

Assessing Recovery and Training Quality: Swimmers'
Perceptions and Practices

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i. CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Stephanie Shell declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Health, Sport and Exercise Discipline, at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution.

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Production Note:

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Stephanie Shell

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iii. PREFACE

This thesis for the degree of Doctor of Philosophy is in the format of Thesis by compilation and abides by the ‘Procedures for Presentation and Submission of Theses for Higher Degrees – University of Technology Sydney; Policies and Directions of the University’.

Based on the research design and data collection by the candidate, four manuscripts have been submitted to peer reviewed journals for publication. These papers are initially brought together by an *Introduction*, which provides background information defines the research problem, in addition to the purpose and significance of each of the four studies. A *Literature Review* follows to provide an overview of recovery strategies and their hypothesised effect on training quality. The manuscripts are then presented in a logical sequence following the development of research ideas within this thesis. Each manuscript outlines information pertaining to the design methodology and findings of each study separately. Figures, tables and reference numbers have been retained. The *Discussion of Thesis* chapter contains information pertaining to the collective findings, practical applications and suggestions for future research based on the series of studies. This chapter additionally contains the thesis conclusion; a synopsis of the research hypothesis and conclusions from each study. American Medical Association reference style has been used throughout the document, with the reference list at the end of the thesis.

iv. PUBLICATIONS

List of Articles Submitted for Peer Review Publication

1. **Shell, S.J.**, Slattery, K., Clark, B., Broatch, J.R., Halson, S., Kellmann, M., & Coutts, A.J. (2019). Perceptions and use of recovery strategies: Do swimmers and coaches believe they are effective? *Journal of Sports Sciences*, *Accepted for Publication*, DOI: 10.1080/02640414.2020.1770925.
2. **Shell, S.J.**, Clark, B., Slattery, K., Broatch, J.R., Halson, S., & Coutts, A.J. (2019). Self-Report v Practice: Comparisons between swimmers' reported and observed recovery strategy use. *Journal of Science and Medicine in Sport*, *Under Review*.
3. **Shell, S.J.**, Slattery, K., Clark, B., Broatch, J.R., Halson, S., & Coutts, A.J. (2019). Development and Validity of the Subjective Training Quality scale. *Journal of Sports Sciences*, *Under Review*.
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1. **Shell, S.J.**, Clark, B., Slattery, K., Miller, J., Broatch, J.R., Halson, S., Kellmann, M., & Coutts, A.J. (2018). Use of Recovery Strategies by Swimmers during Training and Competition. European College of Sport Science (ECSS) Conference, Dublin, Ireland. 6th July.
2. **Shell, S.J.**, Clark, B., Slattery, K., Miller, J., Broatch, J.R., Halson, S., Kellmann, M., & Coutts, A.J. (2018). Use of Recovery Strategies by Swimmers during Training and Competition. Queensland Academy of Sport (QAS) Applied Physiology Conference, Brisbane, Australia. 23rd November.
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vii. LIST OF ABBREVIATIONS

AIS	Australian Institute of Sport
BLa	Blood lactate
°C	Degrees Celsius
CFA	Confirmatory factor analysis
CK	Creatine kinase
CWI	Cold water immersion
CWT	Contrast water therapy
CV	Coefficient of variation
DOMS	Delayed onset muscle soreness
GPS	Global positioning system
H	Hours
HR	Heart rate
HWI	Hot water immersion
Hz	Hertz
ICC	Intraclass correlation coefficient
Km	Kilometres
m	Meters
m/s	Meters per second
min	Minutes
N	Sample size
PMR	Progressive muscle relaxation
RH	Relative humidity
RMSEA	Root mean square error of approximation

ROM	Range of motion
RPE	Rating of perceived exertion
SD	Standard deviation
sec	Seconds
SRMR	Standardised root mean square residual
STQ	Subjective training quality scale
UTS	University of Technology Sydney

viii. ABSTRACT

Maintaining an adequate balance between training and recovery is essential to optimise performance outcomes. Recovery is a multifaceted, time-dependent process that can promote adaptation. Numerous studies have examined the efficacy of recovery strategies, including their mechanistic and performance benefits, however, limited evidence exists examining athlete and coach recovery perceptions, and practices in the training and competitive environments. Given its importance, understanding how recovery strategies are used could improve programming and education. Training quality is important in the evaluation of training effectiveness, where increases in soreness and fatigue may lead to reduced training quality. However, training quality remains empirically undefined, with no available monitoring tools. Therefore, this thesis aimed to investigate recovery strategy perceptions and practices, describe training quality, and develop a training quality assessment tool in competitive swimmers, via implementation of a sequential explanatory, mixed methods research design.

Study One used a survey to understand swimmers' and coaches recovery strategy use, prescription, and perceived effectiveness, in training and competition. Study Two implemented a survey, and semi-structured interview for comparison between swimmers' self-reported and observed strategy use. Study Three aimed to define training quality through semi-structured interviews. Once defined, the Subjective Training Quality (STQ) scale was developed and checked for internal consistency and face validity. Finally, Study Four aimed to further validate the STQ scale in training, assessing the measurement accuracy of swimming metrics using a wearable monitoring device. However, due to the device's inaccuracy, comparisons with the STQ ratings was not possible. Therefore, future longitudinal research into the validity of the wearable device in comparison with the STQ ratings is required.

The primary outcomes of this thesis are, 1) multiple recovery strategies are used and prescribed in training and competition, with greater use in competition; 2) swimmers overestimate recovery strategy use when self-reporting, compared to observation; 3) training quality encompasses physical, technical and mental constructs; 4) initial validation suggests the STQ scale could monitor training quality; and 5) the wearable device investigated was not a valid indicator of swimming metrics. This thesis provides insight to swimmers' and coach's recovery strategy perceptions and practices, highlighting the need for tailored education and individualisation of recovery programming, to promote appropriate use. Moreover, initial findings suggest training quality and the STQ scale may provide greater insight into an athlete's training effectiveness, and enhance the coach's ability to prescribe training. Collectively, these findings provide a platform for future research into the relationship between recovery strategies, training quality and performance outcomes.