval. * $p < .05$. ** $p < .01$. *** $p < .001$.

7.2.2.3 Indirect relations. Following recommendations by Perera (2013), empirical significance tests of the hypothesized indirect relations were conducted using the bootstrap procedure under NT ML estimation. Specifically, bias-corrected bootstrap standard errors and 95% confidence intervals were obtained for the point estimates of the indirect relations using 10,000 bootstrap samples. Table 7.7 shows the bootstrap estimates of the indirect associations and corresponding 95% confidence intervals. Consistent with H_{IR3}, there was a statistically significant indirect association between TEI and psychosocial adaptation via perceived social support. Approximately 27% of the total effect of TEI on psychosocial adaptation was due to this mediated relation. Support was also found for H_{IR5} as greater TEI at T1 was indirectly associated with better mid-semester academic adaptation through engagement coping. This mediated effect explained 100% of the corresponding total effect, suggesting complete mediation of the TEI-academic adaptation association. Furthermore, in line with H_{IR7}, TEI was indirectly associated with first semester achievement via engagement coping and academic adaptation linked serially in a three-path mediated sequence. In the final model, 100% of the total effect of TEI on achievement was attributable to this three-path mediated effect, indicating complete mediation of the relation.

Table 7.7

Bootstrap Estimates of the Indirect Effects and Bias-Corrected 95% Confidence Intervals

Parameter	Predictor		Mediators		Outcome	ab_{cs}	ab	BC 95% CI for mean ab[a]		P_M
								LL	*UL*	
$\gamma_{3,1}\beta_{5,3}$	TEI	→	Academic adjustment	→	Achievement	.00 [b]	0.00 [b]	–	–	–
$\gamma_{4,1}\beta_{5,4}$	TEI	→	Psychosocial adjustment	→	Achievement	.00 [b]	0.00 [b]	–	–	–
$\gamma_{1,1}\beta_{4,1}$	TEI	→	Social support	→	Psychosocial Adjustment	.21	0.69	0.21	1.33*	.27
$\gamma_{2,1}\beta_{,4,1}\beta_{5,4}$	TEI	→	Social support → Psychosocial adjustment	→	Achievement	.00[b]	0.00[b]	–	–	–
$\gamma_{2,1}\beta_{3,2}$	TEI	→	Engagement coping	→	Academic Adjustment	.30	0.28	0.19	0.38*	1.00
$\gamma_{2,1}\beta_{4,2}$	TEI	→	Engagement coping	→	Psychosocial Adjustment	.09	0.29	–0.05	0.65	.11
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	TEI	→	Engagement coping →Academic adjustment	→	Achievement	.11	0.08	0.05	0.12*	1.00
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	TEI	→	Engagement coping →Psychosocial adjustment	→	Achievement	.00[b]	0.00[b]	–	–	–

Note. $N = 458$. ab = unstandardised indirect association; ab_{cs} = completely standardised indirect association; BC = bias corrected; CI = confidence interval; *LL* = lower limit; *UL* = upper limit. [a] These values are based on unstandardized path coefficients. [b] These coefficients are equal to zero because $\beta_{5,4}$ and $\gamma_{3,1}$ were constrained to zero in the final solution, and multiplication by a zero always produces a zero. P_M = proportion mediated. * This 95% confidence interval excludes zero; therefore, the indirect relation is significant at $p < .05$.

Results from the tests of five of the eight mediated relations were inconsistent with the study hypotheses. No support was found for H_{IR6} as TEI was not significantly indirectly associated with psychosocial adaptation via engagement coping (i.e., the 95% confidence interval included zero; see Table 7.7), though the mediated effect was in the expected direction and constituted approximately 11.2% of the corresponding total effect. Additionally, inconsistent with H_{IR1}, H_{IR2}, H_{IR4}, and H_{IR8} , indirect associations involving parameters $\gamma_{3,1}$ and $\beta_{5,4}$ were equal to zero because these constituent parameters were constrained to zero in the final solution. As indirect associations were computed as the product of implicated coefficients in the present study (Perera, 2013), indirect effects involving null paths were necessarily zero by virtue of multiplication by zero, which always produces zero.

7.2.2.4 Conditioned model analysis. Covariate differences were controlled through the specification of direct paths from (a) manifest neuroticism and extraversion to latent TEI, (b) extraversion to social support, engagement coping and psychosocial adaptation, and (c) neuroticism to psychosocial adaptation and academic adaption in line with theory and prior evidence (see Chapter Four). Neuroticism and extraversion were statistically significantly associated with TEI, $\beta = -.51$, $p < .001$ and $\beta = .45$, $p < .001$, respectively. Neuroticism and extraversion were also statistically significantly associated with each other, $r = -.29$, $p < .001$. However, all five covariate paths to the substantive endogenous factors were trivial and non-significant ($p > .10$), and were thus omitted from the model in line with recommendations by T. D. Little (2013).[13]

In the conditioned model, all estimated structural parameters remained largely unchanged relative to the unconditioned model estimates after controlling for neuroticism and extraversion. TEI continued to show a statistically significant and strong direct association with perceived social support, $\gamma_{1,1cs} = .61$, $p < .001$. The magnitude of this association approximated the parameter coefficient obtained in the unconditioned analysis. After controlling for neuroticism and extraversion, TEI also remained statistically significantly associated with engagement coping, $\gamma_{2,1cs} = .50$, $p < .001$ with the parameter showing only a modest reduction in magnitude under the conditioned analysis. Furthermore, TEI remained statistically significantly associated with psychosocial adaptation after adjusting for the

[13] Direct paths from extraversion to social support ($\beta = .03$, $p > .10$), engagement coping ($\beta = -.06$, $p > .10$) and psychosocial adaptation ($\beta = .11$, $p > .10$) were not statistically significant. Direct paths from neuroticism to academic ($\beta = -.07$, $p > .10$) and psychosocial ($\beta = -.13$, $p > .10$) adaptation were also not statistically significant.

covariate differences, $\gamma_{3,1cs} = .47$, $p < .001$. This parameter was identical to that obtained in the unconditioned model solution.

All four non-zero indirect relations also remained largely unchanged in the conditioned model solution. After controlling for the potentially confounding effects of neuroticism and extraversion, the indirect association of TEI with psychosocial adjustment via perceived social support remained statistically significant and approached the magnitude of the indirect effect obtained in the unconditioned solution, $\gamma_{1,1}\beta_{4,1cs} = .20$, 95% BC CI [.08, .32]. Additionally, TEI continued to show a statistically significant indirect association with academic adaptation via engagement coping when controlling for neuroticism and extraversion, $\gamma_{2,1}\beta_{3,2cs} = .27$, 95% BC CI [.18, .36]. The conditioned effect was only marginally smaller than the coefficient found in the unconditioned solution. The three-path indirect relation of TEI with academic achievement via engagement coping and academic adjustment linked serially also remained statistically significant in the conditioned solution and approximated the unconditioned estimate, $\gamma_{2,1}\beta_{3,2}\beta_{5,3cs} = .10$, 95% BC CI [.06, .14]. Further, after adjusting for covariate differences, the non-significant mediated effect of TEI on psychosocial adjustment via engagement coping remained marginally non-significant, $\gamma_{2,1}\beta_{4,2} = .08$, 95% BC CI [–.01, .17].

7.2.3 Post-hoc APP simulation

A post-hoc Monte Carlo experiment was conducted to evaluate the propriety of the final unconditioned empirical solution, biases in the parameters estimates and standard errors obtained in the solution, coverage, and statistical power of the tests of the estimated parameters.

7.2.3.1 Imperfect samples. In the present Monte Carlo study, 994 of the 1000 sample replications of the simulated data converged to admissible solutions. Six (0.6%) replications produced inadmissible solutions due to NDP theta matrices involving the fixed, dimensional indicator of GPA. The rate of inadmissibility is well below the cut-off of 5% for grossly misspecified models with terminal model-data problems. Thus, the sample of 458 units of observation is sufficient for the final analytic model to converge to a proper solution under empirical testing as was found in the present empirical study.

7.2.3.2 Measurement model parameters. Table 7.8 shows relative parameter estimate and standard error biases, coverage and statistical power for the freely estimated factor

loadings obtained from the final unconditioned empirical solution. As mentioned in Section 7.2.4.5, bias, coverage and power values for $\lambda_{30,7}$ and $\Gamma_{5,1}$ could not be estimated because these parameters were constrained in the analytic model for model identification purposes. In general, bias in the factor loadings estimates was consistently trivial (< 5%), ranging from no bias (e.g., $\lambda_{1,1}$) to an absolute value of only 1.22% ($\Gamma_{6,1}$). Indeed, for 27 of the 30 estimated factor loadings, mean parameter estimates were within 1% of the true population values. Relative standard error biases were also uniformly trivial, with no estimates deviating more than approximately 4.5% from the population values. ML coverage rates were greater than 90% for all estimated factor loadings, indicating a good deal of precision in the confidence intervals around the mean estimates. Finally, with $N = 458$, power to reject the false H_0 that the factor loadings are not significantly different from zero was at unity for all statistical tests.

Table 7.8

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the Post-Hoc Monte Carlo Run with N = 458

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	0.00	2.29	95.4	1.00
$\lambda_{2,1}$	0.23	1.55	94.8	1.00
$\lambda_{3,1}$	0.21	0.22	95.6	1.00
$\lambda_{4,1}$	0.20	–0.22	94.4	1.00
$\lambda_{5,1}$	0.00	–1.91	94.6	1.00
$\lambda_{6,1}$	–0.20	1.36	94.6	1.00
$\lambda_{7,2}$	–0.28	–3.29	93.4	1.00
$\lambda_{8,2}$	–0.62	0.00	94.8	1.00
$\lambda_{9,2}$	–0.41	1.18	94.8	1.00
$\lambda_{10,2}$	–0.29	0.20	94.3	1.00
$\lambda_{11,2}$	–0.38	4.06	96.4	1.00
$\lambda_{12,2}$	–0.80	–0.61	94.6	1.00
$\lambda_{13,3}$	–0.28	–3.51	94.5	1.00
$\lambda_{14,3}$	–0.37	–2.25	94.9	1.00
$\lambda_{15,3}$	–0.32	–2.59	93.8	1.00
$\lambda_{16,4}$	–0.22	–0.39	94.4	1.00
$\lambda_{17,4}$	–0.47	0.19	95.1	1.00
$\lambda_{18,4}$	–0.49	0.19	95.0	1.00
$\lambda_{19,4}$	0.16	2.36	95.8	1.00
$\lambda_{20,5}$	–0.62	–1.91	94.8	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{21,5}$	–0.50	–0.19	95.1	1.00
$\lambda_{22,5}$	–0.38	–2.06	94.9	1.00
$\lambda_{28,5}$	–0.59	–0.19	95.0	1.00
$\lambda_{23,6}$	–0.74	2.24	95.4	1.00
$\lambda_{24,6}$	–0.92	1.27	96.5	1.00
$\lambda_{25,6}$	–1.12	2.45	95.4	1.00
$\lambda_{26,6}$	–0.85	4.23	95.4	1.00
$\lambda_{27,6}$	–1.17	1.15	95.5	1.00
$\lambda_{29,6}$	–0.87	3.00	95.3	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	1.22	–0.17	95.1	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model.

7.2.3.3 Structural model parameters. Table 7.9 displays relative parameter estimate and standard error biases, coverage and statistical power for the direct structural regression path estimates obtained from the final empirical solution.[14] In general, little bias was observed across the estimates of the direct structural parameters. The most discrepant mean parameter estimate was within approximately 2.0% of its population value. Relative standard error biases were also consistently trivial, ranging from –3.68 ($\beta_{4,1}$) to 4.42 ($\beta_{3,2}$). ML coverage rates were ≥ 95% for all direct structural paths, suggesting that the 95% confidence intervals around the mean parameter estimates are reliable at the present sample size (i.e., $N = 458$). Adequate statistical power was obtained for six of the seven freely estimated direct regression parameters. The statistical test of the direct path from engagement coping to psychosocial adjustment was moderately underpowered, raising the possibility of a Type II error associated with this statistical test. For the substantive direct regression paths constrained to zero in the final solution, Type I error rates were uniformly trivial (< 5%).

[14] Relative parameter estimate bias could not be computed for parameters equal to zero in the final solution. This is because division by a zero population value is an indeterminate form with no defined value. Furthermore, for parameters equal to zero in the final model, values in the π column of Tables 7.9 and 7.10 are estimates of Type 1 error associated with tests of the (true) null of no effect.

Table 7.9

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the Post-Hoc Monte Carlo Run with N = 458

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\beta_{5,3}$	0.85	–1.83	95.0	.96
$\beta_{5,4}$	–	–1.32	96.1	<.05[a]
$\gamma_{5,1}$	–	–0.78	95.9	<.05[a]
$\beta_{3,2}$	–0.24	4.42	96.8	1.00
$\gamma_{3,1}$	–	–1.86	95.2	<.05[a]
$\beta_{4,1}$	0.00	–3.68	94.7	.99
$\beta_{4,2}$	–1.99	2.40	96.0	.62
$\gamma_{4,1}$	1.55	0.99	95.4	1.00
$\gamma_{2,1}$	0.75	1.10	95.1	1.00
$\gamma_{1,1}$	1.03	–0.93	95.0	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] For parameters with population values equal to zero, this is an estimate of Type 1 error. Relative bias could not be calculated for null parameters because division by a zero always yields an indeterminate form.

7.2.3.4 Indirect relations. Relative parameter estimate and standard error biases, coverage rates and statistical power for the estimated non-zero mediated effects obtained from the final solution are shown in Table 7.10. This table also shows relative standard error bias, coverage and Type I errors for the mediated effects equal to zero in the retained mediation model. Mean parameter estimates of the indirect relations across the 1000 replications were uniformly within about 1.2% of the population parameter values. Standard error biases for the indirect effects were also well below the 10% cut-off for substantial bias. Coverage rates for both the zero and non-zero mediated effects were consistently optimal, ranging from 95% to 100%. For three of the four estimated indirect relations, statistical tests were adequately powered. Only the statistical test of the indirect association of TEI with psychosocial adaptation via engagement coping was underpowered. For the indirect effects equal to zero in the final empirical solution, Type 1 errors associated with the rejection of (true) zero indirect relations were uniformly acceptable (< .05).

Table 7.10

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Paths from the Post-Hoc Monte Carlo Run with N = 458

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	–	–.56	95.1	<.05[a]
$\gamma_{4,1}\beta_{5,4}$	–	–2.19	98.1	<.05[a]
$\gamma_{1,1}\beta_{4,1}$	0.59	–3.76	94.8	.99
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–	0.00	96.8	<.05[a]
$\gamma_{2,1}\beta_{3,2}$	0.37	2.45	95.4	1.00
$\gamma_{2,1}\beta_{4,2}$	–1.18	2.15	95.6	.62
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	0.54	–0.56	95.1	.95
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–	–0.61	99.6	<.01[a]

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] For parameters with population values equal to zero, this is an estimate of Type 1 error. Relative bias could not be calculated for null parameters because division by a zero always yields an indeterminate form.

7.2.4 Subsidiary Results: The Dimensionality of University Adjustment

For the test of the hierarchical, multidimensional structure of university adjustment proposed in Chapter Three, the structure of adaptation found in the final eight-factor measurement solution served as the initial parametric structure. As mentioned in Section 7.2.4.5, the higher-order factor loadings and disturbance variances associated with the first-order factors were constrained to their standardized values obtained from the final eight-factor measurement model to generate an over-identified and thus testable model. Additionally, start values, taken as the final parameter estimates from the eight-factor measurement solution, were provided for the freely-estimated parameters to optimize the estimation process.

The test of this multidimensional, second-order measurement structure resulted in an acceptable fit to the sample data, MLR $\chi 2$ (75, N = 341) = 210.25, $p < .001$, RMSEA = .07 (90% CI = .06, .08), CFI = .93, SRMR = .06. Figure 7.2 shows the second-order measurement model with standardized estimates. All 14 freely estimated lower-order factor loadings were uniformly moderate-to-strong (λs = .52 – .85) and statistically significant. Notably, these factor loading estimates were virtually identical to those obtained in the final eight-factor measurement solution. Furthermore, in line with the present conceptualization of

university adjustment, the psychosocial and academic adaptation factors were strongly associated.

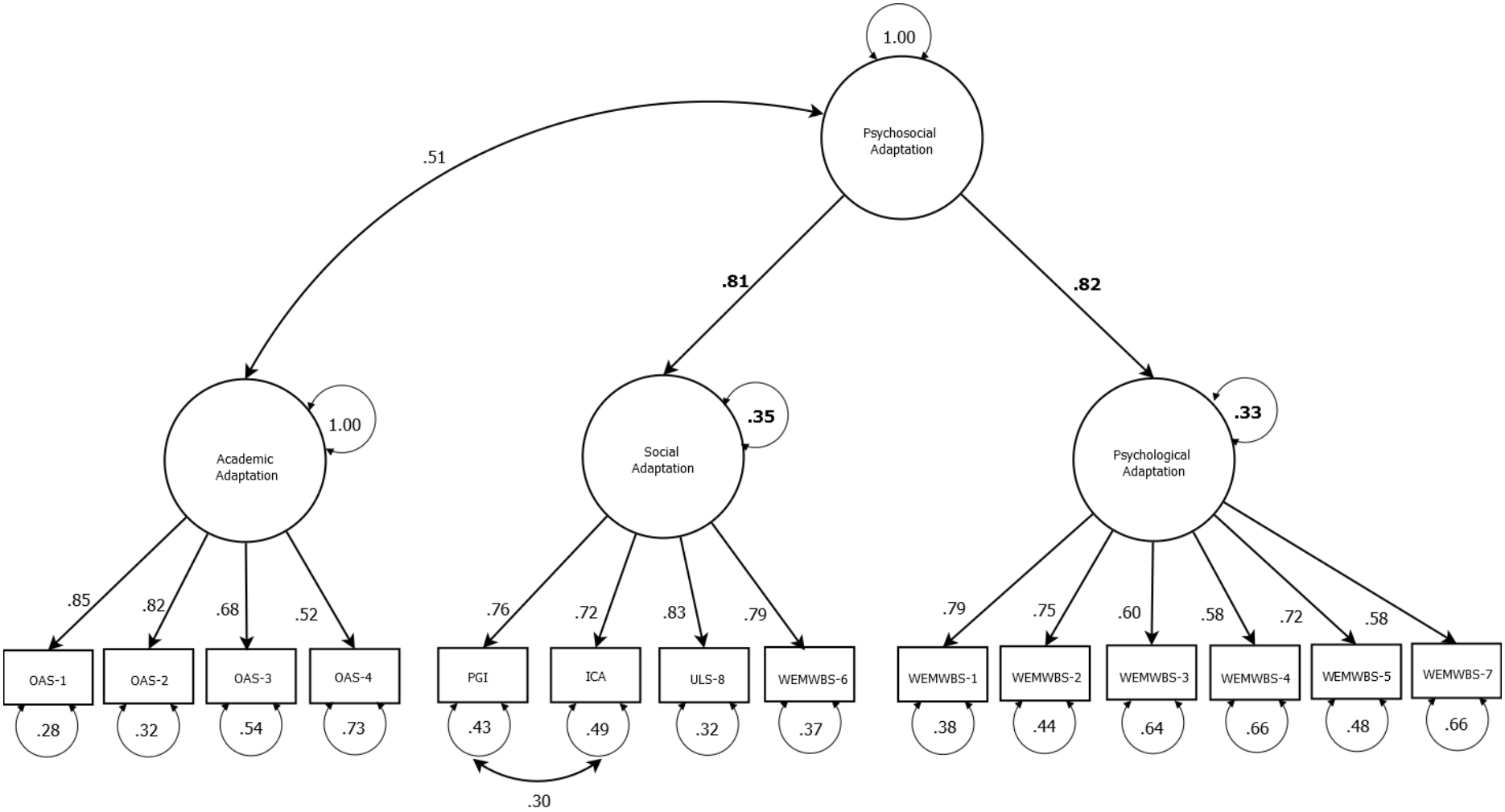

Figure 7.2. The hierarchical, multidimensional structure of university adjustment with standardized estimates. $N = 341$. Values in bold were fixed in the solution to generate an over-identified model. The freely estimated factor loadings, error covariance and factor correlation are significant at $p < .001$.

7.3 Discussion of Results

Despite considerable interest in the role of TEI in achievement and adaptation in educational settings, research on the pathways through which TEI is associated with better educational adjustment and achievement is underdeveloped. The current study represents the first systematic attempt to investigate both the direct and indirect associations of TEI with adaptation and achievement. Specifically, a target multistage mediation model and theoretically-plausible alternative structures linking TEI, perceived social support, engagement coping, adjustment and achievement were specified and tested in the context of a major educational stressor, namely the university transition. The target model is one in which higher TEI is posited to predict better first semester achievement during the university transition both directly and indirectly via (a) perceived social support and engagement coping and (b) academic and psychosocial adaptation linked serially in a temporal chain of unfolding events. This multistage model extends the meta-analytic review reported in Chapter Five by elucidating the processes that constitute the total effect of TEI on achievement. More broadly, the mediating processes implied in the model extend the existing literature by illuminating the psychosocial pathways through which distal affective traits promote better adaptation and achievement during a stressful event. In totality, the hypotheses implied by the integrative target model were partially supported by the sample data, with some unexpected findings, as reflected in the retention of an alternative parametric structure. In the following sections, the results bearing on the direct and indirect relations are discussed with respect to extant theory and empirical evidence.

7.3.1 Direct Relations of TEI

Perhaps the most noteworthy finding in the present study involved the direct relationship between TEI and achievement. Contrary to H_{DR1}, an alternative parametric structure was supported in which the direct path from TEI to achievement was constrained to zero. This restricted solution did not result in a statistically significant degradation in fit relative to the more complex model in which the direct relation was freely estimated. Even though the more constrained model provided a better, more parsimonious, fit to the data and was thus retained, it is interesting to note that, when the direct path from TEI to achievement was freely estimated, the parameter assumed a trivial, negative and statistically non-significant value. This anomalous finding can be explained in at least two ways.

First, taken with the statistically significant and positive indirect association of TEI with achievement via engagement coping and academic adaptation linked serially, this result constitutes weak evidence of inconsistent mediation (cf., MacKinnon et al., 2000). Inconsistent mediation refers to a type of suppressor effect in which a direct association and an indirect association in the same mediational structure have opposite signs. Take, for instance, a simple mediation model specifying associations among students' intelligence (*X*), level of classroom boredom (*M*) and performance on a math task (*Y*) (see McFatter, 1979 and Shrout & Bolger, 2002 for comparable hypothetical examples; see Braithwaite, Selby, & Fincham, 2011 for an empirical example). All else being equal, it may be argued on conceptual grounds that students with higher intelligence would perform better on the math task than their lower ability counterparts. Yet, the more intelligent students may also show higher levels of classroom boredom, and boredom, in turn, would be associated with poorer performance. If the mediated effect is taken as the product of the $X \rightarrow M$ and $M \rightarrow Y$ path coefficients in line with current recommendations (Perera, 2013), it is clear that the direct effect (+) and mediated effect (–) have opposite signs. In combination, these two effects may counteract each other, leading to a total effect that is equal to zero. Even where the opposing direct and indirect relations do not perfectly cancel each other out (i.e., $c \neq 0$), these paths of opposite signs may result in a near-zero, non-significant, total effect (MacKinnon et al., 2000). In both cases, the total effect of *X* on *Y* may obscure the complexity of the underlying 'causal' relations between the constructs.

The pattern of direct, indirect and total effects involving TEI and achievement is suggestive of the presence of inconsistent mediation. The total effect of TEI on achievement, obtained from the final measurement (or structurally saturated) solution, was small and non-significant (see Table 7.5). When freely estimating the direct path from TEI to achievement, the path assumed a negative, though trivial and non-significant, value. On the contrary, the non-zero indirect path from TEI to achievement via engagement coping and academic adaptation linked serially was statistically significant and positive, exceeding the value of total effect in absolute magnitude. This pattern of relations is suggestive of the presence of inconsistent mediation (MacKinnon et al, 2000; Shrout & Bolger, 2002). Specifically, the findings raise the possibility that, after accounting for the "positive effect" of TEI via the mediational pathway (i.e., via engagement coping and academic adaptation linked serially), all that remains is the "negative impact" of TEI on achievement manifested in the direct path.

This constitutes a novel line of theorizing concerning the divergent effects of TEI on achievement. Accounting for the effect of self-regulatory TEI dispositions via the mediational mechanism, it may be that sociability traits (e.g., a prosocial orientation and tendencies toward the development and maintenance of social bonds) increase novel social opportunities and social stressors (e.g., helping others to manage problems), which may impede academic achievement (Chamorro-Premuzic & Furnham, 2003; De Raad & Schouwenburg, 1996). An empirical test of this complex theoretical position would require an examination of TEI at lower levels of conceptual aggregation in which self-regulatory dispositional traits, such as optimism, self-control, self-motivation and emotion regulation, are distinguished from the sociability traits (Perera & DiGiacomo, 2013). Such a test may lead to a more refined understanding of the role of TEI in academic achievement. It should be noted, however, that the findings discussed constitute only weak evidence of inconsistent mediation. This is because, when freely estimated, the direct path from TEI to achievement, though negative, was near-zero and statistically non-significant (Shrout & Bolger, 2002). Indeed, in the final, most parsimonious, solution supported in the study, this direct path was constrained to zero with no substantive impact on model fit or the parameter estimates. This raises the possibility of the presence of empirical suppression, which is considered next.

Although the foregoing account provides a compelling theoretical explanation for the presence of inconsistent mediation, the author cannot rule out the possibility that, when freely estimated, the modest, negative structural coefficient for the direct path from TEI to achievement is a statistical artifact generated by spurious or empirical suppression. Empirical suppression refers to a spurious suppression effect in which a direct effect in a mediational structure, with a zero population value ($c' = 0$), takes on a non-zero, but typically small and non-significant, value that is of the opposite sign to the mediated effect, when holding constant the mediator, due to sampling variability alone (Shrout & Bolger, 2002). This is not true statistical suppression as in the case in inconsistent mediation (MacKinnon et al., 2000). Empirical suppression is posited to occur when a third variable completely mediates the association between a predictor and outcome. In a Monte Carlo experiment addressing this spurious form of suppression, Shrout and Bolger (2002) found that, when a population process in which a positive mediated effect was specified to completely account for the total causal effect (i.e., $c' = 0$), the sample estimate of the direct effect assumed a negative value approximately 50% of the time. The simulation results suggest that, given complete mediation of an *X* to *Y* relation, empirical suppression involving c' is expected to occur about

half of the time. Thus, it is possible that, when freely estimated, the trivial, negative structural coefficient for $\gamma_{5,1}$ is an empirical artifact generated by a mediational model with a hypothesized mechanism that fully mediated the relation of TEI with achievement. This possibility is supported by the observation that the direct path was near-zero and non-significant when freely estimated (Shrout & Bolger, 2002).

A second unexpected finding is that TEI did not directly predict academic adaptation. Although no studies have hitherto investigated this link, conceptually it seems plausible that TEI would support the effort and engagement that is required to function optimally in the academic environment. Inconsistent with H_{DR2}, however, in the structural equations analyses, an alternative model was supported in which the direct path from TEI to academic adaptation was constrained to zero. This, more parsimonious, parametric structure did not result in a statistically significant degradation in fit relative to the more complex model in which the association was freely estimated. One explanation for this null finding is that the positive mediated relation of TEI with academic adaptation via engagement coping completely accounted for the corresponding total effect, rendering null the direct path from TEI to academic adjustment and, by implication, the two-path mediated effect of TEI on achievement via academic adaptation. This possibility is considered further in the discussion of indirect effects below.

A second explanation for this null finding is that lower-order TEI dispositions, though strongly related, have differential effects on academic adjustment. Self-regulatory affective-motivational traits, such as an optimistic disposition, self-control and self-motivation, are expected to promote better academic adjustment to the university transition. Theoretically, from the perspective of expectancy-value models of behavioral self-regulation, TEI may foster academic adaptation because an optimistic disposition could lead to increased engagement and sustained effort to meet educational demands (Perera & McIlveen, 2014; Scheier et al., 1994). Further, in line with psychobiological models of human regulation, it may be that self-motivation dispositions, such as perseverance and an achievement orientation, which are believed to be grounded in biologically-based attentional systems of regulation, enhance the individual's ability to engage in and focus on academic tasks even under stressful conditions (Derryberry et al., 2003). Additionally, self-control dispositions among high TEI individuals, which may also be grounded in attentional systems, could offset the negative influence of proximal, externally-elicited-motives on behavior, thereby

sustaining academic goal approach even under exposure to university stressors (Fishbach & Shah, 2006; Fujita, 2011). On the contrary, sociability dispositions, such as a prosocial orientation and tendencies toward the development and maintenance of social bonds, may interfere with successful academic adaptation, leading the individual to socialize and pursue other social activities instead of attending to academic work and pursuing academic goals (De Raad & Schouwenburg, 1996; Poropat, 2009). This effect may be compounded by a lower level of academic structure and increased novel social opportunities characterizing the novel university environment (Credé & Niehorster, 2012; Petruzzello & Motl, 2006). In effect, such differential relations may have cancelled each other out at the global TEI level in the present study, leading to a null direct path. As is the case with the TEI-achievement relationship, the high bandwidth of the global TEI construct may have obfuscated the possibly divergent predictive effects of lower-level TEI dispositions.

The present study yielded evidence in support of the theoretical propositions concerning the direct relations of TEI with perceived social support and engagement coping. In the current study, students high on TEI were more likely than their low TEI counterparts to perceive greater social support and use engagement coping strategies to manage university stressors. The former finding can be attributed to dispositional expression and perception among those high on TEI, which sustains the flow of emotion-based information between social partners in ways that enhance the organism's ability to identify, develop and maintain supportive social relationships (Shiota et al., 2004). In addition, for high TEI students, an optimistic disposition may be attractive for social partners, initially promoting integration into new social networks, which provide sources of support (Carver et al., 1994). The latter result is consistent with both expectancy-value and psychobiological models of emotion and regulation. From an expectancy-value perspective, for those high on TEI, it may be that an optimistic disposition promotes the greater use of engagement strategies, such as active coping and planning, because generalized positive expectancies for eventual success lead to greater engagement and increased effort to overcome adversity (Carver et al., 2010; Nes & Segerstrom, 2006). From a psychobiological perspective, it may be that appetitive and attentional systems, which are presumed to underlie traits, such as positive emotionality, perseverance, determination, low-impulsivity and an achievement orientation, captured in the TEI content domain, provide a framework for the selection and regulation of engagement coping efforts under stress to meet environmental demands (Connor-Smith & Flachsbart, 2007; Derryberry et al., 2003). These results replicate previous work reporting direct

associations of TEI with perceived social support (Kong et al., 2012a, 2012b; Koydemir et al., 2013) and engagement coping (Davis & Humphrey, 2012; Petrides, Pita et al., 2007).

The data obtained in the present study are also consistent with the view that TEI promotes better psychosocial adaptation. This replicates previous work showing that TEI is directly associated with better psychosocial functioning (Frederickson et al., 2012; K. J. Gardner & Qualter, 2010; Martins et al., 2010). This finding has been attributed to the moderating role of TEI in the link between stress and distress. It may be that TEI moderates pathogenic biological responses and minimizes susceptibility to mood deterioration under stressful conditions, such as the university transition (Mikolajczak et al., 2009). The result may also be explained from the perspective of the social-functional account of emotions and expectancy-value models of behavioral self-regulation. From the former perspective, greater dispositional emotion expressivity and perception among high TEI individuals may help to sustain the flow of emotion-based communication between conspecifics, leading to more situationally-appropriate and socially-concordant behavioral responses that may enhance social interactions (Keltner & Kring, 1998). From the latter perspective, for individuals high on TEI, generalized favorable expectancies for behavioral discrepancy reduction between valued goals and current attainment may minimize defeat-related negative affect, thereby maintaining psychological well-being (Carver & Scheier, 1985; 1998; Segerstrom et al., 1998).

In addition to replicating past work reporting direct associations of TEI with perceived social support, engagement coping and psychosocial adjustment, these results extend previous findings by tentatively demonstrating the directionality of the relations. Much of the previous work investigating these links has been based on cross-sectional data. For example, in two recent investigations of the relationships of TEI with social support and psychosocial adjustment in samples of Chinese students and community volunteers, Kong et al. (2012a, 2012b) obtained positive directed regression paths of similar magnitude to the estimates reported in the present study. In both studies, measures of the putative cause, mediator and outcomes were simultaneously administered; yet, from the resultant data, the authors inferred the directionality of the relations. Inferences regarding the direct effects of TEI on engagement coping strategies have also been based on cross-sectional data (Mavroveli, Petrides, Rieffe, & Bakker, 2007; Petrides, Pérez-González et al., 2007). Conclusions

regarding the directionality of associations cannot, however, be drawn from cross-sectional data.

The interpretation of associations as indicative of directional effects assumes, as a minimum, temporal precedence. Temporal precedence can be demonstrated when a putative cause precedes a putative outcome in the passage of time (Kline, 2012). In behavioral and social sciences research, this is typically achieved by imposing time lags between the measurement of a cause and an effect (Gollob & Reichardt, 1987; Little et al., 2007). In the present study, temporal precedence was established through the measurement of the predictor, proximal mediators, distal mediators, and outcome at four distinct time points in line with the effect priority implied by the target mediation model. The timing of the measurement waves was designed to capture the processes of students' network development and stress and coping, ensuring that students had ample time to develop relationships, encounter normative university transition stressors and cope with these stressors towards adjusting (Brooks & DuBois, 1995; Cutrona, 1982; Halamandaris & Power, 1997). This demonstration of temporal precedence in the present study tentatively supports the directional interpretation of the relations observed and the underlying population processes proposed. The author urges caution, however, in drawing strong inferences about directionality from these data because the research design did not control for prior levels of the endogenous mediators, which would constitute stronger evidence of directional and even causal connections (Cole & Maxwell, 2003; Lyubomirsky et al., 2005; Maxwell & Cole, 2007). This shortcoming is considered in detail in the discussion of limitations below.

Although the failure to control for initial levels of the endogenous factors limits inferences of directionality and causality, inferences regarding the true direct associations of TEI with perceived social support, engagement coping and psychosocial adjustment are strengthened by the statistical control for known confounders and the post-hoc Monte Carlo results. In the present study, conditioned model analysis revealed that these direct links were robust when controlling for neuroticism and extraversion. These findings rule out the possibility that the results obtained were merely due to individual differences in extraversion and neuroticism and add to the growing body of literature showing that TEI contributes some incremental variance to the prediction of diverse substantive outcomes over and above the personality supertraits (Kluemper, 2008; Parker et al, 2011; Petrides, Pérez-González et al., 2007). Furthermore, post-hoc Monte Carlo analyses within the APP framework revealed that the

parameter estimates and standard errors obtained for these relations in the final model solution were unbiased, and the statistical tests of these directed regression paths were adequately powered. Taken together, these results point to the tenability of the population processes implied by these direct paths in the model.

7.3.2 Mediational Mechanisms

In addition to examining the direct relations of TEI with the mediators and outcome, several indirect associations were investigated. In the present study, empirical significance tests of mediation were conducted using the bootstrap resampling procedure. This non-parametric approach to estimating and testing mediated relations was preferred to traditional approaches to conducting mediation analysis, such as the product of coefficients strategies and the causal steps approach, for the following two reasons: (a) the bootstrap procedure does not assume that the indirect effect is normally distributed, as is the case with the product of coefficients procedures, yielding greater statistical power to detect true mediated effects (Perera, 2013; Preacher & Hayes, 2004; Preacher et al., 2007); (b) unlike the causal steps approach, under the bootstrap procedure, the absence of a total effect of *X* on *Y*, as was found in the present data, does not preclude examining indirect associations because the resampling technique operationalizes the mediated effect as the product of implicated path coefficients (Hayes, 2009; MacKinnon et al., 2002; Rucker et al., 2011; Shrout & Bolger, 2002; Zhao, Lynch, & Chen, 2010). This property of the bootstrap approach was particularly beneficial in the present investigation.

The present research contributes to the small, but promising, body of literature examining mediators of the association between TEI and adaptation (e.g., Downey et al., 2010; Kong & Zhao, 2013; Kong et al., 2012a, 2012b; Koydemir et al., 2013; Liu, Wang, & Lü, 2013). Mediational analyses yielded a statistically significant indirect association of TEI with psychosocial adjustment via perceived social support, which constituted approximately 27% of the corresponding total effect. The mediating mechanism is consistent with several existing conceptual models of university adaptation in which perceived social support has been found to carry the effects of distal trait determinants to adaptation (Aspinwall & Taylor, 1992; Brissette et al., 2002). Notably, the finding of this mediated relation also replicates recent data indicating that perceived social support constitutes a means through which TEI is associated with better psychosocial adaptation (Kong et al., 2012a, 2012b). Consistent with the stress-buffering account of social support (S. Cohen et al., 2000), one reason for this

mediated effect may be that the greater availability of interpersonal provisions perceived by students high on TEI attenuated or diminished strong threat appraisals of university transition stressors, thereby not only inhibiting or dampening pathogenic behavioral and neuroendocrine responses to stress that undermine psychological adaptation but also promoting greater involvement in the social environment (S. Cohen & Willis, 1985). A second way in which perceived social provisions may have fostered psychosocial adaptation among high TEI students is by satisfying desired or expected levels of social relationships (Perlman & Peplau, 1981, 1982). This function of social support may have protected against the experience of loneliness and resulted in greater relationship satisfaction during the university transition.

In addition to the mediating pathway via perceived social support, the indirect pathways through engagement coping are informative. A statistically significant indirect link was observed between TEI and academic adjustment via engagement coping. This indirect effect accounted for 100% of the total effect of TEI on academic adaptation. The finding that the use of engagement coping strategies mediated the relation between TEI and better academic adjustment accords with evidence indicating that active attempts to control, change, resolve or adapt to university transition stressors play an important role in adjusting to novel academic environments (Aspinwall & Taylor, 1992; Leong et al., 1997; Tao et al., 2000). The result also extends the existing TEI literature by demonstrating, for the first time, that engagement coping represents an intermediary mechanism through which TEI is linked with better adaptation to educational transitions. Consistent with expectancy-value and psychobiological models of human regulation, it may be that engagement coping reflects increased cognitive and behavioral efforts to attain high-priority academic goals mobilized and maintained by TEI dispositions (e.g., optimism, perseverance) in a causal chain of events when confronting adversity (Carver et al., 2010; Connor-Smith & Flachsbart, 2007; Davis & Humphrey, 2012; Derryberry et al., 2003). This explanation is also in accord with the theoretical view that coping reflects personality in action under stress given relevant situational contingencies (Bolger, 1990).

Although all of the total effect of TEI on academic adaptation was attributable to the mediational pathway via engagement coping in the final model solution, inferences regarding complete mediation may be limited by the study design. In statistical mediation analysis, complete mediation is indicated when an indirect association is equal to the total effect of *X*

on *Y* (Shrout & Bolger, 2002). Assuming sufficient statistical power and no major model misspecifications, findings of full mediation may be taken as evidence that all possible intervening pathways have been included in the model. In the final model obtained in the present study, the ratio of the indirect association of TEI with academic adjustment via engagement coping to the total effect was 1.00. This proportion of the total effect mediated indicates that the data are consistent with a completely mediated process (Preacher & Kelley, 2011). Theoretically, in the context of the university transition, complete mediation of the TEI-academic adaptation link via engagement coping may be plausible. It may be that the mobilization of effort and regulation of behavior to meet academic demands, motivated by TEI dispositions, are psychologically manifested as engagement coping strategies when confronting adversity (Bolger, 1990; Zeidner et al., 2012). However, given the possibility of differential direct effects of TEI dispositions (e.g., self-motivation vs. sociability traits) on academic adjustment raised above, some caution is urged in the inference of complete mediation from these data. Systematic empirical efforts to delineate any differential direct relations of TEI dispositions with academic adaptation will likely clarify the extent of mediation of the link via engagement coping.

In the current study, engagement coping did not statistically significantly mediate the link between TEI and psychosocial adjustment. This may seem surprising as a few prior studies have obtained evidence of a positive indirect link between comparable distal affective traits and psychosocial adaptation via engagement coping efforts (Aspinwall & Taylor, 1992; Brissette et al., 2002; Perera & McIlveen, 2014). Furthermore, conceptually, it seems plausible that engaging in efforts to control, change, resolve or reframe stressors, motivated by TEI, would enhance well-being when confronting adversity. For instance, by fostering approach to goals and rewards and the engagement of attention when confronting adversity, TEI may guide the use of primary-control coping efforts, reflecting approach-oriented responses directed at the stressor, toward sustaining goal-directed behavior and promoting approach-related well-being as the individual moves towards the desired goal (Carver & Scheier, 1998; Carver & White, 1994; Davidson et al., 2000). Additionally, secondary-control engagement strategies, such as cognitive reappraisal, which may also be triggered by TEI under stress, could protect the individual from the pathogenic effects of acute transition stressors by modulating psychobiological responses to stressors initially appraised as threatening (S. E. Taylor & Stanton, 2007). In the two-path mediated sequence in which engagement coping was predicted to intervene in the TEI-psychosocial adaptation link,

although TEI facilitated the use of engagement coping, the engagement efforts did not, in turn, appreciably transmit this effect to psychosocial adjustment. There are at least two plausible explanations for this finding that are discussed below.

One explanation for the absence of a statistically significant association between engagement coping and psychosocial adaptation, which resulted in a weak and non-significant mediated effect of TEI, may be that the direct link depends on more complex personal and situational contingencies. One such personal contingency is the perceived controllability of specific transition stressors. For example, it may be that engagement efforts are more adaptive for perceived high-control academic stressors (e.g., managing academic workloads and time pressure). On the contrary, lower-control socio-emotional challenges, such as changes in relations with friends and interpersonal strains, may require the use of more passive strategies (e.g., restraint) at least in the short-term (Park, Armeli, & Tennen, 2004; Suls & Fletcher, 1985). This explanation corresponds to the coping goodness of fit hypothesis, which holds that (a) the effectiveness of coping strategies is moderated by controllability appraisals of the stressful events and (b) better appraisal-coping fit leads to better adaptation (Folkman & Moskowitz, 2004; Park et al., 2004). To the extent that university transition stressors are perceived as both high and low control, engagement coping efforts may have only limited utility. Furthermore, the modeling of engagement coping at the highest level of conceptual aggregation (Connor-Smith et al., 2000; Connor-Smith & Flachsbart, 2007), and the failure to assess coping responses for distinct transition stressors, may have masked specific relations of discrete engagement efforts (e.g., active coping vs. cognitive restructuring) with adaptation. Future investigators seeking to achieve a more refined understanding of the ways in which engagement strategies carry the effects of TEI to psychosocial adaptation might profitably examine distinct engagement coping efforts across a range of discrete transition stressors (e.g., making friends, interpersonal strains, novel academic coursework, time pressure, financial responsibilities) with measures of perceived stressor controllability.

The absence of a statistically significant association between engagement coping and psychosocial adjustment may also reflect the possibility that the path is not fully independent of the contribution of perceived social support. In the present model, the direct path from perceived social support to psychosocial adjustment was specified as operating independently of students' engagement coping efforts. It is, however, possible that perceptions of the

availability of interpersonal provisions and engagement coping strategies reflect overlapping resources for managing stressful events (Parkes, 1986; Thoits, 1986, 1995). For example, in line with stress-buffering models of social support (S. Cohen et al., 2000), perceptions of a supportive social network may broaden the repertoire of potential coping strategies to include instrumental, informational and emotional support in managing stressful events (Brissette et al., 2002; S. Cohen & Willis, 1985). A second possibility reflects a mediated pathway in which perceptions of the availability of social support facilitate the use of engagement strategies to manage stressors by leading to more benign appraisals of stressful events and, by extension, enhancing the individual's perceived ability to control, change or resolve stressors (S. Cohen et al., 2000; S. Cohen & Syme, 1985; Pierce, Sarason, & Sarason, 1996). Indeed, in one study of the relation of social support and coping to adaptation, Holland and Holahan (2003) found that engagement coping efforts (e.g., positive reappraisal, planful problem-solving) partially mediated the link between perceptions of the availability of social support and psychological adaptation to breast cancer in a sample of Stage I and II patients.

Consistent with these suppositions and evidence, the present data indicate that perceived social support was strongly associated with engagement coping ($r = .47$, $p < .001$). Furthermore, in a re-analysis of the sample data, excluding perceived support from the structural equations, the direct path from engagement coping to psychosocial adjustment was found to be statistically significant and approximately 31% stronger than the structural coefficient obtained in the analysis including perceived support ($\beta_{4,2cs} = .21$, $p < .05$). This finding accords with recent data on university students indicating that there are links between social support and engagement coping in their effects on psychosocial adaptation (Brissette et al., 2002). In the current study, the inclusion of both constructs with related paths to psychosocial adaptation may have resulted in the weak and statistically underpowered parameter for the association of engagement coping with psychosocial adaptation. Although the present data show that engagement coping was strongly related to perceived support, the simultaneous measurement of the constructs in the research design precludes inferences regarding the direction of the association in the temporal chain of events. Future investigators are encouraged to empirically test these suppositions to better understand the temporal ordering of social support and coping in the adaptation process.

The present study also extends the TEI literature by illuminating key adaptation processes that mediate the link between distal affective-motivational traits and achievement. Although

past studies have found that TEI predicts better adaptation and achievement during stressful events (Austin, Evans et al., 2005; Mikolajczak et al., 2006; Parker, Summerfeldt et al., 2004; Perera & DiGiacomo, 2013), no studies have examined the temporal ordering of TEI, adaptation and achievement. In the present study, students high on TEI performed better academically than their low TEI counterparts. Mediational analyses indicated that the greater use of engagement coping efforts and, in turn, better academic adjustment associated with higher TEI played a key role in explaining the link between TEI and first semester achievement. This pathway was statistically manifested as a significant indirect association between higher TEI and better achievement via engagement coping and academic adaptation linked serially in a three-path mediated sequence. The indirect effect accounted for 100% of the corresponding total effect in the final model, suggesting complete meditation of the TEI-achievement relation via this adaptation process. The finding replicates previous work indicating that successful adaptation to the academic environment of university is associated with better achievement (Credé & Niehorster, 2012; Petersen et al., 2009). The finding also extends the meta-analytic results reported in Chapter Five (see also Perera & DiGiacomo, 2013) and previous studies reporting total effects of TEI on achievement (e.g., Ferrando et al., 2011; Sanchez-Ruiz, Mavroveli, & Poullis, 2013), by empirically elucidating one of the pathways through which TEI is associated with achievement. The magnitude of the indirect association is remarkable given that it was computed as the product of three path coefficients (A. B. Taylor et al., 2008; Thoemmes et al., 2010).

This three-path mediated effect obtained in the study is consistent with the interpretation that the way in which TEI promoted higher first-semester achievement is by leading students to use more engagement strategies to cope with transition stressors, which, in turn, fostered better adjustment to the academic environment. In line with expectancy-value and psychobiological accounts of emotion and regulation (Carver & Scheier, 1981, 1990b, 1998; Davidson et al., 2000; Derryberry et al., 2003), it may be that this pathway from TEI to achievement reflects a multistage process of increased engagement and effort to attain valued academic goals triggered by positive expectancies and the activation of appetitive and attentional systems presumed to underlie the TEI. When confronting adversity, this goal or reward driven activation of behavior may be psychologically manifested as engagement coping efforts as the individual attempts to manage academic stressors towards optimal academic functioning characterized by sustained attention to and organization of study activities and academic goal commitment. This behavioral engagement in efforts to meet the

academic demands of the novel environment, reflected in positive academic adaption, may in turn promote better achievement as the individual moves appreciably closer to the desired academic goal. In the present study, this multistage process of adaptation played out along the timeline of the unfolding university transition, activating and regulating engagement and effort in the service of attaining achievement goals. Future investigators are encouraged to examine whether this three-path mediated effect generalizes to other populations experiencing comparable educational transitions, such as students transitioning to high school, graduate school or vocational education settings, or to novel performance settings in which adaptation to the structural features of the environment would seem a plausible precursor to performance attainment (e.g., starting a new job).

In the current study, the two-and-three-path indirect effects involving the direct relation between psychosocial adjustment and achievement were equal to zero by virtue of this null direct path in the final model solution (i.e., $\beta_{5,4} = 0$). The finding of a null direct path from psychosocial adjustment to achievement is inconsistent with a few studies that have acquired evidence for a positive link (B. Andrews & Wilding, 2004; Credé & Niehorster, 2012; DeBerard et al., 2004; Napoli & Wortman, 1998). The result is also incompatible with the present theoretical position that psychosocial adaptation to the university transition facilitates achievement. Conceptually, it appears plausible that being psychosocially well-adjusted would support the regulation of attention and behavior necessary to perform academically. For instance, from a broaden-and-build perspective, the experience of positive affect may promote achievement by broadening the repertoire of methods for problems solving, building existing knowledge bases and integrating information from multiple sources (Fredrickson, 1998, 2001; Valiente et al., 2012). From a psychobiological account of emotion and motivation, the experience of well-being may also facilitate approach-related activities towards the attainment of achievement goals (Davidson et al., 2000). Additionally, for students with low negative affect, which is also a component of psychosocial adaptation, achievement when confronting adversity may be optimized because they are less likely to (a) retreat into a self-protective stance, (b) inhibit goal-directed behavior and (c) focus on the source of unpleasant affect that may hinder learning (Valiente et al., 2012).

One explanation for this null finding may be that the influence of psychosocial adjustment was not specific to psychosocial adjustment but shared with academic adjustment. In the present study, academic adjustment is conceptualized as involving, in part, the extent of

students' attention to academic activities (Astin, 1999; Kim et al., 2010; Perera & McIlveen, 2014), which may promote achievement. Psychosocial adjustment also includes dimensions of attention from both hedonic (e.g., affect balance) and eudaimonic (e.g., thinking clearly) perspectives that may also foster performance (Lent, 2004; Stewart-Brown & Janmohamed, 2008; Valiente et al., 2012). It may be that the positive contribution of psychosocial adjustment to achievement was not completely independent of the effect of academic adjustment, leading to the attenuation of the effect of psychosocial adjustment. One possibility is a mediated pathway in which the experience of affective balance (e.g., absence of negative affect) and thinking clearly foster greater attention to academic activities, which, in turn, leads to better achievement. The present study design, including the concurrent measurement of academic and psychological adjustment, does not enable drawing inferences about the direction of relationship between these adaptation constructs and, by implication, the possibility of the mediated effect. Future studies are encouraged to reconsider the temporal ordering of the adaptation construct during the transition to university.

Additionally, any remaining positive relation of psychological adjustment, after accounting for academic adjustment, may have been further attenuated at the second-order level due to potential opposing effects of social adjustment. In line with the present conceptualization of university adaptation, a second-order psychosocial adjustment factor was predicted to underlie the lower-order social and psychological adjustment constructs, reflecting generalized positive socio-emotional functioning (see Chapter Three). Social adjustment refers to positive interpersonal adaptation including involvement with university activity, perceptions of satisfying peer-group relations and low loneliness (Astin, 1999; Kim et al., 2010; Tinto, 1993). Psychological adjustment probes for positive psychological functioning characterized by satisfaction with life, affective balance, self-actualization, meaning, purpose and growth (Diener et al., 1999; Lent, 2004; Ryff, 1989). Although there is considerable conceptual overlap between the constructs, and they share much empirical variance, there may be key differences in the phenomenology of these adjustment dimensions that have differential implications for achievement. Psychological adjustment is centrally concerned with cognitive and affective responses to the novel environment (Lent, 2004). Thus, in psychological adjustment, an individual's degree of adaption in evaluated somewhat apart from his or her behavioral engagement with the environment. In social adjustment, although there are cognitive (i.e., perception of satisfying relations) and affective (i.e., loneliness) dimensions (Tinto, 1993), a core object of concern is the extent of one's physical

involvement in the social environment of university (Astin, 1999; Kim et al., 2010). Thus, adaptation is evaluated, at least in part, as the degree to which the individual is behaviorally engaged with the social context.

To the extent that behavioral involvement in social activities interferes with academic tasks, any effect of social adjustment on achievement may be at odds with the potentially beneficial effect of psychological adjustment. It may be that greater social involvement in the university environment hinders achievement by (a) increasing exposure to social stressors that interfere with academic engagement and/or (b) simply reducing the amount of time spent on academic work. Indeed, a handful of studies have obtained evidence for a negative link between social adjustment and achievement (e.g., Baker & Siryk, 1984; Grayson, 1997; McKenzie & Schweitzer, 2001). Particularly noteworthy are the findings of Grayson (1997) showing that involvement in highly-regulated social environments (e.g., tutorials) positively predicts achievement whereas less-restricted involvement, such as participation in campus social events or social club activities, is negatively associated with achievement. Given the centrality of the social involvement facet to social adaptation in the present conceptualization, which largely probes for participation in extracurricular social activities, any positive effect of psychological adjustment may have been offset by the effect of social adjustment, resulting in the null direct psychosocial adaptation-achievement relation and, by implication, the zero mediated effects involving the psychosocial adaption-achievement path. An important avenue for future research is to examine the specific mediated pathways from TEI to achievement via the adaptation constructs modeled at lower levels of aggregation as well as the temporal ordering of the adaptation constructs over the first semester of university.

Although non-zero mediated relations were observed for four specific pathways from TEI to adaptation and achievement, the extent of mediation documented was not equal for each pathway. Conceptually, all four non-zero mediated effects are important because they enrich understanding of the mechanisms that drive the associations of TEI with adjustment and achievement outcomes. Furthermore, all four mediated effects obtained extend prior work by allowing the causal processes implied by the model to unfold over time via the sequential design. Yet, the proportion of the total effects explained by these mediation processes varied across the indirect pathways. The mediated effects were least strong for the TEI-psychosocial adaptation relation. Indeed, the final, most parsimonious, model retained in the present study is an alternative parametric structure in which partial mediation of the TEI-psychosocial

adaptation link was observed. The indirect pathways from TEI to psychosocial adjustment via perceived support and engagement coping, operating in parallel, accounted for 27.0% and 11.2% of the corresponding total effect, respectively. This finding of only partial mediation raises the possibility of further mediational processes, such as hormonal or dynamic mood changes in response to stress, social network development, or changing health behaviors (e.g., caffeine, nicotine, alcohol or drug use), underlying the association between TEI and psychosocial adjustment. Future investigators are encouraged to harness this finding and attend to additional mediational processes to more fully account for the association between TEI and psychosocial adjustment.

7.3.3 The Structure of University Adjustment

Another issue addressed in this study was the dimensionality of university adjustment. According to the present conceptualization of university adjustment, the process of adaptation occurs in the following three domains: academic adjustment; social adjustment; psychological adjustment. A central postulate of this novel formulation is that university adjustment is characterized by a multidimensional, hierarchical structure. Specifically, a higher-order psychosocial adjustment construct was expected to account for the commonality between the social and psychological domains. Further, the academic and psychosocial dimensions were expected to be positively and moderately-to-strongly associated. The evidence obtained from the second-order CFA test of this multidimensional, hierarchical structure is largely consistent with these expectations.

First, the supplementary analyses yielded evidence underpinning the proposition that adjustment to university is a multidimensional construct. A second-order CFA test supported the a priori parametric measurement structure in which academic adjustment and psychosocial adjustment were specified to be related but distinct constructs. In the final four-factor solution, academic adjustment was strongly associated with psychosocial adjustment. This association suggests that students who were academically adjusted were more likely to be psychosocially adjusted. However, the strength of the association did not preclude the possibility of substantial within-person variation across the adjustment domains. In this regard, the finding is consistent with the theoretical view that incoming undergraduates may have differential adaptation experiences in the academic and psychosocial domains of university life (Baker & Siryk, 1984; Credé & Niehorster, 2012). Take, for instance, the incoming student who regularly attends campus social events and interacts with peers.

Although this student is likely to report high psychosocial adjustment, he or she may not necessarily set and pursue academic goals or organize and attend to academic work. The present finding also accords with recent meta-analytic data, based on the SACQ measures of the adaptation constructs, indicating that academic adaptation is strongly related to both social and psychological adjustment (Credé & Niehorster, 2012).

The supplementary CFA analyses also yielded support for the tenability of the higher-order representation of the social and psychological adjustment factors. The second-order model in which the higher-order loadings of social and psychological adjustment on psychosocial adjustment were fixed to their values obtained in the eight-factor measurement solution—for model identification purposes—provided a reasonable fit to the sample data. Notably, the higher-order factor loadings were strong and virtually identical. These findings suggest that social and psychological adjustment contributed equally to the definition of psychosocial adjustment, which accords with the present conceptualization of university adaptation. In this formulation, psychosocial adjustment is hierarchical, with evaluations of functioning in related emotional and social domains at the base of the hierarchy shifting to inferences about generalized socio-emotional functioning at the apex. At the broadest level of experience, it may be that the internalization of social disconnection as feelings of loneliness and perceptions of unsatisfying social relations, which are reflected in low social adaptation, constitute, in part, the low affective balance, lack of life satisfaction and disengagement that are characteristic of suboptimal psychological wellness.

Although this hierarchical representation is theoretically plausible, the high bandwidth of the second-order construct may paradoxically be its chief limitation. The second-order factor model is one approach for representing generalized constructs comprising highly-related domains (e.g., psychological and social functioning). In a typical application, the higher-order factor is posited to account for the relationships among the first-order factors. Mathematically, the second-order construct is an empirically weighted average of the lower-order factors from which it is inferred (H. W. Marsh & Yeung, 1998). The hierarchical representation is limited to the extent that the generalized factor may mask differential relations of the lower-order factors with substantive external criteria. In the present study, it may have been that the generalized representation of psychosocial adjustment as an empirically weighted average of the psychological and social domains concealed differential relations of these dimensions with achievement notwithstanding their high degree of

conceptual and empirical commonality. This is consistent with the observation that even two highly related constructs can show substantially different predictive relations with external criteria (McCornack, 1956).

7.3.4 Limitations

Notwithstanding the important advances represented by the present findings, several limitations warrant acknowledgement. These limitations, in some respect, qualify the research findings and serve to guide the appropriate interpretation of the results. Additionally, the identified limitations may be used to suggest directions for future research, and this too is considered.

First, as with the meta-analytic review, although parsimony was enhanced by modeling TEI at the highest level of conceptual aggregation, this may have resulted in the masking of specific effects of lower-level affective dispositions on the mediators and achievement outcome. For instance, it may be that specific oppositional processes (e.g., effects of sociability traits vs. self-regulatory traits) are operative in the relation between TEI and achievement, such that, at the highest level of conceptual aggregation, these lower-order effects may not only be concealed but also weaken the overall relation. Indeed, in the present study, tentative evidence was obtained for divergent direct and indirect effects of TEI on achievement that potentially reflect these lower-order processes. Notwithstanding this possibility, it was considered best to begin the process of investigating complex direct and indirect associations of TEI with adaptation and achievement with a parsimonious model, especially in light of the dearth of literature addressing the role of lower-order TEI dispositions in adaptation and achievement (Perera & DiGiacomo, 2013). In future research, however, systematic attempts should be made to link the lower-level dispositions to theoretically-plausible criteria towards a more refined understanding of the ways in which TEI promotes adaptation and achievement during stressful educational events. This suggestion is consistent with recent calls to examine the construct at the subscale or subfactor level (Downey et al., 2010; Perera & DiGiacomo, 2013; Zeidner et al., 2012).

Second, an issue to be considered in interpreting the present findings is the nature of the stressor itself in producing the pattern of observed relationships. As in several other studies investigating the transition to university (e.g., Aspinwall & Taylor, 1992, Brissette et al., 2002; Chemers et al., 2001; Srivastava et al., 2009), in the present study, the transition was

assumed to be a global, normative stressful event. Although there is a good deal of support for the view that the university transition is typically an ongoing stressor for many students (Feldman & Newcomb, 1994), there is some evidence that students may differentially experience discrete transition stressors in distinct academic and social domains (e.g., making friends vs. a new academic structure) (Arthur & Hiebert, 1996). This corresponds to the notion that students may differentially adjust to various domains of the university experience (Credé and Niehorster, 2012). The possibility of experiencing qualitatively distinct stressors raises the question of whether the present findings generalize to finite transition stressors. As discussed in above, it may be that specific coping efforts (e.g., active coping, restraint, and reinterpretation) are differentially implicated in discrete transition stressors, which may have been masked in the present study. In view of this limitation, one crucial direction for future research is to address the relations among TEI, perceived support, coping and adaptation across a range of discrete transition stressors (e.g., new social activities, making friends, preparing for and sitting exams, participating in tutorials). In addition, it will be important for investigators to consider closely the types of coping efforts that are likely to be adaptive or maladaptive for the specific stressors as opposed to a molar assessment of coping.

A third limitation concerns the presence of common-method biases. The hypothesized target model and alternative parametric structures largely relied on self-reported data for empirical testing. Although many of the constructs examined in this study can only be efficiently measured through self-report, it is widely recognized among methodologists that self-report measures of both predictor and criterion may result in inflated correlations due to common method variance (Podsakoff et al., 2003). Common method variance refers to variance that is attributable to the method of measurement rather than to the construct under scrutiny (Podsakoff et al., 2003). This type of method effect results from artifactual covariance between a predictor and criterion generated by common sources of responding, similar item characteristics and common mediums of assessment (Podsakoff et al., 2003). Common method bias is a source of systematic measurement error that may provide an alternative explanation for the magnitude of observed covariances in the sample data (Bagozzi & Yi, 1991). In this regard, this type of self-report method effect constitutes a potential confounding influence in the interpretation of observed relations and may lead to a greater risk of committing Type I errors assuming inflationary effects (D.T. Campbell & Fiske, 1959; Podsakoff et al., 2003). In the present study, data for the predictors, proximal mediators and distal mediators were obtained from the same individual (i.e., common rater

effects), using web-based questionnaires (i.e., common medium effects), which often contained items with comparable scale formats and anchors (i.e., item characteristics effects). Taken together, these methods effects may have resulted in biased observed covariances.

Although common method biases are possible in any design that largely depends on mono-methods, two procedural remedies in the design of the present research may have served to minimize any bias. First, aside from statistical control techniques, such as the specification of error covariances, which, incidentally, was used in the present study to account for strong method effects (Byrne et al., 1989; Gerbing & Anderson, 1984), the temporal separation of predictor and criterion measurements may minimize the possibility of common-method biases (Podsakoff et al., 2003). In the present study, data were collected in four waves in line with the temporal ordering of constructs implied by the target model. Notably, the theoretically-informed time lags introduced between self-report measurements of the predictor, proximal mediators and distal mediators may have had methodological benefits in terms of minimizing biases in the response process. For example, responses to the TEI measure at the start of the semester may have been less available in short-term memory during the later measurement of the proximal mediators in the current sequential design relative to a cross-sectional design in which the measures are simultaneously administered. Temporal separations between measurements may reduce bias in responses by rendering previous responses less accessible or relevant to later responding, thereby diminishing the potentially inflationary effects of consistency motifs, implicit theories and retrieval cues on the observed covariation between indicators (Podsakoff et al., 2003).

Second, common method biases may have been minimized by obtaining measures of the outcome from a non-self-report source. For self-reported data, a major cause of common method biases is obtaining measures of the predictor and criterion from common sources (e.g., common rater effects). Following from this, one approach to controlling for the effects of common method variance is to obtain measures from different sources (Podsakoff et al., 2003). For example, a measure of a child's motivation to engage in learning tasks may be obtained using self or teacher reports whereas a measure of the child's achievement may be obtained from a register of standardized test results. The collection of predictor and criterion data from distinct sources minimizes common-rater effects by diminishing the potentially inflationary impact of consistency motifs, socially desirable, acquiescence and leniency responding, implicit theories, and mood states on the observed covariance between the

predictor and criterion (Podsakoff et al., 2003). In the present study, though data on the predictor and mediators were obtained from common sources, achievement data were obtained from university records. Thus, relations involving first-semester achievement may have been less susceptible to common-method biases. Notwithstanding these procedural safeguards, it is important for future research to investigate the present processes using data derived from additional sources, such as informant-based measures of personality, coping and adaptation and more objective indices of adjustment (e.g., the number of classes attended, assignments submitted, subject withdrawals, and extracurricular social club memberships) These approaches, however, depend to a large extent on fiscal resources and may not be feasible in many cases.

A fourth potential limitation concerns the initial response rate. Despite extensive recruitment efforts, the T1 response rate was approximately 15% of the available first year cohort. This is typical of response rates for comparable studies with university students using web-based data collection procedures (Sax et al., 2003); however, it raises the possibility that non-respondents may have differed in important ways from those who participated in the study (Aspinwall & Taylor, 1992). For example, it may be that some students did not participate because they were unwilling to acknowledge initial adjustment difficulties or a lack of social support. Moreover, it is important to note that a comparison of demographic data on the first-year cohort with the T1 sample revealed a failure to sufficiently sample from three faculties of the institution. Two faculties were not available for sampling due to institutional restrictions. Students from a third faculty were not adequately sampled because many of the students are located on a secondary campus that was largely inaccessible. Although sufficient range was observed across all observed indicators in this study, it is not known whether differences between respondents and non-respondents would influence the pattern of observed relations among the variables.

A fifth, related, limitation is the *N* obtained in the present study. An a priori Monte Carlo simulation suggested that a sample of 2000 units of observation was required to obtain an admissible solution, unbiased model estimates and sufficient statistical power for tests of the substantive model parameters given the model specification, estimated population effect sizes, nominal alpha criterion, desired level of power, predicted pattern of missingness, and the ML estimation routine (see Chapter Six). In the present study, the final sample for data analysis (i.e., $N = 458$) constituted only 23% of the minimum required sample estimated

based on the Monte Carlo procedure. Although this *N* is consistent with samples reported in studies using comparable mediational designs (see Section 6.4), and was unlikely to lead to an inadmissible solution or biased model estimates, the obtained *N* raises concerns about statistical power for tests of individual parameters. Insufficient power for statistical tests of model parameters may compromise the detection of true effects or, put another way, increase the risk of committing Type II errors, leading to limited and potentially misleading results (J. Cohen, 1992b).

While the results of the a priori simulation and empirical study were suggestive of the possibility of underpowered parameters, a post-hoc Monte Carlo study furnished specific evidence about the quality of the solution and parameters. This simulation revealed that the sample was adequate to yield an admissible solution and unbiased model estimates. However, statistical power for tests of the model parameters was not uniformly acceptable. Specifically, in accord with the a priori Monte Carlo results, power for the statistical tests of the direct path from engagement coping to psychosocial adjustment and indirect path from TEI to psychosocial adjustment via engagement coping was approximately 23% below the recommended cut-off of .80 (π = .62). This reflects a non-trivial probability of committing a Type II error associated with these tests (J. Cohen, 1992b). Future studies are encouraged to test these relations with a larger *N* in light of these Monte Carlo results. Moreover, quite apart from the results of this specific study, researchers are also encouraged to conduct, at the very least, post-hoc Monte Carlo studies using empirical results as population estimates to evaluate the propriety of the final empirical solution, extent of bias in model estimates and the power of statistical tests of the estimated parameters. Such post-hoc diagnostics can provide a rich context for the interpretation of model parameters.

A sixth possible limitation is the presence of lag effects within intervals of measurement that may have influenced the observed relations. In the present study, the T1, T2 and T3 measurement occasions spanned approximately one week to maximize response rates and ensure sufficient time had elapsed between measurement occasions for the causal processes to manifest. Although the interval of measurement is comparable to other studies using sequential designs and is not considered large (e.g., Aspinwall & Taylor, 1992), the one-week lag, from the beginning to the end of each measurement occasion, may represent a source of confounding in the relationships among the observed variables. This is because participants responding at the end of a measurement interval will have had about a week longer to

experience the university environment than those responding at the beginning (T. D. Little, 2013). For the personality traits examined in the present study (e.g., TEI and covariates), the within-occasion lag effects are unlikely to be problematic due to the short-term stability of these constructs (Hampson & Goldberg, 2006; Petrides, 2009). On the contrary, standings on perceived social support, engagement coping and the adaptation constructs may be more sensitive to the time of administration in the intervals because these constructs hinge on the individual's experience of the academic and social environment (Brissette et al., 2002; Cutrona & Russell, 1987; Lazarus & Folkman, 1984). For instance, subjects responding towards the end of the interval for the second measurement occasion may have had more time to make friends and experience university stressors, resulting in higher reported perceived social support and engagement coping. In line with recent developments in the modeling of time-dependent associations (Selig et al., 2012), future investigators examining mediational processes with longitudinal data are encouraged to precisely record time of administration within a measurement interval and use this index as a covariate or even moderator in examining the effects of within-time lags on observed associations (T. D. Little, 2013).

The current study did not control for initial levels of the mediators and outcomes, which constitutes a seventh limitation. Throughout the present work, it has been assumed that TEI exerts effects on the proximal mediators, which, in turn, exert effects on the distal mediators. These distal mediators, in turn, exert an influence on the achievement outcome. This proposed multistage process is reflected in the temporal ordering of constructs in the sequential design. The measurement of TEI at T1 preceded the measurement of engagement coping and perceived support at T2. The measurement of the adjustment factors at T3 followed the proximal mediators in time but temporally preceded the measurement of achievement at T4. Notwithstanding the use of these time lags, the data obtained in this study cannot determine whether TEI directly or indirectly predicted changes in the mediators or outcome, which would constitute stronger evidence for the direct relations and mediational mechanisms specified (Cole & Maxwell, 2003; Lyubomirsky et al., 2005; Maxwell & Cole, 2007). This is because initial or baseline measures of the mediators and outcome were not controlled at earlier time points.

This failure to include autoregressive effects in the model raises the possibility that TEI predicted only basal levels of the mediators and outcome that were largely maintained across the first semester. Put another way, the study cannot disentangle change influences from

stable influences over time. As mediation comprises causal processes that unfold overtime via changes in constructs (Maxwell & Cole, 2007), the present data should be regarded as somewhat weaker evidence of the mediational processes as they reflect standings on, not changes in, the constructs. Thus, though the data are consistent with the mediational mechanisms proposed, inferences about causal processes are strongly discouraged (Gollob & Reichardt, 1987). Future investigators might profitably re-examine these direct and indirect associations using a full panel design in which the model specifications judiciously incorporate both cross-lagged and theoretically-plausible autoregressive paths over time to clarify potential relationships found here (Cole & Maxwell, 2003; Little et al., 2007 Maxwell & Cole, 2007).

The extent of the present limitation concerning the omission of autoregressive paths hinges on the tenability of the autoregressive effect as a true causal effect. In full longitudinal designs, the autoregressive effect captures the stability of individual differences on a construct from time $t - 1$ to t. Recent methodological arguments for the inclusion of autoregressive effects in mediational tests of longitudinal data center on the plausibility of the stability path as a true, competing explanation for an observed effect (Cole & Maxwell, 2003; Gollob & Reichardt, 1987, 1991; MacCallum & Austin, 2000; Maxwell & Cole, 2007; Selig & Little, 2012). This argument can be understood from the broader perspective of inferring causality from regressive relations in the SEM framework. In SEM, the interpretation of estimates of direct and indirect paths as indicative of causal effects assumes, inter alia, that isolation has been sufficiently demonstrated (Kline, 2012). Isolation refers to the condition in which there are no plausible extraneous or confounding explanations for the covariation between *X* and *Y* (Cole & Maxwell, 2003; Kline, 2012). In statistical terms, isolation is established when the association between *X* and *Y* is robust, controlling for all known and unknown third variable confounders. Of course, the possibility of several unknown confounders renders the determination of isolation virtually impossible in reality. In line with this principle of isolation, to the extent that prior levels of an endogenous construct constitute a theoretically plausible third variable confound, autoregressive paths should be incorporated in the parametric structure. The failure to control for prior levels of a dependent variable can lead to spurious, upwardly biased estimates of the causal path under scrutiny (Cole & Maxwell, 2003; MacCallum & Austin, 2000). To minimize bias in the estimation of cross-lagged paths, some methodologists have recommended the inclusion of all possible autoregressive paths in the application of the sequential design (Cole & Maxwell, 2003;

Maxwell & Cole, 2007). It may, however, be that the autoregressive effect is not always theoretically plausible in longitudinal processes.

In some cases, an autoregressive effect may be questionable as a true causal effect and represent a fundamentally misspecified parameter. Quite apart from the issue of masking true contributions of predictors by virtue of the overpowering impact of autoregressive effects (Stoolmiller & Bank, 1995), in some longitudinal processes, an autoregressive effect may simply be theoretically implausible. Take, for instance, a longitudinal study in which an investigator is interested in stress in response to a discrete academic stressor (e.g., mid-semester exam) as a mediator in the link between neuroticism and achievement. Conceptually, neuroticism at T1 is expected to influence the experience of stress when confronting the academic stressor at T2, which, in turn, predicts achievement at T3. In this hypothetical, but not unusual, example, the interpretation of any autoregressive effect of stress at T1 on stress at T2 is theoretically ambiguous because the examination stressor has not been experienced at T1 (cf., Segerstrom et al., 1998). Moreover, there are likely to be important differences in the phenomenology of the T1 and T2 stress constructs given the lack of exposure to the stressful event at the initial measurement occasion. This may be statistically manifested as longitudinal factorial non-equivalence between the constructs, which would violate the assumption of longitudinal measurement invariance required for mediational tests of repeated measures data (T. D. Little, 2013; Little et al., 2007). In the present study, it is possible that controlling for initial (i.e., T1) levels of perceived social support, engagement coping and academic adjustment would be theoretically questionable because students had not yet encountered most transition stressors and engaged in the social environment. The aim of the present account is not to discourage researchers from including autoregressive paths in their tests of longitudinal mediation but, instead, encourage the judicious specification of these paths, where possible, in line with theoretical considerations.

A final, related, limitation concerns the presence of unmeasured confounders and alternate structural models that may threaten the validity of the present findings. Although this study controlled for the effects of two dominant confounders—extraversion and neuroticism—in the TEI literature, there may be several unknown third variables that plausibly explain the covariation of TEI with the mediators and outcome (Kline, 2012). Likewise, though the present study examined three theoretically-plausible alternative parametric structure to minimize the risk of confirmation biases (MacCallum & Austin, 2000), there remains several

equivalent, near-equivalent and non-equivalent alternative models that may explain the observed data as well as or better than the retained model, thereby presenting a threat to the validity of the supported covariance structure (MacCallum et al., 1993; McDonald & Ho, 2002; Tomarken & Waller, 2003). One possibility is a near-equivalent parametric structure in which perceptions of the availability of social provisions inform coping selection in response to transition stressors in a temporal chain of events leading from TEI to adaptation and achievement (Pierce et al., 1996). Another possibility is a non-equivalent reciprocal effects model in which initial psychosocial adjustment to the transition affects subsequent academic adaptation and, in turn, achievement, which thereby enhances later psychosocial well-being (Valiente et al., 2012). As such, future research would do well to (a) ensure sufficient statistical control for known confounding influences in model testing and (b) systematically address the possibility of theoretically-plausible alternative parametric structures.

7.3.5 Summary

The present study has provided the first systematic attempt to examine both the direct and indirect relations of TEI with adaptation and achievement during the transition to university. In doing so, this study contributes to and extends a growing literature on the role of TEI in adjustment and achievement in educational settings. The present study specified and tested an integrative multistage mediation model, as well as theoretically-plausible alternative structures, linking TEI, perceived social support, coping, adjustment, and achievement in the context of the stressful university transition. The model specifications drew on multiple accounts of emotion, regulation and adjustment, including TEI theory, social-functional and broaden-and-build accounts of emotion, stress-buffering models of social support, expectancy-value and psychobiological models of motivation and emotion, and the present formulation of university adjustment. Although these theoretical accounts variously underscore different variables as their central constructs, when taken together, they provide a comprehensive picture of the ways in which TEI and pertinent proximal mediating processes, such as coping efforts and social support, operate together to promote adaptation and, in turn, achievement during stressful events. In this regard, the current study redresses the lack of conceptual elaboration concerning the associations of TEI with social support, coping, adjustment and achievement.

The present study yielded support for an alternative parametric structure. The model is one in which TEI directly predicted perceived social support, engagement coping and

psychosocial adjustment and indirectly predicted (a) psychosocial adjustment via perceived support, (b) academic adjustment via engagement coping, and (c) first semester achievement via engagement coping and academic adjustment linked serially in a three-path mediated sequence. The research replicates previous findings indicating that TEI is linked with perceived support, engagement coping and psychosocial adjustment. The present research also replicates prior work showing that TEI is indirectly associated with psychosocial adaptation via perceived support. In addition, the current work extends the TEI literature by acquiring evidence for an indirect relationship between TEI and academic adaptation via engagement coping. Finally, the current work advances the existing literature reporting TEI-achievement relations, including the meta-analytic review reported in Chapter Five, by finding support for an underlying pathway through which TEI is indirectly associated with better achievement via engagement coping and academic adjustment linked serially. Taken together, the findings reported in the present work contribute to an understanding of the mechanisms through which TEI is associated with adaptation and achievement in educational settings. In addition, they highlight the need to examine these processes at lower levels of conceptual aggregation, under exposure to specific transition stressors, as well as consider further plausible mediational mechanisms in the TEI-adaptation links.

Chapter Eight
General Implications and Conclusions

Despite considerable interest in the role of TEI in adaptation and achievement in educational settings, the pathways through which TEI is linked with these constructs have received only little systematic investigation (Kong & Zhao, 2013; Kong et al., 2012a, 2012b; Koydemir et al., 2013; Liu et al., 2012; Mikolajczak, Menil et al., 2007). Accordingly, understanding of the mechanisms underlying the associations of TEI with adaptation and, especially, achievement is underdeveloped. The goal of the present research was to examine the direct and indirect contributions of TEI to adaptation and achievement in the context of a major stressful educational event, namely the university transition. To this end, two substantive studies were conducted to investigate these links. In light of the inconsistent TEI-achievement relations observed in the existing literature (Mavroveli & Sánchez-Ruiz, 2011; Perera & DiGiacomo, 2013), the first study was centrally concerned with clarifying the validity of TEI for predicting achievement via meta-analytic methods. In doing so, the meta-analytic data reinforced the model specifications of the direct and indirect relations of TEI with adaptation and achievement with which the second study was centrally concerned. A number of supplementary research issues were also addressed in the process of conducting the meta-analytic review and model testing. These include the moderating effects of gender, age, academic level and TEI measure on the summary relation between TEI and achievement as well as the dimensional structure of adaptation from the perspective of the present conceptualization of university adjustment. The results obtained from the present research contribute to the advancement of theory bearing on TEI and adaptation, educational practice, and methodology in important and novel ways as discussed below.

8.1 Implications for Theory

The results of the meta-analytic review and empirical tests of the parametric structures reported in this research have important implications for TEI theory. The findings of (a) a near-moderate summary relation between TEI and achievement obtained in the meta-analysis and (b) an indirect association of TEI with first-semester achievement in the test of the structural models suggest that theorists should reconsider the theoretical foundations on which extant postulations concerning the TEI-achievement link are based. In the psychological literature, a prevailing postulation of TEI theory is that TEI should be orthogonal or only weakly related to cognitive-loaded outcomes, such as academic

achievement (Mavroveli et al., 2008, 2009; Mavroveli & Sánchez-Ruiz, 2011; Petrides, 2011). However, conceptually, it is unclear why TEI would be expected to be unrelated or only trivially related to achievement as it encompasses affective-motivational traits, including dispositional self-motivation, self-control and emotion regulation and an optimistic disposition, that would appear to support the regulation of effort and attention necessary to achieve valued academic goals even when confronting adversity (Carver et al., 2010; Carver & Scheier et al., 1998; Derryberry et al., 2003; Fishbach & Shah, 2006). A number of studies have acquired evidence for a positive TEI-achievement link in line with this novel theorizing (e.g., Austin, Evans et al., 2005; Ferrando et al., 2011; Parker, Summerfeldt et al., 2004; Sanchez-Ruiz et al., 2013; see Perera & DiGiacomo, 2013 for a review). The present work extends this evidence by obtaining a non-trivial summary total effect, based on the synthesis of almost 50 independent effect sizes, and showing that this effect is primarily attributable to subtle mediational mechanisms.

In the absence of transparent explanatory accounts proffered by TEI theory for the TEI-achievement link, the present research drew on well-established theories of emotion and regulation to understand the nature of this effect. The difficulties presently hampering the TEI-achievement literature stem from vaguely specified theoretical mechanisms linking the constructs (Perera & DiGiacomo, 2013). One reason for this lack of theoretical clarity is the failure of researchers to sufficiently connect the TEI construct to the emotion and regulation literatures on which the construct should, conceptually, be based. Indeed, though efforts have been made to tie the construct to the existing personality literature (Petrides & Furnham, 2001; Petrides, Pita et al., 2007), it is difficult to understand why a construct, reflecting the human propensities to perceive, express and regulate emotions, persevere, control impulses, and hold generalized favorable outcome expectancies, has been examined absent of the emotion and regulation literatures (Averill, 2004; Izard, 2001). For instance, scientific definitions of an optimistic disposition have emerged from expectancy value theories that posit that behavior reflects the pursuit of valued goals (Carver & Scheier, 1998). For TEI dispositions, such as positive emotionality, self-control, self-motivation and perseverance, psychobiological models of emotion and motivation provide a framework within which to understand how these traits promote engagement in and regulation of efforts to move towards and focus on environmental reward cues (Davidson et al., 2000; Derryberry et al., 2003; Rothbart & Rueda, 2005). Although these accounts of emotion and regulation have not historically been tied to TEI and emphasize different focal constructs (dispositional optimism

vs. perseverance vs. positive emotionality), taken together, they provide a more complete picture of the ways in which TEI promotes adaptation and achievement. This alignment is central to not only understanding the effects of such a high bandwidth construct but also connecting the nascent construct to the mainstream psychological literature.

An important benefit of linking TEI to well-developed accounts of emotion and regulation in the present work is that it allowed for the explication of potential processes underlying the relation of TEI with achievement that had hitherto been neglected (Perera & DiGiacomo, 2013). One such process supported via empirical testing in the present work is the indirect association between TEI and first-semester achievement via engagement coping and academic adaptation linked serially in a three-path mediated sequence. To explain this multistage mediational pathway, the present study drew on expectancy-value and psychobiological accounts of emotion and regulation. From an expectancy-value perspective, favorable outcome expectancies for eventual success that, in part, define TEI result in greater engagement and increased effort to attain valued academic goals in the face of adversity (Carver et al., 2010; Carver & Scheier, 1981, 1990b, 1998; Scheier & Carver, 1988). From a psychobiological perspective, biologically-based appetitive and attentional temperament system underlying TEI facets, such as positive emotionality, perseverance and an achievement-orientation, provide a framework for the selection of engagement coping efforts that preserves the mobilization of efforts towards goal attainment under stress (Connor-Smith & Flachsbart, 2007; Derryberry et al., 2003). These explanations, though emerging from distinct theoretical traditions, elucidate two complementary mechanisms linking TEI with achievement that center on the activation and regulation of engagement and effort (Carver & Connor-Smith, 2010). A major advantage of the latter mechanism is that it is anchored in psychobiological accounts of the neural structures that underlie temperament systems, thereby providing a functional basis for the causal process triggered by TEI (Derryberry et al., 2003; Derryberry & Rothbart, 1997). In light of this novel theorizing and the present findings, future research would do well to not only reconsider the prevailing theoretical position on the TEI-achievement link but also refine this position through additional conceptual integration concerning the ways in which individuals' diverse affective-motivational personality traits, as captured in the TEI construct, operate to influence achievement.

Any reconsideration of the theoretical position concerning the TEI-achievement link also needs to take into account the potential negative impact of TEI on achievement. In the empirical tests of the structural models reported in Chapter Seven, tentative evidence was obtained for a small, direct negative effect of TEI on achievement, after partialling out the influence of the positive three-path mediated effect via engagement coping and academic adaptation. This evidence is suggestive of inconsistent mediation in the data (MacKinnon et al., 2000; Shrout & Bolger, 2002), raising the possibility of divergent effects of TEI on achievement. To the best of the author's knowledge, this is the first documentation of a novel line of theorizing concerning the potential divergent effects of TEI on achievement. It may be that, after accounting for the self-regulatory affective-motivational tendencies reflected in TEI (e.g., positive-emotionality, perseverance, self-control, achievement-orientation, an optimistic disposition), which regulate approach behaviors and attention, via the mediational pathway, all that is left over is the negative impact of TEI. One possibility is that sociability dispositions (e.g., prosocial orientation, tendencies toward social interaction and the formation and maintenance of social bonds), which also define TEI, hamper achievement by increasing exposure to social stressors (e.g., managing others' problems) and novel social opportunities (Chamorro-Premuzic & Furnham, 2003; Sanchez-Marin, Rejano-Infante, & Rodriguez-Troyano, 2001). The presence of these divergent effects could also, at least in part, explain previous findings of null or non-significant total effects of TEI on achievement as was found in the empirical tests of the structural models in the present research (see also Barchard, 2003; Newsome et al., 2000). In line with TEI theory, the present theorizing and empirical findings depart from the popular "EQ is good for you" perspective (Petrides, 2009, 2011). However, this theorizing and evidence warrant the reconsideration of the prevailing theoretical position concerning the TEI-achievement link to include the possibility of divergent effects of TEI.

The findings of the present work also suggest that theory bearing on TEI may be advanced by examining the construct at lower levels of conceptual aggregation (i.e., first-order factor or facet levels). One criticism of the TEI construct is its generality or high bandwidth (Landy, 2005; Mayer et al., 2008; Perera & DiGiacomo, 2013), which may obscure meaningful links with substantive criteria. In the current research, though parsimony was preserved through the examination of TEI at the highest level of conceptual aggregation (i.e., global TEI), it may be that the examination of global TEI concealed specific effects of lower-order affective dispositions. For instance, in the meta-analytic review, the synthesis of literature reporting on

global measures of TEI may have masked both the specific effects of TEI dispositions on achievement as well as refined moderating influences, such as gender, on the summary effect (Perera & DiGiacomo, 2013). Likewise, in the test of the structural models, the modeling of TEI at the highest level of conceptual aggregation may have obscured differential effects of lower-level TEI dispositions on the mediators and outcome. Consistent with these suppositions, tentative evidence was acquired for the divergent direct and indirect effects of TEI on achievement, which may be due to the differential effects of the self-regulatory vs. sociability traits defining TEI. Hitherto, few studies have been centrally concerned with examining the role of TEI in adaptation and achievement at lower levels of conceptual aggregation. As noted in a number of recent studies, this issue is in need of sustained and systematic theoretical and empirical attention (Downey et al., 2010; Perera & DiGiacomo, 2013; Zeidner et al., 2012). Indeed, the role of TEI in adaptation and achievement cannot be understood adequately if its multidimensionality is ignored.

Although the examination of TEI at lower levels of conceptual aggregation may be theoretically informative and enhance fidelity, the scientific utility of TEI as a parsimonious representation of affective traits may be diminished by empirical disaggregation. This issue broadly resembles the bandwidth-fidelity trade-off observed in the mainstream personality literature in which the higher efficiency of broad bandwidth constructs is set against the higher fidelity of more narrowly-conceived traits (Saucier & Goldberg, 2003; Saucier & Ostendorf, 1999). One of the chief advantages of the global TEI factor is that it serves an integrative function, unifying conceptually related affective personality traits (Petrides, 2011). For example, variation in the propensity to perceive, express and regulate emotions in social interactions, which is straightforwardly reflected in the global TEI construct, would otherwise require some cumbersome combination of traits from existing personality frameworks to be adequately captured (Mikolajczak, Luminet et al., 2007). Despite the benefit of parsimony, broad bandwidth constructs, such as global TEI, can be definitionally ambiguous and obscure specific effects of related, yet conceptually distinct, subcomponents (Saucier & Ostendorf, 1999).

In the TEI literature, several researchers have proposed the representation of narrower TEI constructs in empirical studies to address the limitations of the broad bandwidth representation (e.g., subfactor level; Downey et al., 2010; Perera & DiGiacomo, 2013; Zeidner et al., 2012). A possible benefit of such disaggregation is an increase in predictive

accuracy, potentially minimizing the likelihood of masking specific effects (Goldberg, 1993; Mershon & Gorsuch, 1988; Saucier & Ostendorf, 1999). However, to the extent that global TEI is a higher-order, efficient representation of affective traits that are partly scattered across extant personality and emotion taxonomies (Petrides, Pita et al., 2007), these subcomponents may not be independent of established traits. Thus, at lower levels of conceptual aggregation, these TEI subcomponents may not show sufficient discriminant validity against established personality traits to be scientifically useful. Future research should examine the discriminant validity of the TEI subcomponents against theoretically-plausible confounders to determine the scientific utility of disaggregating the construct.

This issue of discriminant (and incremental) validity has been a particularly contentious one in the TEI literature. A major criticism of the TEI construct is that, even at the broad bandwidth level, it possesses little discriminant or incremental validity with respect to existing personality traits (Davies et al., 1998; MacCann, Roberts, Matthews, & Zeidner, 2003, 2004; G. Matthews, Roberts, & Zeidner, 2004; McCrae, 2000; Roberts, MacCann, Matthews, & Zeidner, 2010). Critics maintain that items measuring TEI across self-report instruments (e.g., TEIQue, SEIS) are conceptually and semantically similar to personality measures, which limits the discriminant validity of TEI (MacCann et al., 2003). Critics cite correlations of TEI with established personality factors, especially neuroticism and extraversion, in the order of .40 to .50 to support this claim (Austin, Saklofske et al., 2005). Aside from the theoretical position that TEI is a personality construct, located at the lower strata of existing personality taxonomies, and should, therefore, show non-trivial relations with the established personality factors (Petrides, 2001; Petrides & Furnham, 2001; Petrides, Pita et al., 2007), these correlations are not so high as to suggest conceptual redundancy and preclude the possibility of incremental validity (H. W. Marsh, Dowson, Pietsch, & Walker, 2004; McCornack, 1956). Indeed, a growing body of literature indicates that TEI has incremental validity over established personality factors in the prediction of several substantive criteria, including physiological reactivity to stress (Mikolajczak, Roy et al., 2007), achievement (Ferrando et al., 2011; Sanchez-Ruiz et al., 2013), satisfaction with life, rumination, engagement and emotional coping (Petrides, Pérez-González et al., 2007; Petrides, Pita et al., 2007), depression, dysfunctional attitudes, hostility, and sensitivity to emotional expression (Petrides, Pérez-González et al., 2007). The present research builds on these efforts to acquire evidence for incremental validity by demonstrating the unique direct relations of TEI with perceived social support, engagement coping and psychosocial

adjustment and the indirect associations with psychosocial adjustment, academic adjustment and achievement, controlling for the effects of neuroticism and extraversion.

The results of the present work also address the long-standing criticism of the reliance in the TEI literature on mono-methods in validation studies. A criticism directed at the TEI literature concerns the paucity of objective criteria in construct validation research (G. Matthews, Zeidner, & Roberts, 2007). Critics maintain that much of the TEI validation literature is contaminated by the prevalence of self-report measures of both TEI and theoretically-relevant criteria (Perera & DiGiacomo, 2013). As discussed at great length in Chapter Seven, self-report measures of both predictor and criterion may result in inflated covariances due to common method biases (Podsakoff et al., 2003). This raises the possibility that existing evidence for predictive validity based on mono-methods is, at least in part, an artifact of method effects. The present research addresses this criticism in two ways. First, a near-moderate, positive mean association of TEI with achievement, based on the synthesis of almost 50 observed correlations of TEI with objective indices of performance, was obtained in the meta-analytic review. Second, in the empirical tests of the structural models, evidence was acquired for an indirect association of TEI with first-semester achievement, indicated by an objective measure of performance (i.e., GPA). Taken together, these results contribute to a growing literature showing relations of TEI with objective academic and socio-emotional criteria (Ferrando et al., 2011; Frederickson et al., 2012; Mavroveli et al., 2009; Petrides & Furnham, 2003; Sanchez-Ruiz et al., 2013). Future researchers are urged to build on these efforts to include more objective criteria in study designs towards enhancing the validity of the TEI construct.

The present work also advances current theorizing concerning the role of TEI in perceived social support and social adjustment. It is well-established that emotions play an important role in coordinating social interactions and negotiating the social environment (Shiota et al., 2004). Thus, it is surprising to find that research stemming from TEI theory has seldom addressed the social functions of emotions in accounts of the role of TEI in social support or social adjustment (Keltner & Haidt, 2001). In the present work, the social functional account of emotions was integrated with prevailing definitions of TEI as reflecting the propensity to perceive and express emotions to explain these links. From this integrative perspective, the associations of TEI with perceived support and social adjustment involve a dynamic interplay between emotion perception and expressivity in the social environment. The tendencies to

perceive others' emotions and fluently express one's own emotions regulate the flow of emotion-based information between social partners (Izard, 2001; Keltner & Kring, 1998). This on-going, reciprocal process of emotion exchange may facilitate not only the identification, development and maintenance of supportive social relationships but also situationally appropriate and socially adaptive responding that enhance social functioning (Shiota et al., 2004). Although the integration of the social-functional account of emotions with TEI theory offers a comprehensive picture of the ways in which TEI may be implicated in perceptions of support and social adaptation, the present data should only be considered as rudimentary evidence supporting the social-functional explanation for these associations. This is because the single measurement of TEI at the beginning of the semester precludes inferences about the dynamic interplay between dispositional emotion expressivity and perception along the entire timeline of unfolding social relationships. Nevertheless, the present integrative account may serve to theoretically undergird previous findings and provide a conceptual basis on which future research on these links can be conducted.

In addition to these implications for TEI theory, the present work has important implications for future inquiry into university adjustment. Although the past two decades have witnessed a growing interest in examining adaptation to university, advances in the study of adjustment have been limited by the absence of a coherent, theoretically-based definition of the construct. The most widely used definition and operationalization of university adjustment in the psychological literature stems from a descriptive taxonomy of adaptation with little theoretical grounding (Baker & Siryk, 1984). In this taxonomy, developed by Baker and Siryk (1984), elucidation of the core facets of the adaptation construct preceded any substantial review of the theoretical adjustment literature and was predicated on the limited definition of adjustment as only the extent to which students meet various role demands (Baker & Siryk, 1984; M. A. Taylor & Pastor, 2007). Indeed, in an unpublished manuscript that Baker was conceiving at the time of his death in 2002, he argued that the validity of the empirical constructs contained in his descriptive model of adjustment rests on empirical evidence and not theoretical grounds. This is problematic for two reasons. First, empirical derivation of the adjustment constructs precludes their theoretical connection to existing accounts of university integration, involvement and well-being. Second, the lack of a theoretical foundation undergirding the conceptual content domain of the adjustment constructs suggests that the validity of the construct hinges on the weight of empirical evidence alone. The presence of anomalous empirical findings can call into question the

validity of the descriptive construct (M. A. Taylor & Pastor, 2007), which cannot be recovered on theoretical grounds.

In the present work, a novel formulation of university adjustment was advanced to address the limitations of Baker and Siryk's (1984) descriptive model and provide a coherent, theoretically-derived definition of adjustment to guide the present research and future inquiry. The novel theoretical formulation is based on the synthesis of several accounts of institutional integration and well-being (Astin, 1999; Diener et al., 1999; Lent, 2004; Ryff, 1989; Tinto, 1993). Specifically, Tinto (1993) and Astin's (1999) theories of student departure and involvement, respectively, were integrated to conceptualize academic and social adjustment in terms of optimal academic and social functioning. In addition, SWB and PWB perspectives on well-being were integrated to propose the major components of psychological adjustment in line with the emerging tradition of optimal well-being (Keyes et al., 2002; Lent, 2004). From this integrative perspective, adaptation is posited to occur in interrelated academic, social and psychological domains, and the social and psychological adjustment factors are hypothesized to index a generalized, higher-order psychosocial adjustment construct.

The present study yielded a good deal of support for this formulation. First, the primary-level factor loadings were uniformly moderate to strong, suggesting sufficient covariation among the theoretically-specified indicators in the definition of the adjustment constructs. Second, as expected, CFA analyses yielded support for the higher-order factor structure in explaining the covariation between the social and psychological adjustment factors. Third, academic adjustment was found to be strongly, but not perfectly, related to psychosocial adjustment, supporting the multidimensionality tenet of the present account. Although the conceptual content domain of this formulation of university adjustment resembles the sampling domain of Baker and Siryk's (1984) descriptive taxonomy, the major advantage of the present account is that it can be tied to existing theories of integration and well-being.

Quite apart from providing a conceptual definition of adjustment and guiding the operationalization of the constructs in the present research, it is hoped that researchers find this integrative conceptualization useful in the conduct of studies investigating university adjustment. However, any future research examining adaptation in line with this account should consider closely the utility of the higher-order representation of the social and psychological adjustment factors. To the extent that social and psychological adjustment are

differentially predicted by various exogenous variables (e.g., personality) or differentially implicated in various external criteria (e.g., achievement, retention), the hierarchical structure, notwithstanding its conceptual plausibility, may be limited. Additionally, a logical next step in advancing this formulation is the development of a measurement instrument designed to operationalize the constructs with a higher degree of fidelity.

8.2 Implications for Methodology

The present work also holds a number of important implications for educational and psychological methodology. First, in the course of reporting the methods and results of the simulation in Chapter Six, the present work advanced a general framework for the conduct of a priori N_{min} estimation based on Monte Carlo methods. This approach, known as the APP approach, integrates traditional power analytic perspectives on N_{min} determination and parameter evaluation (J. Cohen, 1992a, 1992b) with AIPE (Kelley & Maxwell, 2003) and model quality (Gagné & Hancock, 2006) approaches. Specifically, *N* planning in the APP framework involves not only obtaining a reasonable probability of rejecting the false null for estimated parameters but also achieving optimal model quality and unbiased parameter estimates and standard errors as well as reliable confidence intervals. Addressing the issue of N_{min} estimation from this integrative perspective using Monte Carlo methods redresses the limitations of existing approaches, such as the overall model-data fit approach (MacCallum et al., 1996) and general heuristics (P. Barrett, 2007; Hoogland & Boomsma, 1998; Tanaka, 1987), which are not sufficiently model-specific and may result in substantially biased estimates of N_{min} requirements. Indeed, the APP approach may improve the precision of the N_{min} estimate because specific data and model contingencies, which are known to influence sample requirements, can be adequately modeled (e.g., missing data, model complexity) (L. K. Muthén & Muthén, 2002; Wolf et al., 2013). This approach represents a paradigmatic shift in a priori N_{min} determination from a power analytic perspective exclusively, as espoused in the classical hypothesis testing paradigm, to a focus on optimizing solution quality and enhancing estimation as well as achieving sufficient statistical power. Approaching *N* planning from the APP perspective may lead to the generation of optimal study designs in which there is adequate power for some minimally important parameter while also obtaining an admissible solution containing unbiased estimates.

The APP framework can be seamlessly extended to post-hoc investigations of accuracy, propriety and power. Once data are collected and the analytic model fitted, researchers should

investigate the sufficiency of the obtained *N*. To this end, a post-hoc Monte Carlo experiment can be conducted to evaluate the propriety of a final solution, the extent of bias in model estimates and the statistical power of discrete tests of estimated parameters based on the obtained *N* (Thoemmes et al., 2010). In this simulation, estimates obtained from a final empirical solution are used as input population values along with modeling observed data characteristics (e.g., observed missingness). A post-hoc Monte Carlo study can provide rich information about the quality of the model solution and concomitant parameters, which may aid in the interpretation of findings. For instance, as shown in the empirical tests of the structural models reported in Chapter Seven, the failure to find a statistically significant path from engagement coping to psychosocial adjustment could be attributed to (a) the absence of any real effect in the population or (b) inadequate statistical power to reject the H_0. The post-hoc Monte Carlo results, considered with findings obtained from the a priori simulation, served to clarify this empirical finding of non-significance. In this regard, inferences drawn from analytic results can be enriched by the Monte Carlo findings.

The Monte Carlo procedures for *N* estimation and post-hoc model evaluation from the APP perspective presented are relevant to investigators analyzing data within a broad mean and covariance structure framework. This includes parametric structures ranging from simple single-level regression models comprising only manifest variables to complex multi-level latent variable models incorporating both mean and covariance structures (L. K. Muthén & Muthén, 2002). However, as with the AIPE approach to *N* planning (Kelley & Maxwell, 2003) estimates of N_{min} based on the APP simulation procedure will only be as good as the input parameters provided. This necessitates a thorough familiarity with the relevant literature on the part of the investigator. It is also acknowledged that the Monte Carlo procedure is computationally intensive, much more so than other available methods for estimating sample requirements (MacCallum et al., 1996; Satorra & Saris, 1985). The problems of selecting input effect sizes and high computational complexity should not, however, lead investigators to reject the Monte Carlo approach in favor of common rules of thumb. Even the use of the APP procedure with rough input population parameter estimates is likely to be better than using general heuristics that contain no data-or-model-specific information. Furthermore, with rapid advances in CPU speed and RAM capacity over the past 15 years, computational burden is unlikely to be a major difficulty for most analytic models in the social and behavioral sciences. Aside from enhancing the design of the present research by providing a robust estimate of *N* requirements and clarifying the present model results, it is hoped that

substantive researchers find this integrative framework useful in the design of research and analysis and interpretation of findings.

A second methodological implication of the present work concerns the continued use of the causal-steps procedure for assessing mediation in the scientific literature. Over the past two decades, the most widely used procedure for assessing mediation has been Baron and Kenny's (1986) causal steps approach (Fritz & MacKinnon, 2007; Perera, 2013;). The strategy can be summarized in the following three steps: (a) demonstrate that *X* has a significant effect on *Y* (i.e., $c \neq 0$); (b) demonstrate that *X* significantly predicts *M* (i.e., $a \neq 0$); (c) demonstrate that M significantly influences Y, partialling out the influence of X (i.e., $b \neq 0$). Full or perfect mediation is typically reported when the effect of *X* on *Y* is reduced to zero, controlling for *M* whereas partial mediation is reported when the effect of *X* on *Y* remains significant after controlling for the influence of the intervening variable (Baron & Kenny, 1986). In this traditional mediational framework, the significance of the total effect of *X* on *Y* is a prerequisite to proceeding with analyses of mediation (Baron & Kenny, 1986). Indeed, perhaps due to the quasi-paradigmatic status of Baron and Kenny's original paper, which has been cited approximately 43,000 times as of March 2014, the conventional wisdom among many applied researchers is that the absence of a total effect precludes the possibility of finding indirect relations. It even appears that some reviewers are rejecting for publication manuscripts reporting evidence of mediated effects on the basis that the initial *X*-to-*Y* total effect is not demonstrated, and this is a cause for concern (Zhao et al., 2010).

The statistical significance of the total effect as a precondition to assessing mediation may be overly restrictive. This is because significant indirect effects can emerge in the absence of significant total effects (Hayes, 2009; Rucker et al., 2011; Zhao et al., 2010). Recent simulation evidence shows that when the total effects is weak, relative to the *a* and *b* paths constituting the indirect effect, significant indirect effects can be detected notwithstanding the absence of a significant total effect. For example, with an $N = 200$, a small-to-medium population value of the total effect (i.e., $c = .20$) and population values of the *a* and *b* paths equal to .4 (i.e., $ab = .16$), Rucker et al. (2011) demonstrated that detecting a significant indirect effect in the absence of a significant total effect can be expected to occur about 45% of the time. This is by no means indicative of an infrequent occurrence with sample sizes typical of research in education and psychology. In the present work, empirical evidence was obtained to complement this simulation evidence. Specifically, a positive indirect effect of

TEI on achievement via engagement coping and academic adjustment linked serially was found in the absence of a significant total effect. It seems quite likely that, had the present analysis of mediation been carried out using the Baron and Kenny (1986) procedure, which requires, in the first instance, a significant total effect, support for the three-path indirect effect would not have been found.

Although somewhat counterintuitive and puzzling prima facie, the idea that an indirect effect can emerge in the absence of a total effect is statistically and conceptually plausible and important for theory testing and development. Statistically, the total effect of *X* on *Y* is computed as the sum of all possible direct and indirect paths from *X* to *Y* (Perera, 2013). To the extent that the constituent direct and indirect paths are of identical magnitudes, but opposite signs, the total effect of *X* on *Y* will equal zero by virtue of the paths cancelling each other out (i.e., inconsistent mediation) (see MacKinnon et al., 2000). Even where the opposing effects are not of equal magnitude, effects of similar magnitude and opposite signs can produce a non-zero, but non-significant, total effect (MacKinnon et al., 2000). In the present research, the latter type of inconsistent mediation was tentatively observed, producing a total effect of TEI on achievement that was not significantly different from zero. Conceptually, this effect was explained by potentially competing theoretical mechanisms linking TEI with achievement (see Chapter Seven). In this case, the present data would not meet the first criterion for mediation in line with the causal steps approach (Baron & Kenny, 1986), leading to misleading conclusions regarding mediation and impeding the development of theory. Taken with the simulation results reported in Rucker et al. (2011) and examples of indirect effect in the absence of total effects emerging in the empirical literature (Pekrun et al., 2009), the present work calls into question the continued use of the causal steps strategy in assessing mediation hypotheses. In line with the recent methodological literature on statistical mediation, the present research recommends a departure from the precondition of significant total effects to proceed to tests of mediation. Instead, researchers testing mediation hypotheses should focus on the magnitude of the indirect effect taken as the product of coefficients (Hayes, 2009; Perera, 2013; Rucker al., 2011).

A final methodological implication of the present research is the importance of employing an alternative models approach to model specification and testing in mean and covariance structure analysis. In the alternative models framework, the target parametric structure is evaluated in two ways. First, the model is assessed with respect to the sample data; second,

given acceptable model-data fit, the target model is evaluated with regard to theoretically-plausible alternative specifications to determine the model that offers the best account of the observed data (Hoyle, 2012). Reviews have suggested a general reluctance on the part of investigators to consider alternative explanations of data in applications of covariance structure modeling (Henley, Shook, & Peterson, 2006; MacCallum & Austin, 2000; MacCallum et al., 1993). However, the costs of ignoring alternative specifications can be serious, including an increased susceptibility to committing confirmation biases (McCallum & Austin, 2000). In line with this recognition, numerous methodologists have recommended the systematic examination of alternative parametric structures, including equivalent, near-equivalent and non-equivalent models (Hershberger & Marcoulides, 2013; McDonald & Ho, 2002; Tomarken & Waller, 2003; L. J. Williams, 2012). Consistent with these recommendations, the empirical tests of the structural models in the present research involved statistical comparisons of four nested, near-equivalent models. Notably, in the present work, support was found for an alternative parametric structure, which, though equally well-fitting relative to the target specification, provided a more parsimonious account of the observed data. It seems quite possible that, had the present model evaluation been carried out using a strictly target-model-only approach (Hoyle, 2012), support for this more parsimonious solution would not have been found. Instead, the target structural model would have been retained by virtue of its acceptable fit in absolute terms, irrespective of theoretically-plausible alternative explanations, thereby resulting in a confirmation bias. In accord with others (McDonald & Ho, 2002; Tomarken & Waller, 2003), the author submits for consideration the requirement that, in all applications of SEM, substantive researchers consider multiple a priori parametric structures that are theoretically defensible.

Any comparative evaluation of multiple a priori models in the alternative models framework should consider equivalent alternative parametric structures. Although no equivalent models were formally considered in the present work, which is a crucial limitation of the current research as noted in Chapter Seven, they present a crucial threat to causal inference (Hershberger & Marcoulides, 2013). Equivalent models are a special class of alternative parametric structures that yield identical implied variance-covariance matrices to a target covariance structure but may differ considerably in substantive interpretability (S. Lee & Hershberger, 1990; MacCallum et al., 1993; Raykov & Marcoulides, 2001, 2007; Stelzl, 1986). It is acknowledged that for any given multivariate dataset there exist several equivalent models. For example, Bollen (1989) showed that an a priori model comprising

three measured variables could produce a staggering 10 equivalent models. These models, whether substantively meaningful or not, can be generated using replacing rules (S. Lee & Hershberger, 1990; Stelzl, 1986) or recently developed automated procedures, such as TETRAD (Hoyle, 2012). The difficulty with equivalent models in the alternative models framework is that they cannot be distinguished statistically from a target specification due to mathematical equivalence. Yet, equivalent models present the greatest threat to the validity of any given covariance structure because any one equivalent model cannot be supported without all of the models being supported (Hershberger & Marcoulides, 2013). How can researchers choose from among potentially several equivalent models?

Once generated, several procedures can be used to select from among equivalent models. Even before data collection, equivalent models can be ruled out on the basis of theoretical implausibility. This includes minimizing the number of possible equivalent structures through protective design features as used in the present study (e.g., multi-wave data) (S. Lee & Hershberger, 1990; MacCallum et al., 1993). More recent methods for choosing among equivalent models include (a) comparing R^2 values for endogenous factors from a suite of equivalent structures (Hershberger, 2006), (b) the computation of the information complexity criterion (L. J. Williams, Bozdogan, & Aiman-Smith, 1996), (c) assessment of model quality, including the diagnosis of estimation difficulties (e.g., high number of iterations for a solution to converge), and (d) the calculation of extended individual case residuals (Hershberger, 2006; Raykov & Penev, 2001). Investigators using SEM techniques to investigate substantive problems are urged to generate equivalent models, evaluate their theoretically-meaningfulness and select from among these equivalent specifications as part of the alternative models strategy. These efforts are likely to not only protect against confirmation biases but also reinforce the tenability of the retained solution (MacCallum & Austin, 2000).

8.3 Implications for Practice

From an applied perspective, the results of the present research have implications for education and university counselling. First, the result of a non-trivial validity coefficient for the TEI-achievement relation obtained in the meta-analysis, and the finding of the indirect TEI-achievement relation in the empirical test of the structural models, suggest that it may be untenable to employ only cognitive ability assessments in academic selection processes (Chamorro-Premuzic & Furnham, 2003; Perera & DiGiacomo, 2013). This is in line with growing calls among educators and university administrators for the assessment of non-

cognitive constructs in addition to traditional ability assessments in a suite of selection tool for evaluating university readiness (Everson, 2003; G. Matthews, Zeidner et al., 2006).

The inclusion of specific affective personality assessments in academic selection processes may be especially important in educational settings where socio-emotional content is under assessment (Perera & DiGiacomo, 2013). One context of particular relevance for the implementation of TEI assessments is medical and nursing schools in which matriculated candidates typically undertake traditional biomedical science subjects as well as community-based practical courses requiring interaction with patients (Austin, Evans et al., 2005). Apart from the motivational dispositions reflected in TEI that may guide coping efforts and promote academic adjustment towards optimal achievement, it may be that dispositional emotion perception and expressivity sustain the flow of emotion-based information between medical students and patients in ways that enhance interaction, resulting in better practical course achievement (Austin, Evans et al, 2005; Perera & DiGiacomo, 2013). A comparable benefit of TEI with respect to achievement may be observed in teacher education programs, requiring practical components, in which the interchange of emotional information between preservice teachers and students is crucial for effective communication, classroom management and, ultimately, teaching performance (Emmer & Stough, 2001; Sutton & Wheatley, 2003).

The present data also have some potential implications for university personnel once students are matriculated in academic programs. The findings of the prospective relations of TEI with university adjustment and achievement suggest that affective personality assessments may be useful as screening devices for university counselors and other student services personnel. This is consistent with recent recommendations for the use of personality assessments in identifying students who are likely to underperform (Poropat, 2009). The failure to employ affective personality assessments as screening tools, predicated on the assumption of null relations, may hamper counselors' and practitioners' early detection of students at risk of maladjustment, academic failure and, ultimately, attrition (Lidy & Kahn, 2006). The identification of students at-risk on the basis of dysfunctional affective personality may support the timely provision of targeted interventions designed to address the academic and social-emotional consequences of this dysfunction (Perera & DiGiacomo, 2013). For instance, in an educational environment of increasingly individualized and flexible academic programs, one possibility is the adjustment of instruction to accommodate the specific

personality characteristics of the students, as assessed by affective personality measures, in order to optimize achievement (Carey, 1998; G. Matthews, Zeidner et al., 2006; Poropat, 2009).

Another possibility is the implementation of psychosocial interventions aimed at developing coping skills and supportive social networks for students with affective personality dysfunction. In the present study, the findings that engagement coping and social support mediated the effects of TEI on adaptation underpin the centrality of these mediators as potential portals for structured psychosocial interventions, such as coping effectiveness training (CET) and peer support programs, designed to optimize adjustment and achievement (Folkman & Moskowitz, 2004; Lidy & Kahn, 2006). From this standpoint, in a temporal chain of events across the first semester, the potentially adverse effects of affective personality dysfunction on adjustment and achievement may be minimized or diminished by intervening at the proximal mediation stage. For instance, individuals who are coping ineffectively, and possibly at-risk of maladjustment, due to affective personality dysfunction may be targeted for early CET, involving the disaggregation of transition stressors into a series of discrete coping tasks, as well as support in the selection of specific coping strategies to manage discrete adjustment challenges contingent on the individual's appraisal of the controllability of the situation (S. E. Taylor & Stanton, 2007). Additionally, the early provision of peer support programs could aid in the development of supportive social networks (Lidy & Kahn, 2006; Pratt et al., 2000), which may serve as a further resource for managing stressors across the transition.

On a more general level, a third possibility is the implementation of interventions aimed at improving emotional knowledge and skills for individuals with affective personality dysfunction. Although TEI dispositions, like other personality traits, may be difficult to modify, especially in the short-term, emotional knowledge and skills may be more amenable to systematic intervention. Emotional knowledge refers to the complexity and extent of an individual's conceptual-declarative knowledge of emotions (Nelis, Quoidbach, Mikolajczak, & Hansenne, 2009). Emotional skills refer to the ability to apply emotion knowledge in an affect-loaded situation (Mikolajczak, Petrides et al., 2009). Both emotional knowledge and skills should be distinguished on conceptual groups from TEI, which reflects affect-related characteristic patterns of feelings, thoughts and behaviors (Perera & DiGiacomo, 2013). The presence of low levels of one dimension does not preclude the possibility of high levels of

another dimension. For instance, an individual dispositionally low in emotion perception, expressivity and regulation may be trained to identify and listen to others' emotions, express emotions to others and regulate their emotions in certain academic and social situations, resulting in higher levels of emotional skills (G. Matthews, Zeidner et al., 2006; Nelis et al., 2009; 2011). The largely positive, but only modest, correlations among these dimensions of emotional functioning found in the empirical literature support this conceptual distinction (Lumley, Gustavson, Partridge, & Labouvie-Vief, 2005; Qualter et al., 2012). The conceptual and empirical distinctions are also suggestive of the possibility of improving the emotional knowledge and skills of those with affective personality dysfunction.

Intervention programs designed to improve the emotional skills and knowledge of individuals have proliferated in the past decade. The development of many of these programs has been motivated by the socio-emotional learning movement that has gripped mainstream education (G. Matthews, Zeidner et al., 2006; Zins, Payton, Weissberg, & O'Brien, 2007; Zins, Weissberg, Wang, & Walberg, 2004). At least 150 different emotional skills and knowledge programs are used across the United States, including the Resolving Conflicts Creatively Program (Aber, Jones, Brown, Chaudry, & Samples, 1998) and Yale-New Haven Social Competence Promotion Program (Shriver, Schwab-Stone, & DeFalco, 1999; see Zeidner, Roberts, & Matthews, 2002 for a review). However, there are at least three important limitations of these programs that merit attention. First, many of these interventions lack a conceptual framework that has been the object of systematic empirical testing (G. Matthews, Zeidner, & Roberts, 2002; Nelis et al., 2009; Zeidner et al, 2002). Second, most of the programs suffer from crucial methodological shortcomings, including inadequate statistical control, the failure to assess long-term effects and the use of suboptimal measures of emotional skills and knowledge, which present a threat to the internal and external validity of any findings (G. Matthews et al., 2002; Zeidner et al, 2002). Finally, many of these programs target only a few emotional competencies while others include skills and competencies (e.g., decision-making), which, while related to emotional skills, are not strictly a part of the emotional competence content domain (Nelis et al., 2009, 2011).

A recent program of emotional competence training has emerged in the emotions literature that redresses the limitations of existing socio-emotional learning programs and may be useful for enhancing the emotional skills and knowledge of individuals with affective personality dysfunction (Nelis et al., 2009, 2011). This program is predicated on both Mayer

and Salovey's (1997) four-branch model of EI and the tripartite model of EI that posits three levels of emotional functioning: affective traits, skills, and knowledge (Mikolajczak, Petrides, 2009). The program aims to develop emotional knowledge and competencies through the provision of an integrated curriculum centered on teaching theoretical knowledge about emotions as well as training participants to apply emotional skills to affect-loaded situations in their lives (Nelis et al., 2009, 2011). For example, in a session on emotion perception, participants learn to identify emotions through nonverbal communication and facial expression decoding (Nelis et al., 2011).

There has been some empirical support for the effectiveness of this program. In a test of the training program using a controlled experimental design, Nelis et al. (2009) found a statistically significant increase in emotional identification and emotion management competencies in participants exposed to the treatment whereas no changes in these emotional skills were observed for control participants. Notably, the development of emotional skills remained stable after 6 months, which is indicative of the long-term effects of the emotional competence training (Nelis et al., 2009). In a second, independent, test of this training program using a comparable experimental design, Nelis et al. (2011) found that the development of emotional competencies was predictive of increases in psychological well-being and the quality of social relationships. For individuals low on TEI, the implementation of emotion knowledge and skills training programs may minimize or diminish the pathogenic effects of affective personality dysfunction on psychosocial functioning. A direct test of this proposition would require the examination of the moderating effect of developed emotional competencies on the affective personality dysfunction-well-being relation.

Notwithstanding these possible implications for practice, practical utility has been a particularly thorny issue in the TEI literature for at least two reasons. First, pseudo-scientific "EQ-is-good-for-you" programs emerged in the psychological and business literatures well before the explication of a rigorous and testable theory (Petrides, 2011). Second, numerous instruments have been developed to measure various EI constructs with little theoretical underpinning, calling into question the validity of empirical results (Perez et al., 2005; Petrides, 2009, 2011). These developments have served to only push the field of TEI and its potential practice implications to the periphery of scientific psychology (Perera & DiGiacomo, 2013). Notwithstanding recent attempts to adequately theorize about and measure the construct (Perera & DiGiacomo, 2013; Petrides, 2011), much more work on the

psychosocial processes through which TEI is linked with optimal functioning is needed before it can be determined whether affective personality assessments will prove useful in the early detection of academically vulnerable and socio-emotionally at-risk students. Similarly, though there have been noteworthy advances in recent years in identifying potential treatment options for those with affective personality dysfunction (Nelis et al, 2009, 2011), further examination of the intervention potential of emotion competence training is required using robust experimental and psychometrically sound designs with long-term outcomes under scrutiny (Zeidner et al., 2002; G. Matthews, Zeidner et al., 2006). Thus, much caution is urged in executing any of the practice-based suggestions raised in this discussion until a systematic program of inquiry addressing these research issues has been carried out and reported.

8.4 Concluding Comments

The present research has been centrally concerned with examining the direct and indirect roles of TEI in adaptation and achievement during a stressful life event. These issues were examined meta-analytically and in short-term sequential models that drew upon theory and empirical evidence bearing on emotions, regulation and adaptation. These models provided an integrative perspective on the mechanisms linking TEI, adaptation and achievement. Addressing these issues with such conceptual integration was crucial to understanding the associations of this high bandwidth dispositional construct with adaption and achievement and extends the bulk of previous research that has typically demonstrated relations without offering much in the way of theoretical explanation.

While the emphasis of the present work was on testing the a priori structural models linking TEI and achievement, a crucial first step in this process was determining the validity of TEI for predicting achievement in light of inconsistent results in the empirical literature. Accordingly, a meta-analytic review of the TEI-achievement relationship was conducted and reported in the first study of this research in which 47 independent effects were synthesized. The meta-analysis yielded evidence for a near-moderate positive validity coefficient for TEI. The meta-analytic findings not only extend the TEI literature by clarifying the TEI-achievement relationship but also, in the context of the present research, served to reinforce the structural model specifications linking TEI with achievement.

In testing the structural models in the second study, the present work extends the acquired meta-analytic evidence and contributes to a growing literature on the direct and indirect roles of TEI in adaptation and achievement in a number of ways. First, the findings replicate commonly reported results indicating that TEI is associated with higher perceived social support, the use of engagement coping and greater psychosocial adjustment. Second, the present work also replicates recent findings indicating that at least one reason that individuals high on TEI report better psychosocial adjustment is that they perceive higher levels of social support. Third, the mediating processes supported by the data extend prior research by demonstrating the centrality of engagement coping as a proximal mediator that carries the effect of TEI to academic adaptation. Finally, the data obtained from the empirical tests of the structural models extend the obtained meta-analytic evidence and prior research by disentangling a multistage pathway through which TEI is linked with achievement via engagement coping and academic adaptation linked serially. This cumulative evidence contributes to an understanding of the underlying mechanisms through which TEI is associated with adaptation and achievement during a stressful educational event.

In addition to addressing these primary research foci, the present work makes a number of other important contributions. For example, the meta-analytic review clarified that age and academic level exerted significant moderating influences on the summary relation between TEI and achievement, suggesting that researchers must consider specific population characteristics in theorizing about the role of TEI in achievement. The meta-analytic review also clarified that, at the highest level of conceptual aggregation, gender was not a significant moderator of the TEI-achievement relationship. In addition, the current research found support for a novel conceptualization of university adjustment based on the integration of existing accounts of university integration, involvement and well-being. Furthermore, in the course of conducting a Monte Carlo experiment to determine N_{min} for the target model specification, the current research advanced a novel framework for the conduct of a prior N_{min} estimation and post-hoc determination of solution propriety, parameter bias and statistical power based on simulation methods. Finally, the present study empirically showed that significant indirect associations can emerge in the absence of significant total effects, complementing existing simulation work. It is hoped that these developments are useful for future investigators in the conduct of inquiry into (a) TEI and university adjustment, (b) *N* planning and model evaluation and (c) tests of indirect effects, respectively.

In summary, the present research entails many novel contributions as follows:

- the research is among the first attempts to align TEI with the existing emotions literature and biological and goal-based models of regulation to provide a comprehensive account of the ways in which the dispositional construct is associated with perceived social support, engagement coping, adaptation and achievement;
- the research comprises a comprehensive meta-analytic review of the TEI-achievement association, clarifying the relationship in the psychological literature and providing evidence for the moderating roles of age and academic level in this link;
- the research is the first to decompose the zero-order relationship between TEI and achievement, showing that the total effect, in the present university sample, was largely attributable to an indirect effect via engagement coping and academic adaptation linked serially;
- the research is the first to document a potential negative impact of TEI on achievement, generating a novel line of theorizing concerning the divergent effects of TEI on achievement;
- the research is the first to empirically show that individuals high on TEI exhibit better academic adjustment to university, and this association is due to the coping strategies they use to manage transition stressors.
- the research is the first to advance an integrative, theoretically-based conceptualization of university adjustment that not only is testable but also links the adjustment constructs to mainstream conceptual accounts of integration, involvement and well-being;
- the research is among the first attempts to outline an integrative, procedural framework for the conduct of a priori N_{min} determination and the post-hoc evaluation of model quality, bias and statistical power based on Monte Carlo methods; and,
- the research is among the first to demonstrate that statistically significant indirect associations can emerge in the absence of significant total effects, adding important empirical evidence to the body of existing simulation work.

Taken together, the studies constituting the present research have provided a great deal of data illuminating the ways in which TEI in linked with adaptation and achievement during a stressful educational event. These data not only hold important implications for TEI theory

and the validity of the TEI construct but are also relevant for educational practitioners and university administrators and counselors who operate in selection and screening contexts. The data acquired also have more general methodological implications for investigators conducting N planning, post-hoc evaluations of model quality, bias and statistical power, and tests of mediation hypotheses in a mean and covariance structure framework. In addition, the data highlight the need to examine TEI effects at lower levels of conceptual aggregation, under exposure to specific stressors, as well as consider further plausible mediational mechanisms in the temporal chain of events leading from TEI to adaptation and achievement. By aligning the construct with the rich literatures on emotions and regulation, it is hoped that the present work will prompt further efforts to integrate TEI with theoretical accounts of emotion and regulation on which the promising affective-motivational construct should be based.

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Appendices

Appendix A: Covariance Algebra used to calculate the Disturbance Variance Terms for the Endogenous Factors in the Population Target Mediation Model for the Monte Carlo Simulation

The five endogenous factor variances in the target mediation model can be expressed as follows:

$$Var(M_1) = a_1^2 \times Var(X) + Var(e_{M1})$$
$$Var(M_2) = a_2^2 \times Var(X) + Var(e_{M2})$$
$$Var(M_3) = c_2^2 \times Var(X) + b_3^2 \times Var(M_2) + 2(c_2 b_3) \times \mathrm{Cov}(X, M_2) + Var(e_{M3})$$
$$Var(M_4) = c_1^2 \times Var(X) + b_1^2 \times Var(M_1) + b_2^2 \times Var(M_2) + 2(c_1 b_2) \times Cov(M_1, M_2) + 2(c1b1) \times Cov(\mathrm{X}, M_1) + 2(c1b2) \times \mathrm{Cov}(X, M_2) + Var(e_{M4})$$
$$\mathrm{Var}(Y) = c_3^2 \times Var(X) + b_4^2 \times Var(M_4) + b_5^2 \times Var(M_3) + 2(b_4 b_5) \times Cov(M_4, M_3) + 2(c_3 b_4) \times Cov(X, M_4) + 2(c_3 b_5) \times Cov(X, M_3) + Var(e_Y)$$

where *Var* is the variance of an endogenous factor; a_1 is the path from TEI to perceived support, a_2 is the path from TEI to engagement coping, c_2 is the path from TEI to academic adaptation, c_1 is the path from TEI to psychosocial adaptation, c_3 is the path from TEI to achievement b_3 is the path from engagement coping to academic adaptation, b_1 is the path from perceived support to psychosocial adaptation, b_2 is the path from engagement coping to psychosocial adaptation, b_4 is the path from psychosocial adaptation to achievement, and b_5 is the path from academic adaptation to achievement; *Cov* is a covariance; and *Var*(*e*) is a residual or unexplained variance term.

As all factor variances were fixed to 1.0 in the population model, disturbance variances were solved by substituting 1 into the equations and solving for the remaining unknowns as follows:

$$Var(M_1) = a_1^2 \times Var(X) + Var(e_{M1})$$
$$1 = .45^2 \times 1 + Var(e_{M1})$$
$$1 = .2025 \times 1 + Var(e_{M1})$$
$$Var(e_{M1}) = 1 - .2025$$
$$Var(e_{M1}) = 0.7975$$
$$Var(M_2) = a_2^2 \times Var(X) + Var(e_{M2})$$
$$1 = .50^2 \times 1 + Var(e_{M2})$$
$$1 = .25 + Var(e_{M2})$$

$Var(e_{M2}) = 1 - .25$

$Var(e_{M2}) = 0.75$

$Var(M_3) = c_2^2 \times Var(X) + b_3^2 \times Var(M_2) + 2(c_2 b_3) \times \text{Cov}(X, M_2) + Var(e_{M3})$

$1 = .36^2 \times 1 + .27^2 \times 1 + 2(.36 \times .27) \times .50 + Var(e_{M3})$

$1 = 0.1296 \times 1 + 0.0729 \times 1 + 2(0.0972) \times .50 + Var(e_{M3})$

$Var(e_{M3}) = 1 - .2997$

$Var(e_{M3}) = 0.7003$

$Var(M_4) = c_1^2 \times Var(X) + b_1^2 \times Var(M_1) + b_2^2 \times Var(M_2) + 2(c_1 b_2) \times Cov\,(M_1, M_2) +$
$2(c1b1) \times Cov\,(\text{X}, M_1) + 2(c1b2) \times \text{Cov}(X, M_2) + Var(e_{M4})$

where

$Cov(M_1, M_2) = Cov(a_1X + Var[e_{M1}], a_2X + Var[e_{M2}])$

$Cov(M_1, M_2) = Cov(a_1X\,,\, a_2X) + Cov(a_1X,\, Var[e_{M2}]) + Cov(Var[e_{M1}], a_2X) +$
$Cov(Var[e_{M1}], Var[e_{M2}])$

$Cov(M_1, M_2) = Cov(a_1X\,,\, a_2X)$

$Cov(M_1, M_2) = a_1 a_2\, Cov(X, X)$

$Cov(M_1, M_2) = .45 \times .50 \times 1$

$Cov(M_1, M_2) = .225$

then

$Var(M_4) = .36^2 \times 1 + .32^2 \times 1 + .09^2 \times 1 + 2(.32 \times .09) \times .225 + 2(.36 \times .32) \times .45 +$
$2(.36 \times .09) \times .50 + \text{Var}(e_{M4})$

$1 = 0.1296 \times 1 + 0.1024 \times 1 + 0.0081 \times 1 + 0.0576 \times .225 + 0.2304 \times .45 + 0.0648 \times$
$.50 + \text{Var}(e_{M4})$

$1 = 0.38914 + \text{Var}(e_{M4})$

$Var(e_{M4}) = 1 - 0.38914$

$Var(e_{M4}) = 0.61086$

$Var(Y) = c_3^2 \times Var(X) + b_4^2 \times Var(M_4) + b_5^2 \times Var(M_3) + 2(b_4 b_5) \times Cov(M_4, M_3) +$
$2(c_3 b_4) \times Cov(X, M_4) + 2(c_3 b_5) \times Cov(X, M_3) + Var(e_Y)$

where

$Cov(X, M_4) = Cov(X, c_1X + b_1M_1 + b_2M_2 + Var[e_{M4}])$

$Cov(X, M_4) = Cov(X, c_1X) + Cov(X, b_1M_1) + \text{Cov}(X, b_2M_2) + \text{Cov}(X, Var[e_{M4}])$

$Cov(X, M_4) = Cov(X, c_1X) + Cov(X, b_1M_1) + Cov(X, b_2M_2)$

$Cov(X, M_4) = c_1 Cov(X, X) + b_1 Cov(X, M_1) + b_2\, Cov(X, M_2)$

$Cov(X, M_4) = .36 \times 1 + .32 \times .45 + .09 \times .50$

$Cov(X, M_4) = 0.549$

and

$Cov(X, M_3) = Cov(X, c_2X + b_3M_2 + Var[e_{M3}])$

$Cov(X, M_3) = \text{Cov}(X, c_2X) + Cov(X, b_3M_2) + Cov(X, Var[e_{M3}])$

$Cov(X, M_3) = Cov(X, c_2X) + Cov(X, b_3M_2)$

$Cov(X, M_3) = c_2Cov(X, X) + b_3Cov(X, M_2)$

$Cov(X, M_3) = 36 \times 1 + .27 \times .50$

$Cov(X, M_3) = 0.495$

and

$Cov(M_4, M_3) = Cov(c_1X + b_1M_1 + b_2M_2 + Var[e_{M4}], c_2X + b_3M_2 + Var[e_{M3}])$

$Cov(M_4, M_3) = Cov(c_1X, c_2X) + Cov(c_1X, b_3M_2) + Cov(c_1X, Var[e_{M3}]) + Cov(b_1M_1, c_2X) + Cov(b_1M_1, b_3M_2) + Cov(b_1M_1, Var[e_{M3}]) + Cov(b_2M_2, c_2X) + Cov(b_2M_2, b_3M_2) + Cov(b_2M_2, Var[e_{M3}]) + Cov(b_2M_2, Var[e_{M3}]) + Cov(Var[e_{M4}], c_2X) + Cov(Var[e_{M4}], b_3M_2) + Cov(Var[e_{M4}], Var[e_{M3}])$

$Cov(M_4, M_3) = Cov(c_1X, c_1X) + Cov(c_1X, b_3M_2) + Cov(b_1M_1, c_2X) + Cov(b_1M_1, b_3M_2) + Cov(b_2M_2, c_2X) + Cov(b_2M_2, b_3M_2)$

$Cov(M_4, M_3) = c_1c_2Cov(X, X) + c_1b_3Cov(X, M_2) + b_1c_2\ Cov(M_1, X) + b_1b_3Cov(M_1, M_2) + b_2c_2Cov(M_2, X) + b_2b_3Cov(M_2, M_2)$

$Cov(M_4, M_3) = .36 \times .36 \times 1 + .36 \times .27 \times .50 + .32 \times .36 \times .45 + .32 \times .27 \times .225 + .09 \times .36 \times .50 + .09 \times .27 \times 1$

$Cov(M_4, M_3) = 0.28998$

then

$Var(Y) = .17^2 \times 1 + .15^2 \times 1 + .36^2 \times 1 + 2(.15 \times .36) \times 0.28998 + 2(.17 \times .15) \times 0.549 + 2(.17 \times .36) \times 0.495 + Var(e_Y)$

$1 = 0.0289 \times 1 + 0.0225 \times 1 + 0.1296 \times 1 + 0.108 \times 0.28998 + 0.051 \times 0.549 + 0.1224 \times 0.495 + Var(e_Y)$

$1 = 0.30090484 + Var(e_Y)$

$Var(e_Y) = 1 - 0.30090484$

$Var(e_Y) = 0.69909516$

Appendix B: Monte Carlo Simulation Results for the $N = 200$ Run

Table B1

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 200 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$\text{Coverage}_{95\%\text{ CI}}$ (%)	π
$\lambda_{1,1}$	–0.20	1.98	95.4	1.00
$\lambda_{2,1}$	–0.10	0.61	95.2	1.00
$\lambda_{3,1}$	–0.10	3.08	95.2	1.00
$\lambda_{4,1}$	–0.04	–0.64	94.6	1.00
$\lambda_{5,1}$	–0.16	–1.16	94.1	1.00
$\lambda_{6,1}$	–0.14	0.87	95.0	1.00
$\lambda_{7,2}$	–0.69	–1.34	94.5	1.00
$\lambda_{8,2}$	–0.90	–2.82	93.8	1.00
$\lambda_{9,2}$	–0.84	–1.34	94.5	1.00
$\lambda_{10,2}$	–0.79	–1.08	93.2	1.00
$\lambda_{11,2}$	–0.71	–0.55	94.5	1.00
$\lambda_{12,2}$	–1.27	–2.82	93.8	1.00
$\lambda_{13,3}$	–0.58	–1.93	93.8	1.00
$\lambda_{14,3}$	–0.01	–6.18	93.4	1.00
$\lambda_{15,3}$	–0.98	–1.21	94.5	1.00
$\lambda_{16,4}$	–2.09	–2.40	93.3	1.00
$\lambda_{17,4}$	–2.06	–5.19	92.2	1.00
$\lambda_{18,4}$	–1.87	–3.94	93.8	1.00
$\lambda_{19,4}$	–2.56	–3.79	92.8	.99
$\lambda_{20,5}$	–1.34	0.64	93.3	1.00
$\lambda_{21,5}$	–1.37	2.13	94.6	1.00
$\lambda_{22,5}$	–1.24	–0.31	93.6	1.00
$\lambda_{23,6}$	–1.84	–6.80	92.5	1.00
$\lambda_{24,6}$	–1.61	–4.10	94.8	1.00
$\lambda_{25,6}$	–2.60	–2.86	94.1	1.00
$\lambda_{26,6}$	–2.22	–7.66	94.0	1.00
$\lambda_{27,6}$	–2.53	–4.13	95.0	1.00
$\lambda_{28,5}$	–2.04	–3.16	95.6	1.00
$\lambda_{29,6}$	–2.30	–3.17	94.8	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\Gamma_{6,1}$	4.12	–17.69	93.4	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table B2

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 200 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	–1.11	–2.71	94.4	.88
$\beta_{5,4}$	–4.33	–1.58	95.1	.35
$\gamma_{5,1}$	–2.65	–2.34	95.4	.33
$\beta_{3,2}$	–1.07	–8.92	95.1	.51
$\gamma_{3,1}$	5.33	–7.25	95.3	.86
$\beta_{4,1}$	1.22	–0.89	95.1	.99
$\beta_{4,2}$	4.00	–2.88	95.2	.18
$\gamma_{4,1}$	0.58	–2.00	95.4	.97
$\gamma_{2,1}$	1.26	–4.25	95.6	1.00
$\gamma_{1,1}$	1.18	–4.25	95.1	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Table B3

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 200 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	4.69	–7.15	91.7	.54
$\gamma_{4,1}\beta_{5,4}$	–3.70	–5.78	93.2	.21
$\gamma_{1,1}\beta_{4,1}$	1.81	–1.20	94.4	.99
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–5.00	–0.65	94.6	.21
$\gamma_{2,1}\beta_{3,2}$	–0.74	–8.00	93.8	.45
$\gamma_{2,1}\beta_{4,2}$	4.00	–5.07	96.7	.15
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–4.49	–3.61	89.3	.25
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–1.03	92.4	.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Appendix C: Monte Carlo Simulation Results for the Substantive Measurement Parameters across the Admissible Runs

Table C1

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 400 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.12	0.64	95.5	1.00
$\lambda_{2,1}$	–0.15	–0.43	95.0	1.00
$\lambda_{3,1}$	0.00	1.28	95.6	1.00
$\lambda_{4,1}$	–0.01	–0.23	94.5	1.00
$\lambda_{5,1}$	0.00	–0.94	95.5	1.00
$\lambda_{6,1}$	–0.17	–0.73	95.1	1.00
$\lambda_{7,2}$	–0.29	0.97	94.9	1.00
$\lambda_{8,2}$	–0.48	0.00	94.6	1.00
$\lambda_{9,2}$	–0.39	4.26	95.5	1.00
$\lambda_{10,2}$	–0.38	2.65	94.9	1.00
$\lambda_{11,2}$	–0.36	4.02	94.5	1.00
$\lambda_{12,2}$	–0.68	–0.97	94.3	1.00
$\lambda_{13,3}$	–0.26	–0.31	95.6	1.00
$\lambda_{14,3}$	–0.04	–3.46	94.7	1.00
$\lambda_{15,3}$	–0.48	–4.37	93.9	1.00
$\lambda_{16,4}$	–0.73	3.08	95.4	1.00
$\lambda_{17,4}$	–0.46	–4.35	93.7	1.00
$\lambda_{18,4}$	–0.67	–1.82	94.2	1.00
$\lambda_{19,4}$	–0.79	–0.66	94.1	1 00.
$\lambda_{20,5}$	–0.47	–1.78	94.0	1.00
$\lambda_{21,5}$	–0.39	–2.21	95.0	1.00
$\lambda_{22,5}$	–0.47	–1.30	94.3	1.00
$\lambda_{23,6}$	–0.98	–0.89	94.7	1.00
$\lambda_{24,6}$	–0.93	–0.36	96.0	1.00
$\lambda_{25,6}$	–1.53	–1.42	94.4	1.00
$\lambda_{26,6}$	–1.27	–1.36	94.5	1.00
$\lambda_{27,6}$	–1.63	–0.91	95.6	1.00
$\lambda_{28,5}$	–1.28	0.47	95.3	1.00
$\lambda_{29,6}$	–1.55	0.12	95.6	1.00
$\lambda_{30,7}$[a]	–	–	–	–

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	2.02	–5.75	95.1	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C2

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 600 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.08	–1.02	95.0	1.00
$\lambda_{2,1}$	–0.10	4.65	96.1	1.00
$\lambda_{3,1}$	0.09	–1.27	94.4	1.00
$\lambda_{4,1}$	–0.05	–0.28	94.1	1.00
$\lambda_{5,1}$	0.00	–0.87	94.5	1.00
$\lambda_{6,1}$	–0.07	–1.76	95.1	1.00
$\lambda_{7,2}$	–0.24	–0.88	93.8	1.00
$\lambda_{8,2}$	–0.32	–0.29	95.3	1.00
$\lambda_{9,2}$	–0.22	5.26	95.9	1.00
$\lambda_{10,2}$	–0.29	1.60	94.0	1.00
$\lambda_{11,2}$	–0.29	3.93	94.8	1.00
$\lambda_{12,2}$	–0.45	–1.41	94.2	1.00
$\lambda_{13,3}$	–0.30	0.96	95.2	1.00
$\lambda_{14,3}$	–0.20	–2.96	95.3	1.00
$\lambda_{15,3}$	–0.31	–3.35	93.6	1.00
$\lambda_{16,4}$	–0.49	–1.10	95.1	1.00
$\lambda_{17,4}$	–0.36	–6.55	93.6	1.00
$\lambda_{18,4}$	0.22	–2.52	94.4	1.00
$\lambda_{19,4}$	–0.39	1.81	96.0	1.00
$\lambda_{20,5}$	–0.25	0.84	94.4	1.00
$\lambda_{21,5}$	–0.10	–0.83	94.5	1.00
$\lambda_{22,5}$	–0.24	0.54	94.2	1.00
$\lambda_{23,6}$	–0.79	0.48	94.5	1.00
$\lambda_{24,6}$	–0.70	0.59	95.3	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{25,6}$	–1.00	–1.17	94.9	1.00
$\lambda_{26,6}$	–0.86	–1.12	93.9	1.00
$\lambda_{27,6}$	–0.99	–4.16	93.6	1.00
$\lambda_{28,5}$	–0.88	0.00	95.1	1.00
$\lambda_{29,6}$	–1.62	0.57	95.1	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	1.39	–5.13	94.5	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C3

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 800 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.07	–0.59	94.3	1.00
$\lambda_{2,1}$	–0.07	0.91	95.1	1.00
$\lambda_{3,1}$	–0.02	–0.30	94.8	1.00
$\lambda_{4,1}$	0.00	–3.45	94.4	1.00
$\lambda_{5,1}$	–0.01	–2.30	94.5	1.00
$\lambda_{6,1}$	–0.03	–3.65	93.8	1.00
$\lambda_{7,2}$	–0.15	–2.65	93.8	1.00
$\lambda_{8,2}$	–0.20	–2.00	94.5	1.00
$\lambda_{9,2}$	–0.14	4.63	95.6	1.00
$\lambda_{10,2}$	–0.16	0.37	94.6	1.00
$\lambda_{11,2}$	–0.18	–1.08	93.9	1.00
$\lambda_{12,2}$	–0.34	–1.89	94.0	1.00
$\lambda_{13,3}$	–0.08	2.47	95.7	1.00
$\lambda_{14,3}$	–0.03	–2.37	94.3	1.00
$\lambda_{15,3}$	–0.28	–0.88	95.5	1.00
$\lambda_{16,4}$	–0.19	–3.04	96.2	1.00
$\lambda_{17,4}$	–0.24	–4.90	92.9	1.00
$\lambda_{18,4}$	0.33	2.68	96.0	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{19,4}$	0.02	–0.19	95.2	1.00
$\lambda_{20,5}$	–0.19	0.00	95.3	1.00
$\lambda_{21,5}$	–0.06	0.00	94.7	1.00
$\lambda_{22,5}$	–0.17	–0.92	94.6	1.00
$\lambda_{23,6}$	–0.61	–0.91	94.8	1.00
$\lambda_{24,6}$	–0.41	–2.65	94.3	1.00
$\lambda_{25,6}$	–0.80	–3.93	94.1	1.00
$\lambda_{26,6}$	–0.62	–2.87	94.6	1.00
$\lambda_{27,6}$	–0.87	–2.84	93.6	1.00
$\lambda_{28,5}$	–0.57	1.17	95.3	1.00
$\lambda_{29,6}$	–0.87	–0.99	94.2	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	0.90	–3.01	94.5	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C4

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 1000 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.05	1.36	95.7	1.00
$\lambda_{2,1}$	–0.02	0.68	96.5	1.00
$\lambda_{3,1}$	0.12	0.00	94.8	1.00
$\lambda_{4,1}$	0.09	–3.83	94.3	1.00
$\lambda_{5,1}$	0.04	–2.56	94.8	1.00
$\lambda_{6,1}$	0.06	–1.89	94.8	1.00
$\lambda_{7,2}$	–0.12	–4.71	93.8	1.00
$\lambda_{8,2}$	–0.12	–0.76	95.5	1.00
$\lambda_{9,2}$	–0.11	3.14	94.8	1.00
$\lambda_{10,2}$	–0.10	–1.22	95.2	1.00
$\lambda_{11,2}$	–0.16	–1.99	94.4	1.00
$\lambda_{12,2}$	–0.24	–3.27	94.1	1.00
$\lambda_{13,3}$	–0.12	0.00	95.2	1.00
$\lambda_{14,3}$	–0.09	1.00	94.7	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{15,3}$	–0.16	1.01	94.8	1.00
$\lambda_{16,4}$	–0.24	2.68	95.2	1.00
$\lambda_{17,4}$	–0.14	–5.25	94.4	1.00
$\lambda_{18,4}$	0.24	–1.84	94.7	1.00
$\lambda_{19,4}$	0.10	0.42	95.1	1.00
$\lambda_{20,5}$	–0.14	1.45	95.7	1.00
$\lambda_{21,5}$	–0.04	–0.36	94.6	1.00
$\lambda_{22,5}$	–0.15	0.00	94.7	1.00
$\lambda_{23,6}$	–0.16	–0.41	95.0	1.00
$\lambda_{24,6}$	–0.11	–0.94	94.4	1.00
$\lambda_{25,6}$	–0.49	–3.32	93.7	1.00
$\lambda_{26,6}$	–0.36	–1.65	94.8	1.00
$\lambda_{27,6}$	–0.57	–4.17	94.0	1.00
$\lambda_{28,5}$	–0.33	0.56	94.7	1.00
$\lambda_{29,6}$	–0.49	–1.65	94.2	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	0.48	–3.52	93.5	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C5

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 1200 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.07	–1.80	93.8	1.00
$\lambda_{2,1}$	0.07	1.88	96.1	1.00
$\lambda_{3,1}$	0.09	–2.49	94.1	1.00
$\lambda_{4,1}$	0.12	–2.70	93.8	1.00
$\lambda_{5,1}$	0.12	–0.82	94.7	1.00
$\lambda_{6,1}$	0.08	–0.84	95.1	1.00
$\lambda_{7,2}$	–0.12	–5.14	93.9	1.00
$\lambda_{8,2}$	–0.12	1.27	95.7	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{9,2}$	–0.11	2.99	95.7	1.00
$\lambda_{10,2}$	–0.12	–1.32	94.5	1.00
$\lambda_{11,2}$	–0.14	–2.60	93.6	1.00
$\lambda_{12,2}$	–0.23	–1.98	94.3	1.00
$\lambda_{13,3}$	–0.13	1.09	95.8	1.00
$\lambda_{14,3}$	–0.13	1.93	95.7	1.00
$\lambda_{15,3}$	–0.10	0.00	94.6	1.00
$\lambda_{16,4}$	–0.08	4.47	95.7	1.00
$\lambda_{17,4}$	–0.11	–4.72	94.5	1.00
$\lambda_{18,4}$	0.16	0.69	95.2	1.00
$\lambda_{19,4}$	0.00	0.00	95.2	1.00
$\lambda_{20,5}$	–0.06	1.59	94.6	1.00
$\lambda_{21,5}$	–0.01	2.81	95.8	1.00
$\lambda_{22,5}$	–0.04	0.00	94.9	1.00
$\lambda_{23,6}$	–0.25	0.00	94.5	1.00
$\lambda_{24,6}$	–0.16	–1.44	95.3	1.00
$\lambda_{25,6}$	–0.47	–3.63	94.2	1.00
$\lambda_{26,6}$	–0.30	–0.20	94.6	1.00
$\lambda_{27,6}$	–0.51	–4.55	93.9	1.00
$\lambda_{28,5}$	–0.24	0.00	94.9	1.00
$\lambda_{29,6}$	–0.49	–0.81	95.4	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	0.48	–3.16	94.2	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C6

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 1600 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.05	–1.66	94.0	1.00
$\lambda_{2,1}$	–0.02	1.73	95.7	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{3,1}$	–0.09	–0.42	95.2	1.00
$\lambda_{4,1}$	0.14	–2.68	94.6	1.00
$\lambda_{5,1}$	0.13	–0.96	95.2	1.00
$\lambda_{6,1}$	0.05	–0.49	94.9	1.00
$\lambda_{7,2}$	–0.08	–4.15	93.4	1.00
$\lambda_{8,2}$	–0.33	–1.89	95.1	1.00
$\lambda_{9,2}$	–0.04	2.46	96.0	1.00
$\lambda_{10,2}$	–0.09	0.00	94.4	1.00
$\lambda_{11,2}$	–0.10	–2.50	94.1	1.00
$\lambda_{12,2}$	–0.19	0.00	95.5	1.00
$\lambda_{13,3}$	0.04	–2.42	94.2	1.00
$\lambda_{14,3}$	–0.08	2.23	95.7	1.00
$\lambda_{15,3}$	–0.25	0.32	94.5	1.00
$\lambda_{16,4}$	–0.12	4.34	96.8	1.00
$\lambda_{17,4}$	–0.02	–4.94	93.5	1.00
$\lambda_{18,4}$	0.07	0.70	97.0	1.00
$\lambda_{19,4}$	–0.10	1.61	95.3	1.00
$\lambda_{20,5}$	–0.05	2.32	95.8	1.00
$\lambda_{21,5}$	0.01	2.32	95.4	1.00
$\lambda_{22,5}$	–0.07	0.00	94.5	1.00
$\lambda_{23,6}$	–0.14	2.39	95.6	1.00
$\lambda_{24,6}$	–0.06	–1.19	95.2	1.00
$\lambda_{25,6}$	–0.23	–3.27	93.8	1.00
$\lambda_{26,6}$	–0.16	–2.72	94.4	1.00
$\lambda_{27,6}$	–0.32	–2.90	94.3	1.00
$\lambda_{28,5}$	–0.03	0.00	94.5	1.00
$\lambda_{29,6}$	–0.31	–1.63	94.9	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	0.27	–1.69	95.2	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C7

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 1600 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.05	–1.66	94.0	1.00
$\lambda_{2,1}$	–0.02	1.73	95.7	1.00
$\lambda_{3,1}$	–0.09	–0.42	95.2	1.00
$\lambda_{4,1}$	0.14	–2.68	94.6	1.00
$\lambda_{5,1}$	0.13	–0.96	95.2	1.00
$\lambda_{6,1}$	0.05	–0.49	94.9	1.00
$\lambda_{7,2}$	–0.08	–4.15	93.4	1.00
$\lambda_{8,2}$	–0.33	–1.89	95.1	1.00
$\lambda_{9,2}$	–0.04	2.46	96.0	1.00
$\lambda_{10,2}$	–0.09	0.00	94.4	1.00
$\lambda_{11,2}$	–0.10	–2.50	94.1	1.00
$\lambda_{12,2}$	–0.19	0.00	95.5	1.00
$\lambda_{13,3}$	0.04	–2.42	94.2	1.00
$\lambda_{14,3}$	–0.08	2.23	95.7	1.00
$\lambda_{15,3}$	–0.25	0.32	94.5	1.00
$\lambda_{16,4}$	–0.12	4.34	96.8	1.00
$\lambda_{17,4}$	–0.02	–4.94	93.5	1.00
$\lambda_{18,4}$	0.07	0.70	97.0	1.00
$\lambda_{19,4}$	–0.10	1.61	95.3	1.00
$\lambda_{20,5}$	–0.05	2.32	95.8	1.00
$\lambda_{21,5}$	0.01	2.32	95.4	1.00
$\lambda_{22,5}$	–0.07	0.00	94.5	1.00
$\lambda_{23,6}$	–0.14	2.39	95.6	1.00
$\lambda_{24,6}$	–0.06	–1.19	95.2	1.00
$\lambda_{25,6}$	–0.23	–3.27	93.8	1.00
$\lambda_{26,6}$	–0.16	–2.72	94.4	1.00
$\lambda_{27,6}$	–0.32	–2.90	94.3	1.00
$\lambda_{28,5}$	–0.03	0.00	94.5	1.00
$\lambda_{29,6}$	–0.31	–1.63	94.9	1.00
$\lambda_{30,7}$[a]	–	–	–	–

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	0.27	–1.69	95.2	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table C8

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 2000 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.08	0.00	95.1	1.00
$\lambda_{2,1}$	0.00	1.45	95.8	1.00
$\lambda_{3,1}$	0.09	0.95	95.7	1.00
$\lambda_{4,1}$	0.10	–1.02	94.9	1.00
$\lambda_{5,1}$	0.10	–1.57	95.3	1.00
$\lambda_{6,1}$	0.02	–0.54	94.7	1.00
$\lambda_{7,2}$	–0.08	–4.12	94.0	1.00
$\lambda_{8,2}$	–0.08	0.00	96.1	1.00
$\lambda_{9,2}$	–0.03	1.64	95.0	1.00
$\lambda_{10,2}$	–0.09	–1.70	94.5	1.00
$\lambda_{11,2}$	–0.11	–2.25	95.0	1.00
$\lambda_{12,2}$	–0.10	0.88	95.9	1.00
$\lambda_{13,3}$	–0.03	–1.03	94.3	1.00
$\lambda_{14,3}$	–0.15	3.24	96.2	1.00
$\lambda_{15,3}$	–0.13	2.15	95.5	1.00
$\lambda_{16,4}$	–0.18	4.88	96.5	1.00
$\lambda_{17,4}$	0.03	–1.71	95.3	1.00
$\lambda_{18,4}$	–0.06	1.81	95.7	1.00
$\lambda_{19,4}$	–0.17	3.04	95.7	1.00
$\lambda_{20,5}$	–0.06	5.88	95.9	1.00
$\lambda_{21,5}$	0.02	2.06	94.7	1.00
$\lambda_{22,5}$	–0.09	4.08	96.4	1.00
$\lambda_{23,6}$	–0.21	2.68	95.1	1.00
$\lambda_{24,6}$	–0.09	0.82	95.4	1.00

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{25,6}$	–0.29	–0.27	95.0	1.00
$\lambda_{26,6}$	–0.22	–3.27	94.5	1.00
$\lambda_{27,6}$	–0.32	–2.26	95.1	1.00
$\lambda_{28,5}$	–0.11	0.26	95.6	1.00
$\lambda_{29,6}$	–0.32	–0.26	95.2	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	0.34	0.00	95.4	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Appendix D: Computational Details of the N_{min} Analyses using the MacCallum Model-Based Approach

All analyses were conducted using Preacher and Coffman's (2006) R utility for the computation of power and minimum *N* for RMSEA.

Test of Not-Acceptable Fit ($RMSEA_0 \geq .08$)

```
Rweb:> png(file= "/tmp/Rout.10267-84914%03d.png",bg="white",height=800,width=800)
Rweb:>
Rweb:> #Computation of minimum sample size for test of fit
Rweb:>
Rweb:> rmsea0 <- 0.08 #null hypothesized RMSEA
Rweb:> rmseaa <- 0.07 #alternative hypothesized RMSEA
Rweb:> d <- 394 #degrees of freedom
Rweb:> alpha <- 0.05 #alpha level
Rweb:> desired <- 0.8 #desired power
Rweb:>
Rweb:> #Code below need not be changed by user
Rweb:> #initialize values
Rweb:> pow <- 0.0
Rweb:> n <- 0
Rweb:> #begin loop for finding initial level of n
Rweb:> while (pow
Rweb:> #begin loop for interval halving
Rweb:> foo <- -1
Rweb:> newn <- n
Rweb:> interval <- 200
Rweb:> powdiff <- pow - desired
Rweb:> while (powdiff>.001) {
+   interval <- interval*.5
+   newn <- newn + foo*interval*.5
+   ncp0 <- (newn-1)*d*rmsea0^2
+   ncpa <- (newn-1)*d*rmseaa^2
+   #compute power
```

```
+   if(rmsea0desired) {
+     foo <- -1
+   }
+ }
Rweb:>
Rweb:> minn <- newn
Rweb:> print(minn)
[1] 221.875
Rweb:>
Rweb:> dev.off()
null device
          1
Rweb:>
```

Test of Not-Close Fit (RMSEA$_0$ ≥ .05)

```
Rweb:> png(file= "/tmp/Rout.16469-98582%03d.png",bg="white",height=800,width=800)
Rweb:>
Rweb:> #Computation of minimum sample size for test of fit
Rweb:>
Rweb:> rmsea0 <- 0.05 #null hypothesized RMSEA
Rweb:> rmseaa <- 0.04 #alternative hypothesized RMSEA
Rweb:> d <- 394 #degrees of freedom
Rweb:> alpha <- 0.05 #alpha level
Rweb:> desired <- 0.8 #desired power
Rweb:>
Rweb:> #Code below need not be changed by user
Rweb:> #initialize values
Rweb:> pow <- 0.0
Rweb:> n <- 0
Rweb:> #begin loop for finding initial level of n
Rweb:> while (pow<-="" n+100="" ncp0="" (n-1)*d*rmsea0^2="" ncpa="" (n-
1)*d*rmseaa^2="" #compute="" power="" if(rmsea0
Rweb:> #begin loop for interval halving
Rweb:> foo <- -1
```

```
Rweb:> newn <- n
Rweb:> interval <- 200
Rweb:> powdiff <- pow - desired
Rweb:> while (powdiff>.001) {
+   interval <- interval*.5
+   newn <- newn + foo*interval*.5
+   ncp0 <- (newn-1)*d*rmsea0^2
+   ncpa <- (newn-1)*d*rmseaa^2
+   #compute power
+   if(rmsea0<-="" qchisq(alpha,d,ncp="ncp0,lower.tail=F)" pow=""
pchisq(cval,d,ncp="ncpa,lower.tail=F)" }="" else="" qchisq(1-
alpha,d,ncp="ncp0,lower.tail=F)" 1-pchisq(cval,d,ncp="ncpa,lower.tail=F)" powdiff=""
abs(pow-desired)="" if="" (powdesired) {
+     foo <- -1
+   }
+ }
Rweb:>
Rweb:> minn <- newn
Rweb:> print(minn)
[1] 292.9688
Rweb:>
Rweb:> dev.off()
null device
          1
Rweb:>
```

Appendix E: Monte Carlo Simulation Results for the *N* = 222 and 293 Runs

Table E1

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 222 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.37	0.16	94.9	1.00
$\lambda_{2,1}$	–0.33	–1.58	95.1	1.00
$\lambda_{3,1}$	–0.12	1.44	95.5	1.00
$\lambda_{4,1}$	–0.09	0.17	95.3	1.00
$\lambda_{5,1}$	–0.23	–1.57	94.4	1.00
$\lambda_{6,1}$	–0.23	–1.61	94.5	1.00
$\lambda_{7,2}$	–0.70	0.36	94.8	1.00
$\lambda_{8,2}$	–0.90	–1.60	94.2	1.00
$\lambda_{9,2}$	–0.80	1.46	94.5	1.00
$\lambda_{10,2}$	–0.73	0.00	94.4	1.00
$\lambda_{11,2}$	–0.71	0.00	94.6	1.00
$\lambda_{12,2}$	–1.03	–0.87	95.3	1.00
$\lambda_{13,3}$	–0.59	–2.92	94.7	1.00
$\lambda_{14,3}$	–0.17	–4.95	93.7	1.00
$\lambda_{15,3}$	–0.80	–5.85	92.6	1.00
$\lambda_{16,4}$	–1.83	0.68	94.1	1.00
$\lambda_{17,4}$	–1.82	–5.54	92.5	1.00
$\lambda_{18,4}$	–1.49	–3.78	94.3	1.00
$\lambda_{19,4}$	–2.06	–0.59	93.2	1.00
$\lambda_{20,5}$	–1.10	2.60	94.9	1.00
$\lambda_{21,5}$	–1.17	2.78	96.0	1.00
$\lambda_{22,5}$	–1.04	–0.81	93.7	1.00
$\lambda_{23,6}$	–1.25	–5.56	92.7	1.00
$\lambda_{24,6}$	–1.24	–0.35	94.9	1.00
$\lambda_{25,6}$	–1.96	–0.27	95.1	1.00
$\lambda_{26,6}$	–1.78	–5.62	94.1	1.00
$\lambda_{27,6}$	–1.79	–5.11	94.3	1.00
$\lambda_{28,5}$	–1.41	–1.27	95.0	1.00
$\lambda_{29,6}$	–1.84	–2.28	94.3	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\Gamma_{6,1}$	3.42	–24.41	94.3	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table E2

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 222 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\beta_{5,3}$	–0.36	–5.14	94.3	.90
$\beta_{5,4}$	–3.80	–4.72	94.3	.39
$\gamma_{5,1}$	–2.47	–2.04	95.4	.35
$\beta_{3,2}$	–2.22	–5.47	94.3	.56
$\gamma_{3,1}$	5.08	–7.03	94.0	.89
$\beta_{4,1}$	0.78	0.14	95.0	1.00
$\beta_{4,2}$	4.22	–5.78	93.6	.19
$\gamma_{4,1}$	–0.08	–0.54	95.5	.98
$\gamma_{2,1}$	1.14	–2.49	95.4	1.00
$\gamma_{1,1}$	0.77	0.55	95.1	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power.

Table E3

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 222 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	5.23	–9.42	91.8	.63
$\gamma_{4,1}\beta_{5,4}$	–3.52	–6.35	92.8	.27
$\gamma_{1,1}\beta_{4,1}$	1.18	–0.51	94.4	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–5.00	–4.03	93.6	.27
$\gamma_{2,1}\beta_{3,2}$	–1.93	–5.36	93.7	.52
$\gamma_{2,1}\beta_{4,2}$	4.44	–6.97	96.2	.16
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–4.90	–2.47	90.8	.31
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–7.14	–3.19	91.8	.01

Note. CI = confidence interval; *SE* = standard error; π = statistical power

Table E4

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Factor Loadings from the N = 293 run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\lambda_{1,1}$	–0.35	2.41	95.3	1.00
$\lambda_{2,1}$	–0.23	0.55	95.3	1.00
$\lambda_{3,1}$	–0.17	–1.77	94.4	1.00
$\lambda_{4,1}$	–0.08	–1.55	94.0	1.00
$\lambda_{5,1}$	–0.02	0.82	95.0	1.00
$\lambda_{6,1}$	–0.15	2.36	94.9	1.00
$\lambda_{7,2}$	–0.43	3.41	95.1	1.00
$\lambda_{8,2}$	–0.60	–2.42	95.0	1.00
$\lambda_{9,2}$	–0.53	2.97	95.0	1.00
$\lambda_{10,2}$	–0.52	1.11	94.3	1.00
$\lambda_{11,2}$	–0.46	0.44	94.9	1.00
$\lambda_{12,2}$	–0.97	–2.76	94.2	1.00
$\lambda_{13,3}$	–0.34	–1.18	93.6	1.00
$\lambda_{14,3}$	–0.10	–1.83	94.2	1.00
$\lambda_{15,3}$	–0.51	–3.26	93.7	1.00
$\lambda_{16,4}$	–1.20	2.27	96.4	1.00

$\lambda_{17,4}$	–1.00	–2.38	94.3	1.00
$\lambda_{18,4}$	–0.95	–2.96	95.1	1.00
$\lambda_{19,4}$	–1.42	1.02	95.0	1.00
$\lambda_{20,5}$	–0.70	1.98	94.4	1.00
$\lambda_{21,5}$	–0.67	–0.19	94.0	1.00
$\lambda_{22,5}$	–0.62	–0.38	93.8	1.00
$\lambda_{23,6}$	–1.25	–4.19	93.1	1.00
$\lambda_{24,6}$	–1.42	–4.01	94.0	1.00
$\lambda_{25,6}$	–1.86	–1.61	95.0	1.00
$\lambda_{26,6}$	–1.78	–4.49	93.9	1.00
$\lambda_{27,6}$	–1.81	–4.35	93.8	1.00
$\lambda_{28,5}$	–1.41	–2.42	95.7	1.00
$\lambda_{29,6}$	–1.82	–4.02	94.5	1.00
$\lambda_{30,7}$[a]	–	–	–	–
$\Gamma_{5,1}$[a]	–	–	–	–
$\Gamma_{6,1}$	3.48	–29.79	94.1	1.00

Note. SE = standard error; CI = confidence interval; π = statistical power. [a] Bias, coverage and power values for these parameters could not be estimated as the parameters were fixed to their population values in the analytic model for model identification purposes.

Table E5

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Direct Structural Regression Paths from the N = 293 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	Π
$\beta_{5,3}$	0.33	–3.75	94.9	.96
$\beta_{5,4}$	–1.80	–1.89	94.5	.46
$\gamma_{5,1}$	–2.41	–0.63	95.1	.44
$\beta_{3,2}$	–1.48	–3.25	94.7	.71
$\gamma_{3,1}$	3.61	–7.86	94.7	.96
$\beta_{4,1}$	0.09	–2.28	95.2	.00
$\beta_{4,2}$	1.22	–3.60	94.6	.23
$\gamma_{4,1}$	–0.06	–1.35	94.7	1.00
$\gamma_{2,1}$	0.76	–0.61	95.9	1.00
$\gamma_{1,1}$	0.73	–0.62	95.2	1.00

Note. CI = confidence interval; *SE* = standard error; π = statistical power

Table E6

Parameter Estimate and Standard Error Biases, Coverage Rates and Statistical Power for the Estimated Indirect Effects from the N = 293 Run

Parameter	$rBias\left(\hat{\theta}_i\right)(\%)$	$rBias\left(SE\left(\hat{\theta}_i\right)\right)(\%)$	$Coverage_{95\%\ CI}$ (%)	π
$\gamma_{3,1}\beta_{5,3}$	4.15	–7.63	92.3	.83
$\gamma_{4,1}\beta_{5,4}$	–1.48	–4.94	92.7	.38
$\gamma_{1,1}\beta_{4,1}$	0.56	–3.45	94.0	1.00
$\gamma_{1,1}\beta_{,4,1}\beta_{5,4}$	–3.64	–1.59	94.8	.36
$\gamma_{2,1}\beta_{3,2}$	–1.03	–5.13	94.5	.67
$\gamma_{2,1}\beta_{4,2}$	1.33	–4.54	95.7	.20
$\gamma_{2,1}\beta_{3,2}\beta_{5,3}$	–2.45	–2.45	91.0	.51
$\gamma_{2,1}\beta_{4,2}\beta_{5,4}$	–5.71	–3.80	91.1	.02

Note. CI = confidence interval; *SE* = standard error; π = statistical power

Appendix F: A Random Sample of Studies drawn from *Personality and Individual Differences* Reporting Comparable Mediational Designs from which an Average *N* was computed

Study	*N*
Baker and Hoerger (2012)	286
Carlo et al. (2012)	1557
Chang (2012)	314
Chen et al. (2012)	178
Di Schiena, Luminet, Philippot, & Douilliez (2012)	174
Fletcher, Shim, & Wang (2012)	367
Flett, Molnar, Nepon, and Hewitt (2012)	228
Hystad and Bye (2012)	1190
Ivory and Kambouropoulos (2012)	337
Jonason, Luevano, and Adams (2012)	210
Karreman and Vingerhoets (2012)	632
Kiel and Maack (2012)	117
Kimbrel, Nelson-Gray, and Mitchell (2012)	207
Kong et al. (2012a)	489
Kong et al. (2012b)	678
Lanciano, Curci, Kafetsios, Elia, and Zammuner (2012)	157
Liang and Borders (2012)	170
Liu, Wang, and Li (2012)	282
Xia et al. (2012)	482
Zhao, Kong, and Wang (2012)	525

Appendix G: Participant Information Notice

Dear student,

Welcome to UTS!

WHO IS DOING THE RESEARCH?

My name is Harsha Perera, and I am a PhD candidate at UTS. I am conducting doctoral research under the direction of my chief supervisor Professor James A. Athanasou and co-supervisors Drs Michelle DiGiacomo and Narelle Smith.

WHAT IS THIS RESEARCH ABOUT?

I would like to invite you to assist me in a study that I am conducting as part of my PhD in Educational Psychology, which looks at first-year students' adjustment to the university experience. You are being asked to participate in this study due to your status as a first-semester student who can assist in investigating whether certain personality traits influence university adjustment and achievement.

WHAT ARE THE ELIGIBILITY CRITERIA?

To be eligible to participate in this research, you need to be ALL of the following:

a. A full-time student in your first semester of university study;
b. A domestic (local) student (i.e., NOT an international student);
c. A recent school leaver (i.e., less than 21 years at enrolment)

IF I SAY YES, WHAT WILL IT INVOLVE?

Participation in this research involves navigating to the following websites three times during semester one:

Session 1: http://www.createsurvey.com/s/0p2L/? (Week One)
Session 2: http://www.createsurvey.com/s/UoHA/? (Week Five)
Session 3: http://www.createsurvey.com/s/TYsU? (Week Nine)

These times are Weeks One, Five and Nine of semester one. At each time point, you will be asked to complete a series of short online questionnaires and personal data sheets. Participating in this research is unlikely to take up more than one hour of your time in total.

If you decide to participate in this research, a gentle reminder will be sent to your UTS email account three days before the online sessions commence, on the day each testing session commences, approximately half-way through the week in which the testing session takes place, and 12 hours before the online testing session for each week closes.

Participation in this research also involves authorizing access to your official academic results from UTS Records Management at the end of semester one. This is to allow the researchers to determine whether your adjustment experiences influence your academic results.

DO I HAVE TO SAY YES?

No. Participation in this research is strictly voluntary. You are under no obligation to participate. If you do not wish to participate, I will thank you for your time and won't contact you about this research again.

IF I SAY YES, CAN I CHANGE MY MIND LATER?

You may terminate your participation without explanation, justification or penalty at any time until 5 August 2013. This date corresponds to approximately two weeks following the retrieval of semester one academic records, after which time all your records will be de-identified and identifying information destroyed. If you decide to withdraw from the study, I will delete all your records from my data file, and I will not contact you about this research.

ARE THERE ANY RISKS?

There are no foreseen physical risks, and minimal psychological risks involved in participating in this research. If you experience any psychological distress or discomfort resulting from your participation, you may contact the UTS counselling service on (02) 9514-1177 to arrange to speak confidentially with a qualified counsellor about your concerns at no cost. Please note that participation in this research will in **no way affect your academic grades or relationships with UTS staff**.

WILL THERE BE COMPENSATION FOR MY TIME?

I understand that participating in this research requires your investment of time over the semester. Accordingly, if you decide to participate, at the end of each of the three testing sessions and after the retrieval of your academic records, you will be entered into a raffle for a range of prizes. All participants will be entered into raffles to win one of 15 $50.00 Coles Group and Myer Gift Cards and one Samsung Galaxy 7" Tablet 8GB.

HOW WILL MY DATA BE PROTECTED?

All data collected during this research will be kept confidential. Data collected via online sessions and the retrieval of academic records will be secured on my password-protected personal computer, and accessible to only the four researchers identified in this information notice. All participants will be identified with an arbitrary numerical code. Any identifying information, such as your UTS ID number and email address, will be detached from the data file and placed in a discrete, password-protected file, which will be destroyed after your academic records are collected. Although these measures will be implemented to protect the confidentiality of your data, researchers do not have legal privilege of confidentiality in the same way as solicitors or barristers. Thus, I can be compelled to disclose your data as directed by subpoenas issued by courts of law. Please note that the data you provide may be used in future research on university adjustment conducted by me. All data will be stored on my personal computer and destroyed after seven years in line with the AVCC guidelines on the storage of data.

HOW WILL MY DATA BE USED?

The results of this study, generated by analyses of your data, will be included in my PhD dissertation, conference proceedings and scholarly journal articles. Please note, however, that no references will be made to your specific data as the analyses will be conducted on pooled data across all participants.

If you have any queries about this research, please feel free to contact me either by email or phone. Alternatively, you may wish to contact my chief supervisor Professor Athanasou either by email or phone.

I should be delighted if you would assist us in completing this research. In any case, I wish you well in your studies. If you are interested in participating, please navigate to the following website: http://www.createsurvey.com/s/0p2L?

Yours Sincerely,

Harsha Perera
PhD Candidate
E. Harsha.Perera@student.uts.edu.au

Professor James A. Athanasou
Adjunct Professor
E. James.Athanasou@uts.edu.au

NOTE: This study has been approved by the University of Technology, Sydney Human Research Ethics Committee. If you have any complaints or reservations about any aspect of your participation in this research which you cannot resolve with the researcher, you may contact the Ethics Committee through the Research Ethics Officer (ph: +61 2 9514 9772 Research.Ethics@uts.edu.au) and quote the UTS HREC reference number 2012-009A. Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.

Appendix H: Instrumentation

Trait Emotional Intelligence Questionnaire – Short Form (TEIQue)

Instructions: Please answer each statement below by clicking the number that best reflects your degree of agreement or disagreement with that statement. Do not think too long about the exact meaning of the statements. Work quickly and try to answer as accurately as possible. There are no right or wrong answers. There are seven possible responses to each statement ranging from 'Completely Disagree' (number 1) to 'Completely Agree' (number 7)

1 . . . . . 2 . . . . . 3 . . . . . 4 . . . . . 5 . . . . . 6 7

1. Expressing my emotions with words is not a problem for me.	1	2	3	4	5	6	7
2. I often find it difficult to see things from another person's viewpoint.	1	2	3	4	5	6	7
3. On the whole, I'm a highly motivated person.	1	2	3	4	5	6	7
4. I usually find it difficult to regulate my emotions.	1	2	3	4	5	6	7
5. I generally don't find life enjoyable.	1	2	3	4	5	6	7
6. I can deal effectively with people.	1	2	3	4	5	6	7
7. I tend to change my mind frequently.	1	2	3	4	5	6	7
8. Many times, I can't figure out what emotion I'm feeling.	1	2	3	4	5	6	7
9. I feel that I have a number of good qualities.	1	2	3	4	5	6	7
10. I often find it difficult to stand up for my rights.	1	2	3	4	5	6	7
11. I'm usually able to influence the way other people feel.	1	2	3	4	5	6	7
12. On the whole, I have a gloomy perspective on most things.	1	2	3	4	5	6	7
13. Those close to me often complain that I don't treat them right.	1	2	3	4	5	6	7
14. I often find it difficult to adjust my life according to the circumstances.	1	2	3	4	5	6	7
15. On the whole, I'm able to deal with stress.	1	2	3	4	5	6	7
16. I often find it difficult to show my affection to those close to me.	1	2	3	4	5	6	7
17. I'm normally able to "get into someone's shoes" and	1	2	3	4	5	6	7

experience their emotions.							
18. I normally find it difficult to keep myself motivated.	1	2	3	4	5	6	7
19. I'm usually able to find ways to control my emotions when I want to.	1	2	3	4	5	6	7
20. On the whole, I'm pleased with my life.	1	2	3	4	5	6	7
21. I would describe myself as a good negotiator.	1	2	3	4	5	6	7
22. I tend to get involved in things I later wish I could get out of.	1	2	3	4	5	6	7
23. I often pause and think about my feelings.	1	2	3	4	5	6	7
24. I believe I'm full of personal strengths.	1	2	3	4	5	6	7
25. I tend to "back down" even if I know I'm right.	1	2	3	4	5	6	7
26. I don't seem to have any power at all over other people's feelings.	1	2	3	4	5	6	7
27. I generally believe that things will work out fine in my life.	1	2	3	4	5	6	7
28. I find it difficult to bond well even with those close to me.	1	2	3	4	5	6	7
29. Generally, I'm able to adapt to new environments.	1	2	3	4	5	6	7
30. Others admire me for being relaxed.	1	2	3	4	5	6	7

Big-Five Inventory (BFI)

Instructions: Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others?* Please answer each statement below by clicking the number that best reflects your degree of agreement or disagreement with that statement. Do not think too long about the exact meaning of the statements. Work quickly and try to answer as accurately as possible. There are no right or wrong answers. There are five possible responses to each statement ranging from 'Disagree Strongly' (number 1) to 'Agree Strongly' (number 5).

1 Disagree Strongly	**2** Disagree a little	**3** Neither agree nor disagree	**4** Agree a little	**5** Agree strongly

I am some who…

1. Is talkative	1	2	3	4	5
2. Is depressed, blue	1	2	3	4	5
3. Is reserved	1	2	3	4	5
4. Is relaxed, handles stress well	1	2	3	4	5
5. Is full of energy	1	2	3	4	5
6. Can be tense	1	2	3	4	5
7. Generates a lot of enthusiasm	1	2	3	4	5
8. Worries a lot	1	2	3	4	5
9. Tend to be quiet	1	2	3	4	5
10. Is emotionally stable, not easily upset	1	2	3	4	5
11. Has an assertive personality	1	2	3	4	5
12. Can be moody	1	2	3	4	5
13. Is sometimes shy, inhibited	1	2	3	4	5
14. Remains calm in tense situations	1	2	3	4	5
15. Is outgoing, sociable	1	2	3	4	5
16. Get nervous easily	1	2	3	4	5

Social Provisions Scale (SPS)

Instructions: In responding to the next set of items, I want you to think about your current relationships with friends, particularly your university peer, lecturers, tutors, and family members over the first semester of university. Please answer each statement below by clicking the number that best reflects your degree of agreement or disagreement with that statement. There are four possible responses to each statement ranging from 'Strongly Disagree' (number 1) to 'Strongly Agree' (number 4). For example, if you feel a statement is very true of your current relationships, you would select 'strongly agree'. If you feel a statement clearly does not describe your relationships, you would select 'strongly disagree'.

1 Strongly Disagree	**2** Disagree	**3** Agree	**4** Strongly Agree

1. There are people I can depend on to help me if I really need it.	1	2	3	4
2. I feel that I do not have close personal relationships with other people.	1	2	3	4
3. There is no one I can turn to for guidance in times of stress.	1	2	3	4
4. There are people who depend on me for help.	1	2	3	4
5. There are people who enjoy the same social activities I do.	1	2	3	4
6. Other people do not view me as competent.	1	2	3	4
7. I feel personally responsible for the well-being of another person.	1	2	3	4
8. I feel part of a group of people who share my attitudes and beliefs.	1	2	3	4
9. I do not think other people respect my skills and abilities.	1	2	3	4
10. If something went wrong, no one would come to my assistance.	1	2	3	4
11. I have close relationships that provide me with a sense of emotional security and well-being.	1	2	3	4
12. There is someone I could talk to about important decisions in my life.	1	2	3	4
13. I have relationships where my competence and skills are recognized.	1	2	3	4
14. There is no one who shares my interests and concerns.	1	2	3	4
15. There is no one who really relies on me for their well-being.	1	2	3	4
16. There is a trustworthy person I could turn to for advice if I were having problems.	1	2	3	4
17. I feel a strong emotional bond with at least one other person.	1	2	3	4

18. There is no one I can depend on for aid if I really need it.	1	2	3	4
19. There is no one I feel comfortable talking about my problems with.	1	2	3	4
20. There are people who admire my talents and abilities.	1	2	3	4
21. I lack a feeling of intimacy with another person.	1	2	3	4
22. There is no one who likes to do things I do.	1	2	3	4
23. There are people I can count on in an emergency.	1	2	3	4
24. No one needs me to care for them.	1	2	3	4

COPE Inventory

Instructions: We are interested in how people respond when they confront difficulty or stressful events in their lives. There are lots of ways to try to deal with stress. This questionnaire asks you to indicate what you have been doing and feeling when you have experienced stressful events in the past few weeks. Different events bring out somewhat different responses, but think about experiences of stressors related to university life in the first semester, such as preparing for and taking examinations or quizzes, preparing for assessment tasks, tutorials and lectures, making friends, interacting with faculty, delivering oral presentations, and class participation.

Please respond to each of the following items by clicking one number on your answer sheet for each item using the response choices listed below. Please try to respond to each item separately in your mind from other items. Choose your answers thoughtfully, and make your answers as true FOR YOU as you can. Please answer every item. There are no right or wrong answers, so choose the most accurate answer for YOU – not what you think most people would say or do. Indicate what YOU have been doing when YOU have experienced a stressful event during the past few weeks of university.

1 I haven't been doing this at all	**2** I have been doing this a little bit	**3** I have been doing this a medium amount	**4** I have been doing this a lot.

1. I have been trying to grow as a person as a result of the experience.	1	2	3	4
2. I have been concentrating my efforts on doing something about it.	1	2	3	4
3. I have been making a plan of action.	1	2	3	4
4. I am taking additional action to try to get rid of the problem.	1	2	3	4
5. I have been trying to see it in a different light, to make it seem more positive.	1	2	3	4
6. I have been trying to come up with a strategy about what to do.	1	2	3	4
7. I have been looking for something good in what is happening.	1	2	3	4
8. I have been thinking about how I might best handle the problem.	1	2	3	4
9. I am taking direct action to get around the problem.	1	2	3	4
10. I have been thinking hard about what steps to take.	1	2	3	4
11. I have been doing what has to be done, one step at a time.	1	2	3	4
12. I am learning something from the experience.	1	2	3	4

Organization and Attention to Study Scale of the College Learning Effectiveness Inventory

Instructions: Below is a list of statements related to aspects of students' organization and application to university studies during the first semester of university. Please read each statement carefully, and indicate the degree to which you agree or disagree with each statement, as it applies to your UTS experience over the past semester, by clicking the number which best reflects your degree of agreement or disagreement. Use the following scale:

1 Never	**2** Rarely	**3** Sometimes	**4** Usually	**5** Always

1. I organize my time so that I have plenty of time to study.	1	2	3	4	5
2. I make study goals and keep up with them.	1	2	3	4	5
3. I break big assignments into manageable pieces.	1	2	3	4	5
4. I find myself day-dreaming when I study.	1	2	3	4	5

Peer-Group Interactions Subscale of the Institutional Integration Scales

Instructions: Below is a list of statements related to students' interpersonal relationships with peers at university. Please answer each statement by clicking the number that best reflects your degree of agreement or disagreement with that statement as it applies to your experience at university over the past semester. Use the following scale to respond to the items:

1 Strongly Disagree	**2** Disagree	**3** Neither Agree nor Disagree	**4** Agree	**5** Strongly Agree

1. Since coming to this university, I have developed close personal relationships with other students.	1	2	3	4	5
2. The student friendships I have developed at this university have been personally satisfying.	1	2	3	4	5
3. My interpersonal relationships with other students have had a positive influence on my personal growth, attitudes, and values.	1	2	3	4	5
4. It has been difficult for me to meet and make friends with other students.	1	2	3	4	5
5. Few of the students I know would be willing to listen to me and help me if I had a problem.	1	2	3	4	5
6. Most students at this university have values and attitudes different to my own.	1	2	3	4	5
7. My interpersonal relationships with other students have had a positive influence on my intellectual growth and interest in ideas.	1	2	3	4	5

Involvement with College Activity Scale of the College Learning Effectiveness Inventory

Instructions: Please find below a list of statements related to students' affiliation with organizations at university and participation in university related activities. Please answer each statement by clicking the number that best reflects your degree of agreement or disagreement with that statement as it applies to your experience at university over the past semester. Use the following scale to respond to the items:

1 Never	**2** Rarely	**3** Sometimes	**4** Usually	**5** Always

1. I participate in social activities on campus.	1	2	3	4	5
2. I belong to an organized club on campus.	1	2	3	4	5
3. I attend events, such as concerts, plays, speakers, or athletic contests as part of the university experience.	1	2	3	4	5
4. I know someone with whom I can study.	1	2	3	4	5
5. I have friends here at university.	1	2	3	4	5
6. I belong to a study group.	1	2	3	4	5
7. I consider university to be a great time in my life.	1	2	3	4	5
8. My friends have good study habits.	1	2	3	4	5
9. I enjoy being a student here.	1	2	3	4	5

UCLA Loneliness Scale-8

Instructions: The following statements describe how people sometimes feel. For each statement, please indicate how often you feel the way described, as it relates to your experience at university over the past semester, by clicking on the number that best reflects the frequency of your feelings. Here is an example:

How often do you feel happy?

If you never feel happy, you would respond by clicking '1' (Never). If you always feel happy, you would respond by clicking '4' (Always).

1 Never	**2** Rarely	**3** Often	**4** Always

1. I lack companionship.	1	2	3	4
2. There is no one I can turn to.	1	2	3	4
3. I am an outgoing person.	1	2	3	4
4. I feel left out.	1	2	3	4
5. I feel isolation from others.	1	2	3	4
6. I can find companionship when I want it.	1	2	3	4
7. I am unhappy being so withdrawn.	1	2	3	4
8. People are around me but not with me.	1	2	3	4

Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)

Instructions: Below are some statements about feelings and thoughts. Please click the number that best describes your experience of each over the last 2 weeks

STATEMENTS	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	1	2	3	4	5
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5

Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)
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