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Intellectual Disability Behaviour Support Program

Economic evaluation of the impact of speech pathology services on criminal justice outcomes

UTS Centre for Health Economics Research and Evaluation (CHERE)

UNSW AUSTRALIA | Intellectual Disability Behaviour Support Program (IDBS)

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June 2020

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About the Intellectual Disability Behaviour Support Program

The Intellectual Disability Behaviour Support (IDBS) Program in the School of Social Sciences at UNSW Sydney was established in 2014 to undertake research to build the capacity of those living and working with cognitive disability. The work of the program focuses on providing meaningful and sustainable improvements to practice and policy which is evidence-informed.
For further details on our work, see https://www.arts.unsw.edu.au/idbs

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About CHERE

The Centre for Health Economics Research and Evaluation (CHERE) is an independent research unit affiliated with the University of Technology, Sydney. It has been established since 1991, and in that time has developed a strong reputation for excellence in research and teaching in health economics and public health and for providing timely and high quality policy advice and support. Its research program is policy-relevant and concerned with issues at the forefront of the sub-discipline.
CHERE has extensive experience in evaluating health services and programs, and in assessing the effectiveness of policy initiatives. The Centre provides policy support to all levels of the health care system, through both formal and informal involvement in working parties, committees, and by undertaking commissioned projects. For further details on our work, see www.chere.uts.edu.au.

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Suggested citation: Dowse, L., Cronin, P., Reeve, R. and Addo, R. (2020) *Economic evaluation of the impact of speech pathology services on criminal justice outcomes*. UNSW Sydney.

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Contents

1. Executive Summary

People with Speech, Language and Communication Needs (SLCN) are at greater risk of lower levels of education, higher rates of unemployment, psychological distress and contact with the criminal justice system. Diagnosis and appropriate treatment of SLCN reduces these risks, leading to better life outcomes for the individual as well as broader social and economic benefits. Speech Pathology Australia (SPA) commissioned the Intellectual Disability Behaviour Support (IDBS) Program at UNSW Sydney in conjunction with the Centre for Health Economics Research and Evaluation (CHERE) at UTS to undertake a project to investigate the life course impact of speech pathology intervention for people with SLCN who are at risk of contact with or are in the criminal justice system and to explore the economic benefits of these interventions.

1.1 Aim of the project

This report provides an economic evaluation of speech pathology interventions for people with SLCN who are at risk of contact with or are in the criminal justice system. The report aims to demonstrate how appropriate intervention for people with SLCN impacts on lifetime future pathways, with a particular focus of reducing the risk of future contact with the criminal justice system and associated costs.

1.2 Approach to the project

To illustrate the potential benefits of interventions for people with SLCN the study utilises a scenario and economic modelling approach to demonstrate the impact of intervention at four points in the life course of individuals with SLCN who are at risk of or are in contact with the justice system. These four points in the life course are specifically selected to capture points at which behaviours, that are precursors to, or are associated with criminal offending, and contact with the justice system occur. These correspond with the models used to report the study findings below and are as follows:

1. As a child or young person prior to the development of anti-social behaviour
2. As a young person at the emergence of anti-social behaviour
3. As a young person at the point of first offence/first contact with the youth justice system and prior to reoffending
4. As an adult at the point of justice custody

The project focuses on the scope for speech pathology interventions at these key points, in order to improve speech, language and communication skills, and as a result influence the emergence of youth anti-social behaviour, the risk of contact with youth justice (YJ) and the occurrence of subsequent adult custody. Benefits are measured in terms of cost savings from appropriate intervention at different life stages and cumulatively. Estimates are included for the settings in which, as young people and as adults, people with SLCN are at risk or in contact with the justice system, including in school, in youth justice settings (including in community and custody settings) and in adult custody settings.

The study utilises three phases which build upon each other to produce an economic model of the costs and benefits of intervention. It provides a summary of the evidence relating to the effectiveness of speech pathology (SP) interventions on criminal justice pathways, utilises a regression analysis to determine the probabilities of the range of criminal justice outcomes for people with SLCN and develops a decision tree model to demonstrate the range of different risk trajectories and their costs. Specifically:

I. A systematic review of the literature was undertaken to:

   a. summarise evidence of best practice speech pathology interventions utilising the three tier adapted 'Response to Intervention' framework for speech, language and communication intervention in justice settings developed by Snow, Sanger, Caire, Eadie and Dinslage (2015). This conceptualises intervention on an individual basis (Tier 3), in a group setting (Tier 2) and embedded in an organisation's practices (Tier 1). We applied this framework to people with SLCN at different points in the life course including: 'while in school'; 'after first contact with police and/or youth justice'; 'during youth custody' and 'prior to adult custody'.

   b. understand and document the impact of interventions at different points in the life course on the trajectories of people with SLCN, with a particular focus on justice outcomes. Intervention outcomes may include: 'sustained school attendance'; 'contact with police'; 'employment/unemployment'; 'children's court appearances'; 'youth detention'; 'adult court appearances'; 'adult incarceration' and 'recidivism'.

II. A regression analysis approach was used to estimate the probabilities and expected frequencies of criminal justice outcomes for people with SLCN who do and do not receive an intervention at four different points in the life course.

III. A decision analytical model was developed to understand and document the costs and benefits of interventions (Tier 1,2,3) at the four different life course points on the trajectories of people with SLCN, with a particular focus on justice outcomes. Two fictional case studies illustrate the pathways for individuals with differing risk trajectories.

1.3 Results

Cost-benefit analysis is a form of economic evaluation which assigns a monetary value to the costs and benefits of a program or intervention and then compares the two values to determine whether the benefits outweigh the costs. The rationale for the cost-benefit study reported here is that a speech pathology intervention program will lead to potential cost savings through improved speech, language and communication skills. In turn, this would be associated with a reduced risk of anti-

social behaviour and offending behaviour. The usual approach to cost benefit analysis is to determine the incremental costs, that is, the difference in costs between *intervention and no intervention*, In this scenario the cost of no intervention is defined as the total cost of anti-social behaviour for the no-intervention group. The cost of intervention is defined as the total cost of anti-social behaviour for the intervention group plus the costs of the intervention. If the intervention is effective, one would expect that the total costs of anti-social behaviour in the intervention group would be reduced (i.e. cost savings). To obtain a 'benefit' the cost savings must be greater than the cost of intervention. For example, if the cost savings of reduced anti-social behaviour is $100 and the cost of intervention is $50, then the cost benefit is $50. If however, the cost of intervention is $150, then the total cost benefit is -$50, which represents no benefit.

$$Cost\ benefit = \quad Cost_{\ Intervention} - Cost_{\ No\ intervention}$$

The findings from this study highlight the potential benefit of speech pathology (SP) interventions in the reduction of youth and adult crime, through improved speech, language and communication skills. Individuals with SLCN at risk of or in contact with the criminal justice system are not a homogenous group. The decision analytical model showed that early intervention for those individuals with the greatest speech language and communication need generated the highest cost savings. Similarly, individuals with inherently more complex risk trajectories associated with, for example, low social economic status, early life disadvantage and multiple youth offences and adult custody, incur significantly higher justice costs, and hence there is potential for greater cost savings with SP intervention.

The extent of economic benefit gained from a speech pathology intervention is determined by a range of factors which include:

- the point in the life course at which the intervention occurs – that is – the earlier in life an intervention occurs the more cumulative benefit is gained
- the type of intervention and its associated costs i.e. on an individual basis (Tier 3), in a group setting (Tier 2) and embedded in an organisation's practices (Tier 1).
- the risk profile of the individual undergoing the intervention – that is – the more complex and numerous the risk factors the higher the likelihood of contact with the criminal justice system and the more intensive the contact will likely be.

Results of the economic modelling are presented below in a way that allows for this variation to be represented. The four models capture key points in the life course. For each model cost savings are presented for each of the identified tiers of intervention. For each intervention the range of costs saved capture variation in the level of offending risk for an individual, from average to high risk.

Model 1 - Childhood: individuals participated in an intervention prior to their first youth anti-social behaviour

The incremental cost savings associated with an SP intervention prior to an individual's *youth anti-social* behaviour is $6,524 per individual[1] and up to $15,169 for the individuals at higher[2] risk. Once the cost of the intervention[3] is considered, and depending on the level of offending risk, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $6,130 to $14,775
- Tier 2 intervention - from $5,057 to $13,702
- Tier 3 intervention - from $4,960 to $13,605

Model 2 – Youth anti-social behaviour: individuals participated in an intervention prior to their first Youth Justice contact

The incremental cost savings associated with an SP intervention prior to an individual's first youth justice contact is $2,955 per individual and up to $8,224 for higher risk individuals. Once the cost of the intervention is considered and depending on the level of offending risk, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $2,561 to $7,830
- Tier 2 intervention - from $1,488 to $6,363
- Tier 3 intervention - from $1,391 to $6,660

Where the Model 2 intervention is conducted in a private practice setting, the net benefit per individual is between $1,150 and $6,025 for Tier 2 and between $105 and $5,374 for Tier 3, depending on the level of offending risk. These estimates represent an average across all SES groups. It is likely that individuals with low SES may have alternative school provisions and higher needs.

Model 3 - First Contact with Youth Justice: individuals participated in an intervention following the first Youth Justice contact and prior to reoffending

The incremental cost savings associated with an SP intervention following an individual's first youth justice contact and prior to reoffending is $1,716 per individual and up to $4,843 for higher risk individuals. Once the cost of a school-based intervention is considered and depending on level of offending risk, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $1,322 to $4,449
- Tier 2 intervention - from $249 to $2,982

[1] Defined by SLCN (-2) and the mean estimate of YJ and adult custody costs.
[2] Higher risk is defined by SLCN (-3), and the upper estimate of YJ and adult custody costs, which can be interpreted as those individuals with multiple youth offences and who go on to adult custody.
[3] Intervention provider assumed to be school (Model 1, 2 and 3), and Justice for Model 4.

- Tier 3 intervention - from $152 to $3,279

Where the Model 3 intervention is conducted in a youth justice setting, the net benefit per individual is $1,484 to $4,611 for Tier 1; $444 to $3,339 for Tier 2 and -$292 to $2,835 for Tier 3, depending on the level of offending risk. Where the Model 3 intervention is conducted in a private practice setting, the net benefit per individual is -$89 to $2,644 for Tier 2 and -$1,134 to $1,993 for Tier 3, depending on the level of offending risk. The lesser or negative cost savings which arise when utilising costings from private practice are because in this scenario the cost of providing speech pathology exceeds the cost savings to the justice system. However it is important to note that there are likely to be savings elsewhere (for example reduced welfare payments due to a greater likelihood of employment) that are beyond the scope of this evaluation. Additionally, we note that services which are embedded provide a positive and more cost effective alternative to those provided privately.

Model 4 - Adult custody: individuals participated in an Oral Communication intervention during adult custody

The incremental cost savings associated with an oral communication course during adult custody is approximated to be $3,637 per individual and up to $7,635 for higher risk individuals. Once the cost of the intervention is considered, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $3,405 to $7,403
- Tier 2 intervention - from $2,597 to $6,363
- Tier 3 intervention - from $1,861 to $5,859

Where the Model 4 intervention is conducted in a private practice setting, the net benefit per individual is between $2,061 and $6,080 for Tier 2 intervention and between $1,016 and $5,267 for Tier 3 intervention, depending on the level of offending risk.

Overall, evidence for the direct effects of SP intervention on youth offending and crime is positive. Existing literature shows significant improvements in language and communication skills in youth offenders and incarcerated adults, for SP interventions delivered over a short period of time. These gains are clinically important and contribute to a better life trajectory of persons living with SLCN in education and employment, and in long-term justice outcomes. Broader savings will likely be incurred in other sectors, to society more generally (through reduced crime) and thorough increased tax dollars/reduced welfare payments if reduced incarceration leads to increased employment.

2. Background

2.1. Context for the issue

People with Speech, Language and Communication Needs (SLCN) are at greater risk of lower levels of education, higher rates of unemployment, psychological distress and contact with the criminal

justice system. Diagnosis and appropriate treatment of SLCN reduces these risks, leading to better life outcomes for the individual as well as broader social and economic benefits (Community Affairs References Committee, 2014).

A high incidence of (previously undiagnosed) speech and language disorders has been found among offender populations. Specifically, in comparison to the general population, difficulties with receptive and expressive language skills have been identified at higher rates in young people in custody (Snow, Woodward, Mathis and Powell, 2015) and in adult custodial settings (AIHW 2019). Clinically these may manifest in difficulties with listening and attention, vocabulary and grammar, higher-level abstract language, identification and labelling of emotions, telling and retelling of stories and events and social communication and interaction (Speech Pathology Australia, 2019). People with SLCN will be disadvantaged at multiple points in their interactions with the justice system. These include for example, during police investigations or trial, in restorative justice contexts, in participation in therapeutic programs and in engagement with educational and vocational programs (Snow, 2019). As Speech Pathology Australia has previously noted, "failure to recognise the high levels of communication problems in individuals within the justice system may contribute to increased costs associated with recidivism". The earlier intervention occurs, the greater the benefits to the individual and society are likely to be (Community Affairs References Committee, 2014).

Speech pathology intervention has demonstrated effectiveness in addressing these risk factors for poor justice outcomes for people with SLCN. Research has identified contributions to improved functioning in a range of areas. These include for example, in enhancing the effectiveness of other intervention programs (Caravella, Tod and Brown, 2012) and in reducing risk of contact with Police (Winstanley et al., 2018). Similarly benefits have been identified for behavioural self-management and other areas of social, educational and vocational function which may reduce the risk of recidivism (Snow, Bagley and White, 2018; Shepherd, Leubbers and Ogloff, 2016).

There is now recognition of the benefits of speech pathology intervention for justice populations. Speech Pathologists undertake assessment, diagnosis and interventions which target the range of issues with speech, language and communication outlined above as critical in justice settings and processes. These interventions are ideally delivered within a three-tiered framework (SPA 2019, Snow, Sanger, Caire, Eadie and Dinslage 2015) which includes:

- *Tier 1: Universal interventions* which address whole populations to prevent and minimise the impact of SLCN difficulties such as providing input to intake screening assessments, as well as modifying the general environment and building the capacity and skills of staff/carers so as to benefit all in the justice setting.

- *Tier 2: Targeted interventions* which include the provision of group therapy and collaboration with other disciplines to support the delivery of other interventions.
- *Tier 3: Specialist interventions* which address the difficulties of individuals who show additional needs that are not met by the universal or targeted interventions through for example the administration of further assessments or provision of individual therapy programs.

(From Speech Pathology Australia, Speech Pathology in Justice Position Statement 2019)

However, to date there has been limited evidence of the specific nature of the economic benefits that may be associated with the provision of speech pathology in the Australian justice context. To address this, Speech Pathology Australia (SPA) commissioned the Intellectual Disability Behaviour Support (IDBS) Program at UNSW Sydney, in conjunction with the Centre for Health Economics Research and Evaluation (CHERE) at UTS, to undertake a project which centres on an economic evaluation of speech pathology interventions for people with SLCN who are in or at risk of contact with the justice system.

2.2 Aims of the project

This project aims to quantify the impact of an intervention on youth and adult crime in order to demonstrate how appropriate intervention for people with SLCN impacts on future pathways, with a particular focus on reducing the risk of future contact with the criminal justice system and associated costs. To illustrate the potential benefits of interventions for people with SLCN, the project focuses on the scope for speech pathology interventions to improve rates of youth anti-social behaviour, contact with youth justice (YJ) and subsequent adult custody. Benefits are measured in terms of cost savings from appropriate intervention at different life stages and/or in different settings.

2.3 Approach to the project

The overall design for the project consists of three key elements which utilise evidence from existing literature together with a regression analysis of data from the Longitudinal Study of Australian Children (LSAC) and evidence from a unique dataset held at UNSW of people with known diagnoses who have been in the criminal justice system in NSW. Finally, a decision-analytical model and economic modelling approach is used to demonstrate the impact of intervention at different life stages, and associated cost savings to the justice system. Specifically, these phases addressed the following:

I. A systematic review of the literature was undertaken to identify evidence of best practice speech pathology interventions on an individual basis (Tier 3), in a group setting (Tier 2) or embedded in an organisation's practices (Tier 1) for people with SLCN at different

contexts/stages of life such as: 'while in school'; 'after first contact with police and/or youth justice'; 'during youth custody' and 'during adult custody'. The results from this review were used to inform the next stage of the project in estimating probabilities and frequencies of criminal justice outcomes.

II. A regression analysis approach was used to estimate the probabilities and expected frequencies of criminal justice outcomes for people with SLCN who do and do not receive an intervention at the four identified different stages of life. Regression analysis is a form of predictive modelling which investigates the relationship between the explanatory variable of interest, in this case SLCN, and the outcomes of interest: criminal and delinquent behaviour. This type of modelling is used as an alternative to published literature estimates, when these are not readily available. These estimates were subsequently used to inform the decision-analytical model.

III. A decision-analytical model was developed to understand and document the costs and benefits of interventions (Tier 1,2,3) at different stages of life on the trajectories of people with SLCN, with a particular focus on criminal justice outcomes. The decision tree provides a schematic representation showing a series of pathways, which represent the experience of a typical person following an intervention (or not). Costs are accumulated along the pathway, based on the individual's probability and frequency of each event within the pathway. The individual cost benefit is calculated as the difference in total pathway costs for a person receiving an intervention, compared to an individual who receives no intervention. Two fictional case studies, 'Jack' and 'Tim' were developed to illustrate the pathways of different risk trajectories.

IV. A sensitivity analysis was conducted to test the robustness of the regression analysis and decision analytical model assumptions. This involves testing the 95% confidence intervals (CI) of key variables in the models and running alternative plausible scenarios to obtain an upper and lower estimate of cost benefit.

3. Systematic review of the literature

3.1 Aims of the literature review

The first stage of the project was a systematic literature review on Speech Pathology interventions for people at risk or in contact with the justice system. In addition, the review aimed at identifying evidence to inform the development of the decision-analytical model and the conduct of an economic evaluation for the next phase of the project.

The objectives of the literature review were to:

I. Identify evidence of best practice speech pathology interventions (Tier 1, 2 or 3) for people with SLCN at different contexts/stages of life, including at the following four key points: 'while in school'; 'after first contact with police and/or youth justice'; 'during youth custody'; and 'during adult custody'.

II. Understand and document the impact of interventions at different stages of life on the trajectories of people with SLCN, with a particular focus on justice outcomes. Intervention outcomes may include: 'sustained school attendance'; 'contact with police'; 'employment/unemployment'; 'children's court appearances'; 'youth detention'; 'adult court appearances'; 'adult incarceration'; 'recidivism'.

III. Estimate the probabilities and expected frequencies of outcomes for people with SLCN who do and do not receive an intervention at the different stages of life (i.e. effectiveness of the interventions). Intervention outcomes may include: 'sustained school attendance'; 'contact with police'; 'employment/unemployment'; 'children's court appearances'; 'youth detention'; 'adult court appearances'; 'adult incarceration'; 'recidivism'.

The findings from the literature review and other available evidence directly informed the approach taken in subsequent project stages; in designing the decision analytical model and in the economic evaluation.

3.2 Method for the literature review

A systematic literature search was conducted in three databases: EMBASE including Medline, PUBMED and Web of Science, to identify studies published during the period January 2000 to 26th July 2019. Keywords used in the search were: 'communication needs', 'speech pathology', 'developmental language disorder', 'justice system', 'incarceration' and 'recidivism'. An additional search was carried out to identify other documents such as reports and PhD theses. A manual search was also undertaken in the reference lists of included studies.

Papers identified were screened using the following inclusion criteria:

- Studies concerned with speech language and communication needs/impairments/disabilities;
- Studies which reported interventions to address SLCN and outcomes for the interventions;

- Studies which captured any of the different contexts/stages of life: 'while in school'; 'after first contact with police and/or youth justice'; 'during youth custody'; 'during adult custody';

- Publication in English.

A total of 1683 citations were initially screened and 43 included for further eligibility screening. The majority of these studies identified did not report on SLCN and/or their interventions. Overall, 13 studies were included for review: the remaining 30 studies were excluded because they reported quality of life of people with SLCN; were general reviews of SLCN; were interventions targeting specific aspects of language (such as word finding, complex sentences), or reported on interventions for multiple conditions including SLCN. Other studies reporting interventions for stuttering, autism and attention-deficit and hyperactivity disorder (ADHD) were also excluded. Three publications were identified which reported the costs or cost effectiveness of SLCN interventions but did not explicitly focus on the outcomes of interest in this study. The publications and data used to derive costings are discussed in Section 5.2: Estimating costs.

Some key characteristics and findings of studies reviewed are summarised in Appendix 1. One study was a systematic review. The remaining 12 studies were conducted in Australia (n = 6), Canada (n = 1), Denmark (n=1) and England (n = 4). The findings from the literature review are presented below under two headings: evidence of best practice speech pathology interventions and impact of SLCN interventions at different stages of life.

3.3 Findings of the literature review

3.3.1 Evidence of best practice speech pathology interventions

The target population for the studies reviewed were children, mostly in school settings, and youth and/or young adults in either custodial (e.g. youth detention centres), noncustodial (e.g. youth offending service), or community settings. Whilst two studies were identified for incarcerated adults, no study was identified for SLCN interventions and outcomes during adulthood outside prison settings. This could largely be due to the focus of such interventions on short-term speech improvements which can better be achieved in younger persons.

Eight of the 13 studies included in the review described interventions provided for persons with SLCN and the short-term outcomes used to measure their effectiveness (Burrows et al., 2012, Ebbels et al., 2017, Gregory and Bryan, 2011, Kirby et al., 2018, Martin, 2018, Martin and Barns, 2015, Snow and Woodward, 2017, Swain et al., 2020) . Only one of these studies (Burrows et al., 2012) assessed the effectiveness of speech pathology intervention delivered by comparing two groups: those who received intervention and those who did not. The remaining five studies (Brownlie et al., 2004, Mouridsen and Hauschild, 2009, Snow and Powell, 2011, Winstanley et al., 2018, Yew and

O'Kearney, 2013b) retrospectively examined a number of long-term outcomes (such as contact with police, anti-social behaviour and convictions) associated with interventions delivered in previous years. Importantly these studies were not necessarily initially designed to measure such outcomes. Speech pathology interventions delivered in these studies were provided on an individual basis (Tier 3), in a group setting (Tier 2) or embedded in an organisation's practices (Tier 1). Some studies utilised a combination of all three tiers of interventions (Gregory and Bryan, 2011, Kirby et al., 2018). Sample sizes of the five studies that reported interventions and their short-term outcomes ranged from four to 70 depending on the type of intervention delivered, duration of studies or both. For study participants who received one-on-one interventions (Tier 3); duration/intensity ranged from six to 19 sessions, each session lasting between 30 to 60 minutes (Burrows et al., 2012, Gregory and Bryan, 2011, Kirby et al., 2018, Snow and Woodward, 2017, Swain et al., 2020). The average number of sessions provided for Tier 2 interventions ranged between 2.2 to 8.6 depending on the focus (Gregory and Bryan, 2011, Kirby et al., 2018). The number of participants in a group session and its duration were not provided by the studies that reported Tier 2 interventions (Gregory and Bryan, 2011, Kirby et al., 2018).

3.3.2 Impact of speech pathology interventions

None of the studies identified was designed to examine the impact of speech pathology interventions on the trajectories of people with SLCN who received them. Those studies reporting interventions focused on short term outcomes such as improving speech (Burrows et al., 2012), attitude and relationships (Burrows et al., 2012), language skills (Gregory and Bryan, 2011, Snow and Woodward, 2017, Swain et al., 2020, Martin, 2018, Martin and Barns, 2015, Ebbels et al., 2017), communication skills (Gregory and Bryan, 2011, Kirby et al., 2018, Snow and Woodward, 2017) and literacy skills (Martin, 2018, Martin and Barns, 2015, Swain et al., 2020).

The long-term outcomes of interest for this literature review included: 'contact with police'; 'children's court appearances'; 'youth detention'; 'adult court appearances'; 'adult incarceration'; 'recidivism'. In addition, interim outcomes: 'sustained school attendance' and 'employment/unemployment' were included as outcomes for SLCN interventions as research has shown them to be "protective factors" or pathways to avoiding the justice system. Five studies reported some form of long-term outcome, some of which were related to the justice system. However, these studies were of low quality and were not designed to evaluate the effectiveness of speech pathology interventions on individuals with SLCN.

These studies examined the incidence and/or prevalence of outcomes of interest in the SLCN population. Many compared persons previously diagnosed with SLCN during childhood who might have received a speech pathology intervention, to a nominated control population without a previous diagnosis of SLCN. The control population utilised in the studies varied and included the

general population, siblings of persons with SLCN and persons with the same intelligent quotient score. Overall, three studies reported justice outcomes such as offenses, arrests and police contact (Mouridsen and Hauschild, 2009, Winstanley et al., 2018, Brownlie et al., 2004). One study reported on emotional and behavioural problems (Yew and O'Kearney, 2013b) and the remaining one examined the association between severity of offense and language impairment (Snow and Powell, 2011). Brownlie et al. (2004) also reported anti-social behaviour and aggressive behaviour as an outcome in addition to justice outcomes.

There were differences in the evidence reported by the three studies comparing justice outcomes for persons with SLCN who did and did not received speech pathology interventions. Winstanley et al.'s English study (2018) reported a difference in the incidence of police contact between adults with a history of developmental language disorder (DLD) and their age-matched peers with no identified history of DLD. Adults with a history of DLD who received targeted intervention during their school years were less likely to have police contact compared to their age-matched peers, without identified DLD. Other non-justice outcomes reported in the same study are provided in Appendix 1. Mouridsen and Hauschild (2009) found no significant difference in the total convictions between Danish adults who received a diagnosis and intervention for DLD during childhood compared to a control group without a history of DLD (see Appendix 1 for detailed results). Of note, the control group in this study were matched to the DLD group based on sex, and time and place of birth; but not on intelligence quotient.

Contrary to the findings of Mouridsen and Hauschild (2009) and Winstanley et al. (2018), but as would be expected in the general population, Brownlie et al. (2004) revealed that language impaired males from Ottawa, Canada were more likely to be arrested and convicted compared to males who were not language impaired. The differences in the number of arrests and convictions between the two groups were statistically significant. However, it remains uncertain whether participants in this study received interventions for their language impairment as this was not reported in the paper and could not be further tracked in the literature. The observed differences in justice outcomes between studies by Mouridsen and Hauschild (2009) and Winstanley et al. (2018) compared to Brownlie et al. (2004) could be attributed to persons with language impairment receiving interventions in the Danish and English setting under the assumption that language impaired males in Canada did not receive any speech pathology intervention. This may also explain why both the English and Danish studies found that the DLD cohort had better outcomes than the comparison group (although this difference was only statistically significant in the English study).

It is important to note that the findings from the remaining eight studies (Burrows et al., 2012, Ebbels et al., 2017, Gregory and Bryan, 2011, Kirby et al., 2018, Martin, 2018, Martin and Barns, 2015, Snow and Woodward, 2017, Swain et al., 2020) did not report benefits of SP interventions on justice outcomes at different stages of life. However, this does not imply that these interventions

did not yield positive results. Persons living with SLCN benefited in the short-term from the SP interventions in other areas of their lives such as in communication skills (Gregory and Bryan, 2011, Kirby et al., 2018, Snow and Woodward, 2017) language skills (Gregory and Bryan, 2011, Snow and Woodward, 2017, Swain et al., 2020, Martin, 2018, Martin and Barns, 2015, Ebbels et al., 2017) and attitude and behaviours (Burrows et al., 2012).

For example, focusing on studies conducted in Australia, children starting kindergarten who were identified with delayed communication improved in their communication after receiving a combination of Tier 3 (an average of 3.3 sessions for mild delay, 6.2 sessions for moderate delays and 7.9 for severe delays) Tier 2 and Tier 1 interventions in a school setting (Kirby et al., 2018). In the Youth detention setting, six Australian male youth offenders demonstrated positive impact on their language and communication skills from Tier 1 SP interventions, although these impacts were not consistent across clinical measures (i.e. treatment goals) and standardised tools. Of the six study participants, four had a positive outcome in clinical measures and all six had some gains in standardised tools skills (Snow and Woodward, 2017). Another Australian study of youth in detention receiving 18 or more sessions of Tier 1 SP interventions reported medium-large improvements in the targeted communication skills and that these gains were maintained at one month post-intervention (Swain et al., 2020). Lastly, in the adult context, five incarcerated Australian males of varying ages demonstrated improvements in language literacy and writing after receiving weekly SP interventions for varying periods (16, 4, 3 and 10 months for men aged 53 years, 21 years, 26 years and 31 years respectively) (Martin, 2018) and a total of 20 sessions within 10 months for the other adult male (Martin and Barns, 2015).

In the youth justice system, oral competence has been strongly linked with socio-economic wellbeing, educational and employment success, better social relationships, reduced behavioural and emotional issues and decreased criminal activities for high-risk population (Hartshorne, 2009, Snow et al., 2016). Winstanley et al. 2018 also revealed that early identification of language difficulties and provision of targeted SP interventions may have longer-term positive outcomes such as reduction in contact with police, arrests, convictions and other risky behaviours (Winstanley et al., 2018). Thus, the observed short-term positive impact of SP interventions on language and communication skills and in behavioural change are significant and relevant outcomes in clinical practice. It is expected that these positive gains would have a long-term impact (i.e. improved distal outcomes) on the life trajectories of persons with SLCN including educational success and less or later contact with police for younger people.

For youth offenders, the extent to which gains made through SP intervention are sustained over time and/or make a difference to developmental trajectories remains unknown (Snow, 2019). However, considering the gains in speech, language and communication demonstrated in the literature, it is expected that post-release outcomes for youth offenders will improve. These may be

associated with for example, improved ability to cope with justice outcomes, protection from re-offending and arrests. Improvement in language will also reduce the rate of re-incarceration given that inadequate language skills has been reported to affect the ability of 'offenders' to comprehend what they are accused of during arrests (Rost and McGregor, 2012). Youth justice workers interviewed about their perception of the benefits of speech language pathology interventions were of the view that these interventions contributed to short term gains for youth offenders, such as increased confidence and improved communication skills, which subsequently improved their classroom learning and behaviour (Snow et al., 2018). Participants in this study also speculated that a long-term impact of these benefits can be seen in reduced re-offending and recidivism.

3.3.3 Additional literature search

Due to the limited number of studies identified from the initial search, a second systematic search was conducted. The aim of this review was to identify the association between observed short term outcomes (e.g. improved communication skills) of SP interventions and the desired interim (e.g. sustained school attendance and employment/unemployment) and long term outcomes (e.g. justice outcomes such as contact with police and youth detention). No studies examining the impact of interventions on the outcomes of interest were identified in this second search. Some studies compared educational and employment outcomes of individuals with a history of SLCN receiving an intervention to those with no history of SLCN. For instance, one study compared the employment rates of persons with DLD to their siblings and other persons. Here, adults with a history of DLD were found to be less likely to be employed compared to their siblings and matched controls (Clegg et al. 2005). Other studies reported the academic and employment outcomes of children with specific language impairment (SLI) who attended special schools. For example, Carroll and Dockrell (2010) reported that whilst some of the participants were either employed (28%) or in school (65%), only 7% were not in training, education or employment (Carroll and Dockrell, 2010).

Overall, the systematic review demonstrated that there is a paucity of research on the benefits of SP interventions for people at risk or in contact with the justice system. In particular, little research addresses the impacts on justice outcomes such as 'contact with police', 'youth detention', 'adult court appearances', 'adult incarceration' and 'recidivism'. Most of the literature focused on short term outcomes of SP intervention such as improving speech, language and communication skills. These studies demonstrated that people living with SLCN make substantial gains in their communication and language skills when they receive SP interventions in schools as pre-schoolers and in youth justice centres as youth offenders. Youth offenders also report improvement in attitudes and behaviours. Incarcerated adults showed improvement in language literacy skills. The gains made for these short-term outcomes are 'clinically significant/meaningful' and are expected to protect persons with SLCN from initial and continuing contact with the justice system over time. The small number of studies which reported on long-term criminal justice outcomes, including aggression, anti-social behaviour and severity of crime, were generally of low quality and were not

designed to evaluate the effectiveness of SP intervention. There was no evidence of best practice SP interventions (Tier, 1, 2, 3), over different life stages nor on impacts of such interventions on justice outcomes for people with SLCN.

One of the initial aims for the systematic literature review was to draw out evidence from which to generate probabilities to inform the decision analytical model (aim III). The results of these studies are promising, but without an experimental component, such as repeated measures throughout the intervention or a multiple baseline design, case studies are interpreted as providing only low-level evidence of effectiveness. Therefore they provide a limited basis to inform the next stage of the project. Consequently, regression analysis was utilised as an alternative approach.

4 Regression Analysis

Regression analysis is a form of predictive modelling which investigates the relationship between the explanatory variable of interest, in this case SLCN, and the outcomes of interest: criminal and anti-social behaviour. Identification of the link between SLCN and youth anti-social behaviour and crime requires understanding and controlling for background factors related to SLCN that also influence future criminal behaviour. This is complicated by the fact that SLCN is a broad term that encompasses a number of distinct groups. According to the *Speech Pathology in Justice Guidelines 2019*, people with SLCN can have deficits in expressive (production), receptive (comprehension), oral (speaking/hearing) or written language (reading/writing/spelling), as well as communicating with others in a social setting (pragmatics). The aim of the regression analysis was to estimate the impact of 'hypothetical speech pathology interventions' (defined by improvement in language) on long-term justice outcomes.

This approach involved estimating the effectiveness of SP interventions utilising longitudinal data (5,000 children aged 4 to 17 years) from the Longitudinal Study of Australian Children (LSAC). From the effectiveness estimates in the regression analysis, the absolute values (i.e. probabilities and frequencies) of outcomes are generated for use in the decision analytical model. In order to estimate the effectiveness of SP interventions from LSAC, we identified the relevant background variables (i.e. risk and protective factors) that define the measures in LSAC (details presented in the next section). These factors were used to assess SLCN and to define the outcomes of interest in the regression analysis. The analysis and results of the regression analysis are then presented. These empirical estimates will subsequently be used to inform the decision analytical model.

4.1 Longitudinal Study of Australian Children

The Longitudinal Study of Australian Children (LSAC) is a national Australian cohort study that commenced in 2004 and follows two cohorts of children, a birth cohort (B cohort) and a kindergarten cohort (K cohort), each comprising 5,000 children. For the purposes of this analysis,

the LSAC K cohort (Wave 1 to Wave 7) is used, when the children are aged 4 – 17 years. These data provide a rich set of individual-level background, health and family information linked with community level measures, and importantly for this study, allows for longitudinal assessment of language development, youth anti-social behaviour and crime. The datasets are de-identified and comply with the Centre for Health Economics Research and Evaluation's (CHERE) program ethics approval UTS HREC REF NO. 2015000135.

The advantage of using longitudinal data such as LSAC is that it allows us to consider the complexity of individual's trajectories by controlling for a rich set of individual, family, school and community risk factors and/or protective factors associated with contact with the justice system. In the literature reviewed for this project, the group most represented are those with a language impairment. However, SLCN as a categorical term may also represent those with language deficits that are associated with a lack of opportunity or associated with a co-morbidity, such as ADHD. By including these explanatory variables in our regression analysis, we can more confidently conclude that any observed effects on outcomes can be directly linked to SLCN interventions.

While LSAC enables estimation of probabilities of contact with the youth justice system, it does not provide a level of detail (for example the number of days in custody) nor does it enable estimates of the frequency and cost of contact with the adult corrections system for people with SLCN. These details were obtained from the Mental Health Disorders and Cognitive Disability in the Criminal Justice System (MHDCD) databank held at UNSW (outlined in Section 5.2.2 below).

4.2 Identification of risk and protective factors associated with youth anti-social behaviour and crime

A literature review was conducted to identify the risk and protective factors associated with anti-social behaviour and crime, which could be matched with comparable measures in the LSAC. These factors are categorised below into five relevant domains: individual; family; peer; school and community

4.2.1 Individual risk factors

The influence of individual risk factors occurs along several dimensions. Children with youth anti-social behaviour have been found to exhibit early anti-social behaviour, most often aggression (Connell et al., 2011, Mohr-Jensen et al., 2019, Sittner and Hautala, 2016), notably before the age of 12 years (Schofield et al., 2015). These children often display impulsivity, hyperactivity and participate in risk taking behaviours at a young age (Wojciechowski, 2017). They have also been found to be at higher risk of social and emotional difficulties (Yew and O'Kearney, 2013a) and cognitive (McGloin and Pratt, 2003, Pyle et al., 2016, Schofield et al., 2015, Jolliffe et al., 2017) and language deficits (Anderson et al., 2016, James et al., 2020). These deficits can lead to poorer peer

and teacher relations (Ttofi et al., 2011), resulting in low educational aspirations, low grade retention and poor motivation which ultimately impacts educational attainment (Schwartz et al., 2019, Pyle et al., 2016) and increases the risk of child anti-social behaviour (Assink et al., 2015). Overall, the number and magnitude of individual risk factors is linked to life course persistent criminal offending (Jolliffe et al., 2017). Conversely, high intelligence and executive function have been found to have a protective influence on anti-social behaviour and criminal activity (Adjorlolo, 2017, Ttofi et al., 2016). In a meta-analytic review of prospective studies, Ttofi et al. (2016) reported that in both high and low risk individuals respectively, higher level of intelligence predicts lower levels of offending (OR = 2.32; 95% CI:1.49-3.63; p = 0.0001) (OR = 1.33; 95% CI: 0.88-2.01; p = 0.18).

4.2.2 Family risk factors

The environmental influences of family on children's behaviour are significant and understood to be associated with an accumulation of a number of factors, as well as the length of exposure. Childhood exposure to family poverty has been observed consistently in studies of youth crime. Children raised in poor, disadvantaged families are at greater risk for offending than children raised in relatively affluent families (Farrington et al., 2017, Mallett, 2017, Berti and Pivetti, 2019). A number of systematic reviews (e.g. Braga et al., 2017, Malvaso et al., 2016) found that exposure to maltreatment during childhood and adolescence was associated with subsequent delinquent or offending behaviours. Braga et al (2018) reported in a meta-analysis of 14 studies and 20,946 individuals, that maltreated youth are nearly two times as likely to engage in anti-social behaviours in adulthood compared with their non-maltreated peers (OR=1.96; CI[1.42, 2.71]) (Braga et al., 2018). Studies have shown that children of families which exhibit high levels of dysfunction and social adversity have a high risk of exhibiting child anti-social behaviour. Notable familial risk factors include: poor parental supervision; punitive or erratic parental discipline; cold parental attitude; child abuse and neglect; parental conflict, family disruption; anti-social parents; large family size and low family income. (Assink et al., 2015, Barnow et al., 2004, Feinberg et al., 2007, Goldfarb et al., 2014, Marquis, 1992, McKinlay et al., 2014, Root et al., 2008, Schwartz et al., 2019, Song et al., 2018, You and Lim, 2015, Jolliffe et al., 2017)

4.2.3 Peer and sibling risk factors

Peer influences on child anti-social behaviour usually appear developmentally later than individual and family influences. Many children entering school, for example, already show aggressive and disruptive behaviours (Assink et al., 2015). Two major mechanisms associated with peer factors or influences are the association with deviant peers and peer rejection (Lansford et al., 2014). Association with deviant peers is related to increased co-offending and an increase in the severity of offending and, in a minority of cases, the joining of gangs (Moss et al., 2003).

A number of studies have underscored the role played by siblings in influencing delinquent behaviour, in both the domains of family and peer influence (Schwartz et al., 2019, Slomkowski et al., 2001). For example, compared with teens with lower rates of offending, teens with high rates of offending were more likely to have siblings who also committed delinquent acts or had been incarcerated (Slomkowski et al., 2001). Some studies speculate that older siblings who are prone to delinquent behaviour may reinforce anti-social behaviour in a younger sibling, especially when there is a close relationship (Song et al., 2018, Assink et al., 2015). The authors concluded that the effects of sibling-related risk factors were larger than risk factor effects of the mother.

4.2.4 School risk factors

Schools play an important role in the socialisation of children and the development of anti-social behaviour. When schools are poorly managed and operated, children are less likely to value their education and are more likely to be exposed to peer influences that promote anti-social behaviour (Farrington et al., 2017, Mallett, 2017, Parks et al., 2020). For example, schools with large enrolments and fewer resources have been shown to have higher levels of teacher victimization by pupils and consequently poor student-teacher relations. Low teaching satisfaction has been linked to higher rates of disciplinary problems within schools, which can be exacerbated by poorly defined rules and expectations of appropriate conduct. Poor rule enforcement within schools has been associated with higher levels of student victimization, which ultimately leads to poor academic performance and school drop-out.

4.2.5 Community risk factors

Numerous risk factors for young people's offending lie within the community domain. Social disadvantage at the neighbourhood level is of primary importance in the development of anti-social behaviours (Case, 2015). Disorganized neighbourhoods with few authority figures may have weak social control networks that allow criminal activity to go unmonitored (Butcher et al., 2015). In terms of violent crimes, one study concluded that social disorganisation and concentrated poverty within a community leads to residents being less willing to intervene when children are engaging in anti-social/ unlawful acts, further contributing to a greater likelihood of violence within neighbourhoods (Case, 2015).

These findings show that the pathway to youth risk-taking behaviour and offending occurs through the complex interaction of biological factors (genetic), psychological factors (mood, personality, behaviour) and social factors (cultural, familial, socioeconomic, community) and highlight the importance of considering these factors when exploring the association between language, anti-social behaviour and crime (refer to Appendix 2 for a summary of the key studies).

Based on these findings, it was possible to match key domains from the literature to comparable explanatory variables in LSAC. The matched explanatory variables are summarised descriptively in Appendix 3.

4.3 Measures used to assess SLCN

The next step in the regression analysis was to identify the children in LSAC with SLCN. The LSAC includes several measures that assess communication and language (outlined in detail in Appendix 3). The main measures used the short version of the Peabody Picture Vocabulary Test-Third Edition (PPVT-III) (4-9 years) (Rothman, 2003); the Academic Rating Scale: Language and Literacy, (10–15 years) (Rothman, 2009); the Rice Test of Grammaticality Judgement (GJT/SLI) (14-15 years) (Rice et al., 2009); PEDS receptive and expressive language (4- 7 years), teacher reported written language (reading, spelling, writing) (4-13 years) and the Child's Communication Checklist (6-7 years) (Australian Institute of Family Studies, 2018).

To capture the multi-dimensional nature of SLCN we followed Kling, Liebman, and Katz (Kling et al., 2007) and estimated a summary index that aggregates information across all of the measures. Summary indices were constructed by taking the average standardized measure (Z-Score) of each component, and standardising these averages. As there is no 'diagnosis' of SLCN in the LSAC, this method improves statistical power to detect effects within the defined domain of SLCN.

4.4 Outcome variables – anti-social behaviour and crime

The LSAC includes several questions to measure youth anti-social behaviour and youth justice (YJ) contact. The measure of youth anti-social behaviour was based on a 17-item child questionnaire adapted from the Self-Report Delinquency Scale developed by Moffit and Silva (1988). Using a 6-point scale (0. Not at all; 1. Once; 2. Twice; 3. Three times; 4. Four times and; 5. Five or more times), respondents were asked: 'In the last 12 months have you….?'

- Got into physical fights in public;
- Skipped school for a whole day;
- Stolen something from a shop;
- Drawn graffiti in public places;
- Carried a weapon like a knife, gun or piece of wood;
- Taken a vehicle for a ride/drive without permission;
- Stolen money or other things from another person;
- Run away from home and stayed away overnight or longer;
- Purposely damaged or destroyed others' property;
- Damaged a parked car (e.g. slashed tyres, scratched paint);
- Gone around with a group of 3+ kids damaging or fighting; Been suspended or expelled from school;

- Broken into a house, flat or vehicle;
- Stolen something out of a parked car;
- Started a fire in a place where you should not burn;
- Used force or threats to get money or things from someone.

The questionnaire was completed in three waves, at 12/13 years, 14/15 years and 16/17 years of age. Reliability was tested by comparing results from two administrations separated by 1 month for 20 pilot subjects. Correlation between the two sets of scores was .85 (Australian Institute of Family Studies, 2018) indicating a high reliability. A summary score of these items was used to construct the outcome measure of youth anti-social behaviour for the regression analysis.

The measure of YJ contact is drawn from a 9-item child questionnaire adapted from the Australian Temperament Project, Wave 11 (1998) (Australian Institute of Family Studies, 2018). It was designed to measure contact with the justice system. Using a 4-point scale (0. Not at all; 1. Once; 2. Twice; 3. More often), respondents were asked 'In the last 12 months have you done any of the following':

- Been required to attend a youth justice conference;
- Been charged with an offence by the police;
- Appeared in court as a defendant;
- Been convicted of an offence;
- Been on community-based supervision;
- Been on community-based supervision after sentencing or
- Detained in a youth detention/youth justice centre.

For the purposes of our analysis, one item from the questionnaire was excluded, (Been told to 'move on'/warned/cautioned, by police) as it was considered to be inconsistent in terms of severity, when compared to the other items in the measure, and as a result, may bias the results. The questionnaire was administered in two waves, when the children were 14-15 years and then again at 16-17 years of age. A summary score of the 8-item questionnaire was used to construct the outcome measures utilised in the regression analysis: first YJ contact, multiple YJ contacts.

4.5 Analysis and results

In order to estimate the effectiveness of a hypothetical SP intervention on three outcomes of interest: youth anti-social behaviour; first YJ contact and YJ recidivism, we employed a linear probability model. This type of regression model is used where the desired outcome variable is a probability, and one or more explanatory variables are used to predict the outcome. The results showed that the effectiveness of an SP intervention which increased SLCN from two standard deviations below the mean to one standard deviation below the mean i.e. an improvement of 1 SD can be estimated as:

- 7.8 percentage point (95%CI[4] 5.6, 9.9) reduction in youth anti-social behaviour.
- 1.7 percentage point (95%CI 0.1, 3.4) reduction in youth justice contacts, following at least one youth anti-social behaviour.
- 22 percentage point (95%CI 0.08, 44.6) reduction in youth recidivism following at least one youth anti-social behaviour and one youth justice contact.

The predictions from this analysis were used to inform the economic evaluation.

5. Economic Evaluation

The key purpose of economic evaluation is to inform decision-makers about the consequences and efficient allocation of resources. Economic evaluation is particularly important when a service provides benefits at additional costs. For example, within a constrained care budget, determining the additional cost that would be paid for a given health gain is important when ascertaining whether such incremental costs represent value for money.

Cost-benefit analysis is a form of economic evaluation which assigns a monetary value to the costs and benefits of a program or intervention and then compares the two values to determine whether the benefits outweigh the costs. The rationale for the cost-benefit study reported here is that a speech pathology intervention program will lead to potential cost savings through improved SLCN. In turn, this would be associated with a reduced risk of anti-social behaviour and offending behaviour.

The usual approach to cost benefit analysis is to determine the incremental costs, that is, the difference in costs between *intervention and no intervention*, which is defined as the ` cost savings from reduced anti-social behaviour and crime minus the costs of the intervention '.

$$Cost\ benefit = \quad Cost_{\ Intervention} - Cost_{\ No\ intervention}$$

5.1 Decision analytical modelling

Decision analytic modelling provides a framework for decision making under conditions of uncertainty. Economic models are simplifications of reality and it may never be possible for a model to include all possible ramifications of any particular option being considered. The purpose is to provide a structure that is consistent with the key features of the economic evaluation, such as the perspective, time horizon and measurement of outcome. Most decision models adopt an 'average patient' approach, exploiting the fact that similar people within a population share the same

[4] 95%CI = 95th percentile confidence interval.

characteristics. These models are known as cohort models and one of the most common forms of cohort model is the decision tree.

5.1.1 The decision tree

The decision tree provides a schematic representation showing a series of pathways, which represent the experience of a typical person following an intervention. The decision tree consists of *decision nodes*, *chance nodes* and *branch probabilities*. Decision nodes, usually at the start of a tree, indicate a decision point between alternative options. Chance nodes show a point where two or more alternatives for a person are possible. Branch probabilities are attached to a chance node and represent the likelihood of an event occurring.

A key concept in decision analysis fundamental to identifying the preferred alternative is the *expected value*. Each event along the pathway of the tree has an *expected cost*. Total costs of each pathway are calculated as the summation of the cost of each event weighted by the sum of the branch probabilities.

5.1.2 Model assumptions

A decision tree was developed to evaluate the costs and benefits of an effective SP intervention, targeting an individual at risk of youth anti-social behaviour, YJ contact and adult crime. Four models were simulated from the age of the individual's first youth delinquent behaviour, and followed throughout their lifetime (Figure 5-1). The four models differed according to the *timing of the SP intervention at different stages of life*.

- In Model 1 *(childhood)* an individual participated in an intervention prior to their first youth anti-social behaviour (depicted 1 in Figure 5-1).
- In Model 2 (*while in school),* individuals participated in an intervention prior to their first youth justice contact (depicted 2 in Figure 5-1).
- In Model 3 *(after first contact with YJ),* individuals participated in an intervention following the first YJ contact and prior to their reoffending (depicted 3 in Figure 5-1).
- In Model 4 (*while in adult custody),* individuals participated in an intervention during adult custody and prior to their reoffending (depicted 4 in Figure 5-1).

The timing of the SP intervention determines how many benefits the individual accumulates over time. In Model 1, it was assumed that individuals accumulate the benefits of intervention at three time points (Youth anti-social behaviour, YJ first contact and YJ recidivism). In Model 2 individuals are assumed to accumulate the benefits of intervention at two time points (YJ first contact and YJ recidivism). In Model 3, individuals are assumed to accumulate the benefits of one time point (YJ recidivism). In Model 4, individuals are assumed to accumulate the benefits of one time point (adult custody).

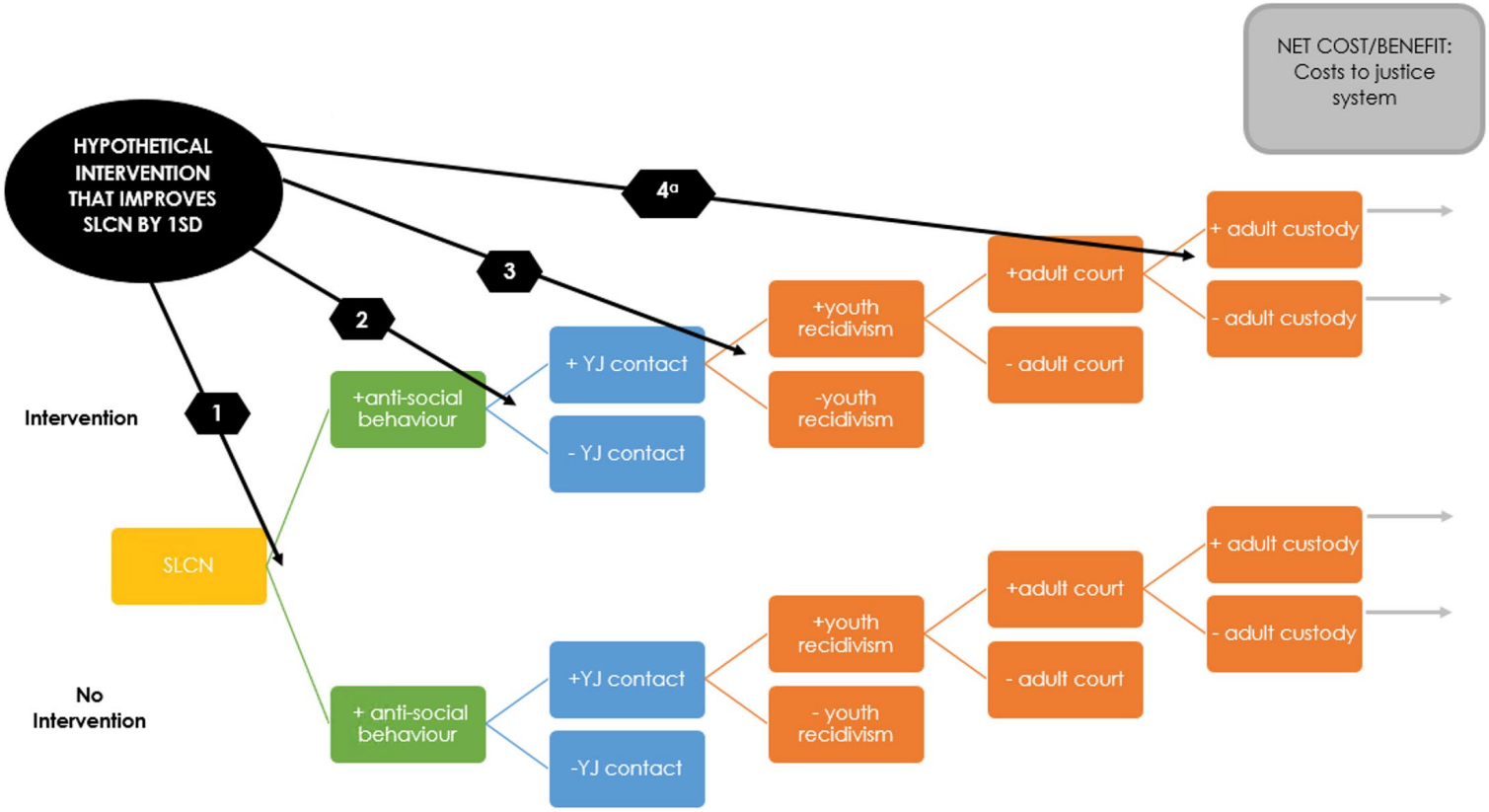
Individuals with SLCN at a level 2 standard deviations below the mean SLCN value (-2) were the focus of the analysis, as this group were identified in the literature as an appropriate cut-off for having an SLC 'impairment'. Cost benefit estimates assuming an individual with SLCN at 3 SD below the mean (-3) and an individual with SLCN at mean values (-1) were considered in a sensitivity analysis designed to test the robustness of model assumptions and the validity of the analysis (outlined in detail in Section 5.3.2). The decision tree pathways were defined from the literature and populated using estimates from LSAC, and costs derived from the Mental Health Disorders and Cognitive Disabilities in the Justice System (MHDCD) databank and other data sources discussed in Section 5.2.2. These pathways capture all the possible outcomes for which robust data were available. In addition, these pathways capture the significant differences in costs, which are driven by lower rates of youth anti-social behaviour and criminal behaviour, in individuals who respond to an effective SP intervention.

In the decision tree developed for this study to explore the trajectories of the population with SLCN, an individual can take one of nine possible pathways. Specifically, an individual with SLCN of -2 (2 standard deviations below the mean) participates in an intervention or not according to the following:

1. The individual (with intervention or not) engages in youth anti-social behaviour, has multiple YJ contacts, in adulthood attends court and is incarcerated.
2. The individual (with intervention or not) engages in youth anti-social behaviour, has multiple YJ contacts, in adulthood attends court but is not incarcerated.
3. The individual (with intervention or not) engages in youth anti-social behaviour, has multiple YJ contacts, but no adult court or custody.
4. The individual engages in youth anti-social behaviour, has one YJ contact, and in adulthood attends court and is incarcerated.
5. The individual engages in youth anti-social behaviour, has one YJ contact, in adulthood attends court but is not incarcerated.
6. The individual engages in youth anti-social behaviour, has one YJ contact and but no adult court or custody.
7. The individual engages in youth anti-social behaviour, has no YJ contacts and in adulthood attends court and is incarcerated.
8. The individual engages in youth anti-social behaviour, has no YJ contact, in adulthood attends court but is not incarcerated.
9. The individual engages in youth anti-social behaviour, has no YJ contact and no adult court or custody.

The next section outlines the data and assumptions used in the decision tree analysis. Section 5.3 then details the results of the cost benefit analysis for each of the four models and presents two case studies in which the findings of the analysis are applied to two case studies, one of an individual with an average youth offending risk, and the other, an individual with high youth offending risk. Tables (5-3 and 5-4) are provided to summarise the justice system costs and associated cost savings for the two cases.

Figure 5-1. Trajectories of individuals with SLCN who participate in youth and adult crime- Intervention and No intervention group



SLCN= Speech, language and communication needs, SD= standard deviation, YJ=youth justice. a. included by request from SPA, based on an oral communication course which reduces adult recidivism by approximately 50%. (Hartshorne, 2009), + indicates 'with', - indicates 'without'. (E.g., SLCN + anti-social behaviour – YJ contact = individual with SLCN, who participates in anti-social behaviour but has no subsequent YJ contact). HARTSHORNE, M. (2009) *The cost to the nation of children's poor communication,* I Can, London.

5.2 Model Data

5.2.1 Criminal justice system trajectories

Using the predictions from the regression analysis (as set out in Section 4.5), the probability of each youth and adult event in the decision tree was estimated. These probabilities are summarised in Table 5-2. Probabilities are derived from a number of sources including published NSW Bureau of Crime Statistics and Research (BOCSAR) reports and from the Mental Health Disorders and Cognitive Disability in the Criminal Justice System (MHDCD) databank held at UNSW.

The probabilities of adult court appearances and custody episodes for people with different youth pathways were identified from reports from the NSW Bureau of Crime Statistics and Research (BOCSAR). These are based on the general population and are therefore likely to be conservative estimates when applied to the population with SLCN. For people with no youth offences, the probability of any adult court appearances and the probability of any adult custody were derived from Weatherburn and Ramsey (2018). Subtracting the cumulative probability of a first court appearance by age 18 (5%) from the cumulative probability by age 33 (24.4%) gives an estimate of the probability of any adult court appearances of 19.4%. Taking the same approach, the probability of adult custody is 2% (2.4 – 0.4), or 10.3% of the 19.4% with a court appearance.

For people with youth offences, probabilities of having any adult court appearance or custody episodes were estimated based on Chen, Matruglio, Weatherburn and Hua (2005). The proportion of people with a first children's court appearance at age 16 (and no reappearances) having at least one adult court appearance within 8 years was 44.2%. This estimate was used to proxy the probability of at least one adult court appearance for people with one youth offence. Of people with a first children's court appearance at age 16 (and no reappearances) 4.8% had at least one adult custody episode within 8 years. For people with multiple youth offences, probabilities of subsequent adult court appearances (73.7%) and custody episodes (21.0%) were also derived by combining the results reported for people with one youth reappearance and two or more youth reappearances.

The Mental Health Disorders and Cognitive Disability in the Criminal Justice System (MHDCD) databank[5], held at UNSW, contains lifelong administrative data on a cohort of 2,731 individuals whose mental health and cognitive disability diagnoses are known and who have been in the corrections system in NSW. A subgroup of people with SLCN were identified from the MHDCD

[5] Databank compiled from an ARC Linkage Grant (Project LP0669246), UNSW, 'People with mental health disorders and cognitive disability in the criminal justice system in NSW'. Chief Investigators: Eileen Baldry, Leanne Dowse, Ian Webster; Partner Investigators: Tony Butler, Simon Eyland and Jim Simpson. Partner Organisations: Corrective Services NSW, Housing NSW, Justice Health NSW, Juvenile Justice NSW, and the NSW Council on Intellectual Disability. UNSW Ethics Approval #HC190681.

databank using low verbal IQ (<=85)[6] as a proxy. For this subgroup, we identified the pattern of contacts with different parts of the justice system for people with SLCN including court attendances, length of youth and adult sentences and to calculate associated costs to the justice system.

5.2.2 Costs

A number of sources and calculations were utilised to develop the estimates of the costs associated with each event in the pathways set out in the decision tree, including the costs of youth anti-social behaviour and crime (both youth and in adulthood) and the cost of SP intervention across tiers 1, 2 and 3. These costs are presented in Table 5-2 and the approach to their calculation is detailed in the sections below. A full summary of the assumptions informing the decision analytic model is provided in Appendix 5.

Costs of anti-social behaviour and crime

The unit costs of interactions with different parts of the justice system were first calculated by Baldry, Dowse, McCausland and Clarence (2012) for the Lifecourse Institutional Costs of Homelessness for Vulnerable Groups Project (Baldry E et al., 2012). These costs were subsequently updated by Reeve and McCausland (2019, working paper - forthcoming), and the updated costs, expressed in 2019 AUD, are used in this report.

Using a subset of data from the MHDCD databank for people with low verbal IQ (as described above) the average number of days per youth and custody episode was calculated. For youth episodes these were calculated separately for remand and sentenced episodes. Unit costs per day were then multiplied by average days per custody episode to estimate the cost per episode. All costs were then multiplied by frequencies obtained from LSAC models for people with one and multiple YJ offences during their childhood (see Appendix 5 for calculations).

Days in adult custody were similarly calculated from the MHDCD databank for people with low verbal IQ. The number of court appearances and number of custody episodes per annum, from age 18 to last observation/death, were calculated separately for people with no youth offences, one youth offence and multiple youth offences, corresponding with the respective pathways in the decision tree. To enable lifetime costs to be calculated, life expectancy estimates from Australian life tables (Australian Bureau of Statistics (ABS), 2018) were adjusted downwards by two years for every year in prison (Widra, 2017). The number of years of adulthood was multiplied by average annual court appearances and custody days and by the cost per court appearance and per day in custody. Each court appearance was assumed to incur one police event as a person of interest and this was added to the court cost. This is likely to be conservative. As court costs differ by the type of

[6] This is less than one SD below the mean verbal IQ. Estimates were also derived for the population with verbal IQ less than 2 SDs below the mean but typically they did not differ significantly so the larger sample was used.

court, the cost per appearance is a weighted average based on the distribution of court types attended by the MHDCD cohort with low verbal IQ.

Costs of intervention

Costs of speech pathology within an institutional setting

The report from the SPyce Project shows that young people in youth justice settings have a high prevalence of disorders associated with SLCN, providing evidence of the need for speech pathologists as part of a multidisciplinary team in this setting (Caire, 2013). Snow et al (2013) report that around 50% of young offenders have SLCN. Snow, Sanger, Caire, Eadie & Dinslage (2015) provide an adapted 'Response to Intervention' (RTI) framework through which to conceptualise, design, develop and evaluate interventions for speech, language and communication intervention in justice settings. Comprising three tiers of service delivery, the adapted RTI framework targets interventions on an individual basis (Tier 3), in a group setting (Tier 2) and embedded in an organisation's practices (Tier 1) (Snow et. al 2015). In schools with a high SLCN population and in justice settings, the cost per person of speech pathology for a therapist who is employed within an institution can be estimated by dividing the cost of employing a speech pathologist by the number of people who would benefit from the service (Tier 1, 2 or 3). Whilst in practice a speech pathologist's time would be split between Tier 1, 2 and 3 interventions, to calculate unit costs for each tier of service, the total annual cost of a speech pathologist is divided by the total number of clients who would be reached per annum if they were only delivering Tier 1, Tier 2 or Tier 3 services.

Speech pathologists in different justice and school settings in Australia were asked by SPA to provide their expert opinion on the expected number of clients who would benefit from their service in a school or youth justice setting, if they were only delivering Tier 1 or tier 2 or Tier 3 interventions. They were also asked about the annual salary of a speech pathologist in their setting and jurisdiction. Of the 17 responses received, 14 (7 in school settings and 7 in youth justice) provided the requested information and these were used to estimate the unit costs per Tier and per person (recognising that in an institutional setting individuals receiving Tier 2 or 3 interventions will also have received Tier 1). A detailed summary of the average responses and calculations costs is provided in Appendix 6. The resulting average cost per person receiving Tier 1 only, Tier 2 or Tier 3 costs in school and youth justice settings is provided in Table 5-2 below.

Costs of speech pathology by a private practitioner

Group and individual SLCN intervention may be delivered by a privately practicing Speech Pathologist rather than one employed within a school or youth justice setting. The cost of private practitioner speech pathology interventions utilised in this study is based on prices set out by the National Disability Insurance Scheme (NDIS) and evidence from the literature.

Tier 3 interventions: Frequency and duration estimates for individual speech pathology interventions (Tier 3) were derived from the six studies concerning this type of intervention found in the systematic literature review. For study participants who received Tier 3 interventions, the duration/intensity ranged from six to 19 sessions, with each session lasting between 30 to 60 minutes. Utilising these data we calculated mid-points and therefore assume that people receiving Tier 3 interventions have 12 sessions of 45 minutes each. The NDIS pays travel time of up to 20 minutes per local client and up to 45 minutes per regional or remote client, per visit (Allied health Professions Australia, 2018/19). ABS data[7] shows that 72% of the population live in major cities and 28% in rural or remote areas. Applying this to the above travel times we derived an overall average of approximately 30 minutes travel time per person. This results in an overall calculation of total time per Tier 3 intervention of 1 hour and 15 minutes (intervention + travel time) for 12 sessions, giving a total of 15 hours per person. NDIS cost per hour for therapy supports is $190 (Speech Pathology Association of Australia, 2020) making a total cost of $2,850 per Tier 1 intervention by a private practitioner.

Tier 2 interventions: In a study of group SLCN intervention (Boyle 2007) the mean number of sessions attended was 38, with each session 30 minutes in duration. Among young people at risk of contact with the justice system who attend group therapy, the estimated number of people per group is 4 (based on information provided to SPA by members in Australia). The NDIS price guide 2019-20 states that "therapy delivered in a group may be claimed using the relevant therapy support line item, but with lower prices than the price limit, as agreed between provider and participant". Based on this we assume that a therapist will divide the $190 cost per hour between the participants (National Disability Insurance Agency). If each session is 30 minutes long plus 30 minutes travel time, on average, then 38 sessions will be paid at one hour each, per group. The total cost for a group of 4 is therefore $7,220 per group, equating to $1,805 per participant receiving a Tier 2 intervention by a private practitioner.

Table 5-1 Key assumptions in the model

Input variable	Value	95%CI	Reference
Base case model			
Probabilities a			
Probability of youth anti-social behaviour (childhood intervention)			
(SLCN=-3)	0.393	(0.329,0.455)	LSAC
(SLCN=-2) (assumed no intervention base case model)	0.314	(0.272,0.356)	LSAC
(SLCN =-1) (assumed intervention base case model)	0.236	(0.215, 0.256)	LSAC
SLCN=0	0.158	(0.157, 0.158)	LSAC
Probability of JJ contact following youth anti-social behaviour (while in school intervention)			
(SLCN=-3)	0.093	(0.043, 0.142)	LSAC
(SLCN=-2) (assumed no intervention base case model)	0.075	(0.041, 0.108)	LSAC

[7] Population Estimates by Remoteness Area (ASGS 2016), 2007 to 2017

(SLCN =-1) (assumed intervention base case model)	0.057	(0.039, 0.074)	LSAC
SLCN=0	0.039	(0.030, 0.047)	LSAC
Probability of youth recidivism (intervention after first YJ contact)			
(SLCN=-2) (assumed no intervention base case model)	0.940	(0.123, 1)	LSAC
(SLCN=-2) (assumed no intervention base case model)	0.717	(0.121, 1)	LSAC
(SLCN =-1) (assumed intervention base case model)	0.494	(0.115, 0.872)	LSAC
SLCN=0	0.271	(0.092, 0.451)	LSAC
Probability of adult court			
No YJ offence	0.194	N/A	BOCSAR
Once YJ offence	0.442	N/A	BOCSAR
Multiple YJ offences	0.737	N/A	BOCSAR
Probability of adult custody			
No YJ offence	0.103	N/A	BOCSAR
Once YJ offence	0.108	N/A	BOCSAR
Multiple YJ offences	0.285	N/A	BOCSAR
Probability of adult recidivism (intervention during adult custody)	probability of adult custody * 0.5	N/A	ref cost to nation
Costs b			
Cost of intervention: School setting			
Tier 1	$394		SP survey
Tier 2	$1,467		SP survey
Tier 3	$1,564		SP survey
Cost of intervention: Youth justice setting			SP survey
Tier 1	$232		SP survey
Tier 2	$1,272		SP survey
Tier 3	$2,008		SP survey
Cost of intervention: Tier 2 private setting	$1,805		NDIS
Cost of intervention: Tier 3 private setting	$2,850		NDIS
Cost of youth offence	$3,289	($1,289, $3,554)	calculated field
Cost of youth recidivism	$73,383	($5,892, $325,152)	calculated field
Cost of adult court (lifetime)			
With no YJ offence	$104,681		calculated field
With one YJ offence	$150,361		calculated field
With Multiple YJ offences	$158,569		calculated field
Cost of adult custody (lifetime)			
With no YJ offence	$611,138		calculated field
With one YJ offence	$654,144		calculated field
With multiple YJ offences	$1,136,255		calculated field

SLCN= Speech language and communication needs, **JJ**= juvenile justice, CI= confidence interval , a. refer to regression analysis for probability calculations, b refer to Appendix X for cost calculations

5.3 Results

5.3.1 Quantifying the impact of SP intervention on youth anti-social behaviour, youth justice contacts and adult crime

The findings from this study highlight the potential benefit of speech pathology (SP) interventions in the reduction of youth and adult crime, through improved speech, language and communication skills. Individuals with SLCN at risk of or in contact with the criminal justice system are not a homogenous group. The decision analytical model showed that early intervention for those individuals with the greatest speech language and communication need generated the highest cost

savings. Similarly, individuals with inherently more complex risk trajectories, that is those associated with for example low social economic status, early life disadvantage and multiple youth offences and adult custody, incur significantly higher justice costs, and hence there is potential for greater cost savings with SP intervention.

The extent of economic benefit gained from a speech pathology intervention is determined by a range of factors which include:

- the point in the life course at which the intervention occurs – that is – the earlier in life an intervention occurs the more cumulative benefit is gained
- the type of intervention and its associated costs ie on an individual basis (Tier 3), in a group setting (Tier 2) and embedded in an organisation's practices (Tier 1).
- the risk profile of the individual undergoing the intervention – that is – the more complex and numerous the risk factors the higher the likelihood of contact with the criminal justice system and the more intensive the contact will likely be.

Results of the economic modelling are presented below in a way that allows for this variation to be represented. The four models capture four key points in the life course. Within each model cost savings are presented for each of the identified tiers of intervention. For each intervention the range of costs saved capture the possible variation in the level of offending risk for an individual.

Model 1 - Childhood: individuals participated in an intervention prior to their first youth anti-social behaviour

The incremental cost savings associated with an SP intervention prior to an individual's youth anti-social behaviour is $6,524 per individual[8] and up to $15,169 for the individuals at higher[9] risk. Once the cost of the intervention[10] is considered, and depending on the level of offending risk, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $6,130 to $14,775
- Tier 2 intervention - from $5,057 to $13,702
- Tier 3 intervention - from $4,960 to $13,605

Model 2 – Youth anti-social behaviour: individuals participated in an intervention prior to their first Youth Justice contact

The incremental cost savings associated with an SP intervention prior to an individual's first youth justice contact is $2,955 per individual and up to $8,224 for higher risk individuals. Once the cost of

[8] Defined by SLCN (-2) and the mean estimate of YJ and adult custody costs.
[9] Higher risk is defined by SLCN (-3), and the upper estimate of YJ and adult custody costs, which can be interpreted as those individuals with multiple youth offences and who go on to adult custody.
[10] Intervention provider assumed to be school (Model 1, 2 and 3), and Justice for Model 4.

the intervention is considered and depending on the level of offending risk, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $2,561 to $7,830
- Tier 2 intervention - from $1,488 to $6,363
- Tier 3 intervention - from $1,391 to $6,660

Where the Model 2 intervention is conducted in a private practice setting, the net benefit per individual is between $1,150 and $6,025 for Tier 2 and between $105 and $5,374 for Tier 3, depending on the level of offending risk.

Model 3 - First Contact with Youth Justice: individuals participated in an intervention following the first Youth Justice contact and prior to reoffending

The incremental cost savings associated with an SP intervention following an individual's first youth justice contact and prior to reoffending is $1,716 per individual and up to $4,843 for higher risk individuals. Once the cost of a school-based intervention is considered and depending on level of offending risk, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $1,322 to $4,449
- Tier 2 intervention - from $249 to $2,982
- Tier 3 intervention - from $152 to $3,279

Where the Model 3 intervention is conducted in a youth justice setting, the net benefit per individual is $1,484 to $4,611 for Tier 1; $444 to $3,339 for Tier 2 and -$292 to $2,835 for Tier 3, depending on the level of offending risk. Where the Model 3 intervention is conducted in a private practice setting, the net benefit per individual is -$89 to $2,644 for Tier 2 and -$1,134 to $1,993 for Tier 3, depending on the level of offending risk. The lesser or negative cost savings which arise when utilising costings from private practice are because in this scenario the cost of providing speech pathology exceeds the cost savings to the justice system. However it is important to note that there are likely to be savings elsewhere (for example reduced welfare payments due to a greater likelihood of employment) that are beyond the scope of this evaluation. Overall, the results demonstrate that model 3 interventions which are embedded in schools or youth justice settings, represent the greatest value for money.

Model 4 - Adult custody: individuals participated in an Oral Communication intervention during adult custody

The incremental cost savings associated with an oral communication course during adult custody is approximated to be $3,637 per individual and up to $7,635 for higher risk individuals. Once the cost of the intervention is considered, the net benefit *per individual* is as follows:

- Tier 1 intervention - from $3,405 to $7,403

- Tier 2 intervention - from $2,597 to $6,363
- Tier 3 intervention - from $1,861 to $5,859

Where the Model 4 intervention is conducted in a private practice setting, the net benefit per individual is between $2,061 and $6,080 for Tier 2 intervention and between $1,016 and $5,267 for Tier 3 intervention, depending on the level of offending risk.

Overall, evidence for the direct effects of SP intervention on youth offending and crime is positive. Existing literature shows significant improvements in language and communication skills in pre-schoolers, adolescents, youth offenders and incarcerated adults, for SP interventions delivered over a short period of time. These gains are clinically important and contribute to a better life trajectory of persons living with SLCN in education and employment, and in long-term justice outcomes. Broader savings will likely be incurred in other sectors, to society more generally (through reduced crime) and through increased tax dollars/reduced welfare payments if reduced incarceration leads to increased employment.

5.3.2 Applying the models to case studies

To illustrate individual pathways and drawing on features derived from the literature review conducted for the project, two case studies of fictional at-risk individuals are presented below.

'Jack' represents a typical trajectory for an individual with an average youth offending risk profile and who participates in a 'childhood' intervention. Data for these case studies are based on mean estimates from LSAC which determines the proportion of young people in a general population sample who experience police charge, court attendance, youth detention, youth detention on remand and therefore represents a lower range risk profile (shown in detail in Appendix 5).

'Tim', represents a typical trajectory for an individual with significant social disadvantage (low SES), with a high risk of youth offending and who has undetected SLCN. Data for this case study are drawn from the MHDCD databank which captures youth justice and risk taking behaviour for individuals who progress to adult custody and therefore represents an upper range risk profile (shown in detail in Appendix 5). While this case study captures the risk of anti-social behaviour and YJ contact associated with low SES, it does not explicitly consider alternative school provisions. As such, intervention costs and benefits should be interpreted as an average across all higher risk students.

'Jack' - Average youth offending risk

Jack is diagnosed with SLCN in childhood. His initial diagnosis is of SLCN at 2 standard deviations below the mean. Based on Jack's individual background, family characteristics, the community he lives in and the school he currently attends, if he receives no SP intervention then the probability that he will commit his first youth anti-social behaviour at 12 years of age is 0.314. Jack is fortunate

to have SP available to him in school and following this intervention his speech, language and communication skills improve from 2 SD below the mean to 1 SD below the mean. On the basis of this improvement, Jack's youth offending risk trajectory is altered. The probability of Jack committing his first youth anti-social behaviour at 12 years of age is now 0.236. Unfortunately, Jack begins to hang out with the wrong crowd, is disruptive in class and truants from school, leading to serial suspension. However, even though he has participated in risk taking behaviours, the long-term benefits of Jack's altered risk trajectory (the assumed long term benefits of SP) means that his risk of subsequently committing a YJ offence is lower than before his SP intervention, down from 0.075 to 0.057. His risk of YJ recidivism is now 0.494 (down from 0.717). Jack does go on to commit one YJ offence, is charged by police and undertakes youth conferencing. His risk of being detained is 1 in 10 (0.10). Jack's risk of appearing in adult court is 0.44 and of being in adult custody is 0.108. If Jack does re-offend, he will participate in youth conferencing, go to court and his risk of being detained becomes one in two (0.515)[11].

The detailed cost-benefit analysis for Jack's trajectory and intervention is presented in Table 5-3.

'Tim' - High youth offending risk

Tim has SLCN at 3 standard deviations below the mean (-3) but his SLCN has been undetected. Tim has an increasingly complex risk profile. He experienced significant social adversity and family dysfunction and is placed in out of home care. Tim's school engagement is poor and he effectively ceases education before 15 years of age. Tim's risk of committing youth anti-social behaviour, based on this SLCN level alone[12], is 0.393. Tim commits his first YJ offence at 14 years of age. His first offence is relatively serious and involves multiple justice contacts. However, it does not include any youth detention. Tim's risk of YJ recidivism is now 0.94. If Tim re-offends, this contact with the youth justice system will amount to 33 police charges, 6 court attendances, and will result in 6 episodes of youth detention and 1 episode of detention on remand. Tim's risk of appearing in adult court is 0.74 and of progressing to adult custody is 0.28. If Tim does progress to adult custody, his average time in custody will be 110 days per annum[13].

The detailed cost-benefit analysis for Jack's trajectory and intervention is presented in Table 5-4.

The decision tree analysis assumes that Model 1 and Model 2 SP interventions for Jack and Tim would be in the school setting. While there is limited evidence (from both LSAC and MHDCD) that

[11] Rates of recidivism (police charge, court attendance, youth detention, youth detention on remand) based on mean estimates from LSAC and MHDCD.

[12] The regression holds all other covariates at their mean values. This means Tim's SES, for example, will be assumed to be the mean SES for all individuals at SLCN (-3).

[13] Rates of recidivism (police charge, court attendance, youth detention, youth detention on remand) based on upper estimates from MHDCD (refer to Appendix 5)

an individual's first YJ offence involves YJ detention, it is feasible that a Model 3 intervention could be undertaken in either a school or justice setting. The main results in Table 5-3 and 5-4 are reported in a school setting. All settings (school, private justice) are discussed in Section 5.3.1. Furthermore, as Tim leaves school before 15 years of age, it is reasonable to assume his Model 3 treatment (Tier 3) could be undertaken privately, at school or in a justice setting. The intervention settings assumed for Jack and Tim are summarised in Table 5-1 below.

Table 5-2 intervention setting

	Tier 1 intervention	**Tier 2 intervention**	**Tier 3 intervention**
Intervention setting			
Childhood intervention (prior to youth anti-social behaviour)	*school*	*school*/private	*school*/private
School based intervention (prior to first YJ offence)	*school*	*school*/private	*school*/private
YJ Intervention (prior to YJ re-offending)	justice/*school*	justice/*school*/private	justice/*school*/private
Adult Intervention (prior to multiple adult offences)	*justice*	*justice*	*justice*

Intervention in italics are those presented in Table 5.3 and Table 5.4. Alternative settings are discussed in the main results text.

The analysis assumed that the effectiveness of SP interventions were constant across SP intervention tiers, as it was not possible to estimate the additional benefit associated with more individualised programming, from the existing dataset or the literature. Consequently, the calculated net benefit for Tier 3 interventions is likely to be conservative.

Average youth offending risk - Jack

The results show that the cost savings to the justice system of early intervention for average risk youth offenders such as Jack amounts to between $4,960 (Tier 3) and $6,130 (Tier 1). Specifically:

- Model 2: If Jack had participated in an SP intervention at the time of the emergence of his youth anti-social behaviour, where for instance he was first cautioned by police, the cost savings to the justice system would equal $1,391 (Tier 3) to $2,561 (Tier 1).

- Model 3 - If Jack had participated in his first SP intervention at the point of his first youth justice offence in a private setting there would be no cost savings (-$1,134 (Tier 3) to -$89 (Tier 1)). The lesser or negative cost savings which arise when utilising costings from private practice are because in this scenario the cost of providing speech pathology exceeds the cost savings to the justice system. However it is important to note that there are likely to be savings elsewhere (for example reduced welfare payments due to a greater likelihood of employment). Additionally, we note that services which are embedded provide a positive and more cost effective alternative to those provided privately.

- Model 4 - If Jack receives no youth intervention and subsequently progresses to adult custody, there may be an opportunity to undertake an oral communication course. This course may reduce his rate of recidivism by 50% (Hartshorne, 2009), which equates to a cost savings to the justice system of between $1,858 (Tier 3) and $3,634 (Tier 1).

High youth offending risk – Tim

The results show that the cost savings to the justice system of early intervention for high risk youth offenders such as Tim amounts to between $13,605 (Tier 3) and $14,775 (Tier 1). Specifically:

- Model 1: If Tim had been identified and received an SP intervention for his SLCN during childhood, his cost to the justice system would be reduced to between $29,522 (Tier 3) and $28,352 (Tier 1), which equates to a cost savings range of $13,605 (Tier 3) to $14,775 (Tier 1).

- Model 3: If Tim had participated in a SP intervention after his first YJ offence, his cost savings would be between $3,376 (Tier 3) to $4,449 (Tier 1) (in a school setting), $2,644(Tier 3) to $4,611 (Tier 1) (in a youth justice setting) and $1,993(Tier 3) to $2,644 (Tier 2) (in a private practice setting).

- Model 4: If Tim receives no youth intervention, but has the opportunity to undertake an 'Oral Communication Course' during adult custody, this may reduce his rate of recidivism, resulting in cost savings to the justice system in the range of $6,109 (Tier 3) to $7,885 (Tier 1) .

Table 5-3 Average youth offending risk (Jack): Cost benefit analysis

	Without cost of Intervention		Tier 1 intervention		Tier 2 intervention		Tier 3 intervention	
Cost benefit	**Mean Cost (pp)**	**Cost savings (pp)**	**Mean Cost (pp)**	**Cost savings (pp)**	**Mean Cost (pp)**	**Cost savings (pp)**	**Mean Cost (pp)**	**Cost savings (pp)**
Childhood intervention (prior to youth anti-social behaviour								
Intervention	$10,796	$6,524	$11,190	$6,130	$12,263	$5,057	$12,360	$4,960
No Intervention	$17,320		$17,320		$17,320		$17,320	
School based intervention (prior to first YJ offence)								
Intervention	$14,365	$2,955	$14,759	$2,561	$15,832	$1,488	$15,929	$1,391
No Intervention	$17,320		$17,320		$17,320		$17,320	
YJ Intervention (prior to YJ re-offending)								
Intervention	$15,604	$1,716	$15,988	$1,322	$17,071	$249	$17,168	$152
No Intervention	$17,320		$17,320		$17,320		$17,320	
Adult Intervention (prior to multiple adult offences)								
Intervention	$13,454	$3,866	$13,686	$3,634	$14,726	$2,594	$15,462	$1,858
No Intervention	$17,320		$17,320		$17,320		$17,320	

YJ = youth justice, **PP**= per person**,** Intervention costs assumed (refer to Table 5-1 and Table 5-2).

Table 5-4 High youth offending risk (Tim): Cost benefit analysis

	Without cost of Intervention		Tier 1 intervention		Tier 2 intervention		Tier 3 intervention	
Cost benefit	**Mean Cost (pp)**	**Cost savings (pp)**	**Mean Cost (pp)**	**Cost savings (pp)**	**Mean Cost (pp)**	**Cost savings (pp)**	**Mean Cost (pp)**	**Cost savings (pp)**
Childhood intervention (prior to youth anti-social behaviour)								
Intervention	$27,958	$15,169	$28,352	$14,775	$29,425	$13,702	$29,522	$13,605
No Intervention	$43,127		$43,127		$43,127		$43,127	
School based intervention (prior to first YJ offence)								
Intervention	$34,903	$8,224	$35,297	$7,830	$36,764	$6,363	$36,467	$6,660
No Intervention	$43,127		$43,127		$43,127		$43,127	
YJ Intervention (prior to multiple YJ offence)								
Intervention	$38,284	$4,843	$38,678	$4,449	$40,145	$2,982	$39,751	$3,376
No Intervention	$43,127		$43,127		$43,127		$43,127	
Adult Intervention (prior to multiple adult offences)								
Intervention	$35,010	$8,117	$35,242	$7,885	$36,514	$6,613	$37,018	$6,109
No Intervention	$43,127		$43,127		$43,127		$43,127	

YJ = youth justice**, PP=** per person**,** Intervention costs assumed (refer to Table 5-1 and Table 5-2).

5.4 Sensitivity analysis

A sensitivity or scenario analysis is used in economic evaluation to test the robustness of model assumptions and the validity of our analysis. Presented here is the approach to testing the key variables in the decision analytical model. Additionally the assumptions made that generate the high risk individual ('Tim's Case Study) representing the upper limit of the cost savings range are defined.

5.4.1 Key variables

Using *Model 1 (childhood intervention)* as the base case, we adjusted the key variables independently and re-simulated the model, to measure the subsequent change in costs (and cost savings). The variables tested were: YJ cost estimates, level of speech language and communication need as base case (SLCN -3, -2, -1) and SP effectiveness estimates.

5.4.2 Cost sources

The cost estimates relied on data from a number of sources. The LSAC is a nationally representative sample of Australian children. However, these data may under-represent high-risk children as these children present with a number of barriers for participation in longitudinal surveys (Gray and Smart, 2008). For example, children with housing instability, family dysfunction and those who are currently in youth justice custody may be more likely to refuse to participate in surveys, be non-responders or be lost to follow up over time. Sample weights are provided with the data to ameliorate the impact of biases in the sample selection process and survey non-response (Australian Institute of Family Studies, 2018). However, it remains a source of uncertainty in the sample utilised in this study. Furthermore, the LSAC relies on the total number of self-reported YJ contacts over two 12-month periods, to inform the costs of youth recidivism (age 14-17 years). In other words, the number of YJ contacts is assumed to be zero in the non-reporting periods, which is a source of uncertainty. As a result, relying on the LSAC estimates alone may underestimate YJ recidivism costs. In contrast, the MHDCD databank relies on retrospective data of youth behaviour of adults who have been incarcerated to generate youth estimates. It is likely that this sample has higher than average youth crime and as such may over-estimate average costs. As a sensitivity analysis, we used estimates from both datasets exclusively, to provide an upper and lower estimate of cost (range $5,487 to $10,051).

5.4.3 Speech pathology effectiveness

To test the robustness of the regression model probabilities, we re-estimated the decision analytical model using the upper and lower (95%CI) probability estimates from Table 5-1. The results showed a cost savings range of between $2,041 and $8,707 per person, for the lower and upper 95%CI, respectively.

5.4.4 *SLCN at level (-3 and -1)*

Individuals with SLCN at a level (-2[14]) were the focus of the analyses as they were consistent with the defined cut offs for 'impairment' in the literature. To illustrate the benefits in other SLCN groups, we estimated the cost savings for individuals with SLCN -3 and SLCN-1 in the sensitivity analysis. For an individual SLCN -3 the costs savings from childhood intervention equals $8,573 p.p. (from a base case of $6,289 pp). The costs savings forSLCN -1is $4,365 p.p.

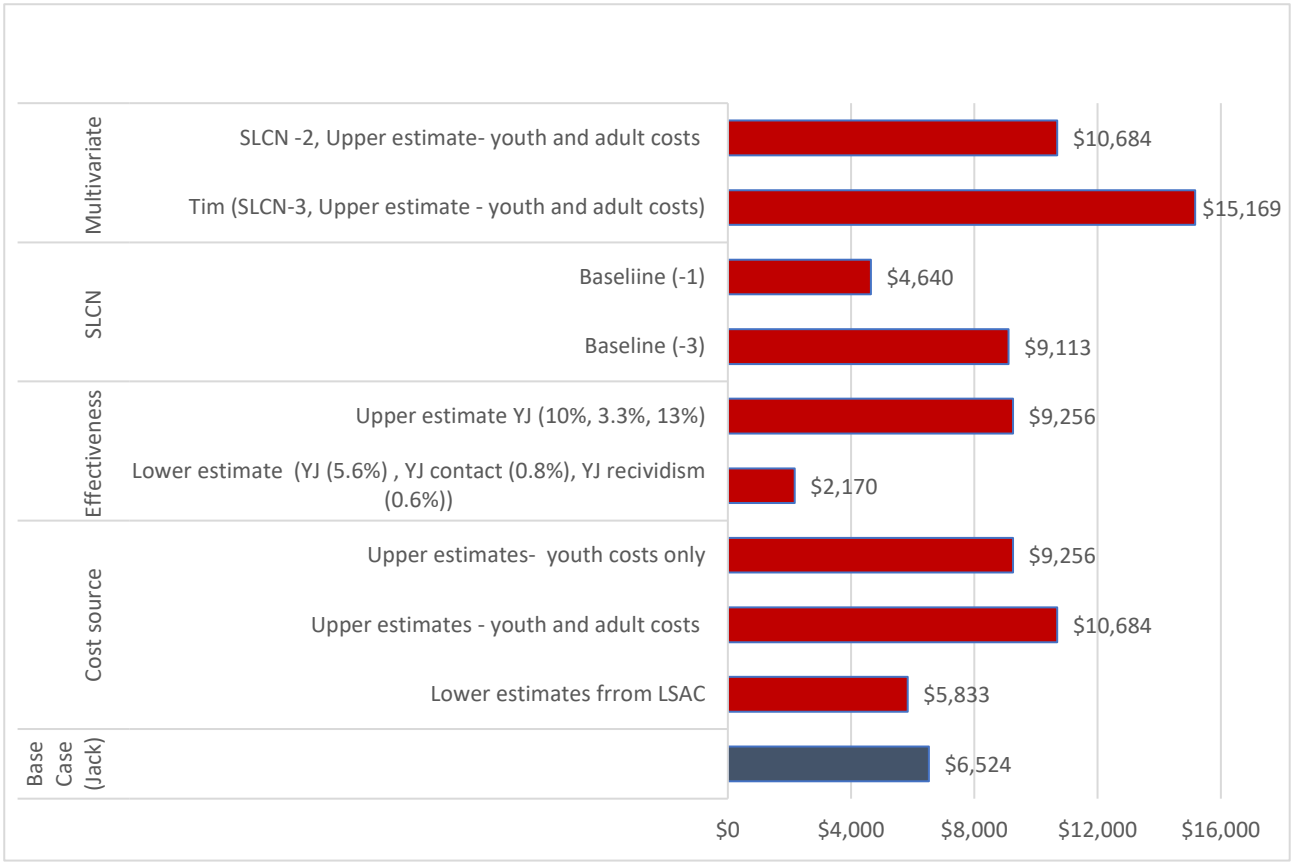
5.4.5 *Multivariate sensitivity analysis*

To demonstrate the impact of risk taking and crime for a range of individuals we estimated a scenario for a higher-risk individual, presented as 'Tim' in case study form. Here, several high-risk factors were combined, SLCN -3 and the upper limit of costs, which is consistent with an individual with multiple youth offences, culminating in adult custody. The results show that the potential cost savings of childhood intervention for a high-risk individual is $14,269 pp. It is important to note that this analysis does not explicitly estimate any additional costs or benefits associated with an individual's inherently complex risk file[15]. There may be unique mediating risk and protective factors, which could alter an individual's offending trajectory and associated costs. Overall, the sensitivity analysis shows that the cost savings are largely driven by the rate and severity of the offending and the level of SLCN.

[14] 2 standard deviations below the mean SLCN value.

[15] The regression analysis estimates rates of risk taking and crime based on levels of SLCN (-3,-2,-1), holding all other covariates at their mean values. This means that Tim's assumed SES, for example, will be the mean SES for all individuals in the sample who are SLCN (-3).

Figure 5-2 Sensitivity analysis of key variables.



5.5 Limitations

It is important to note that the effectiveness measure is based on a hypothetical SP intervention, which generates 1SD improvement in speech, language and communication needs. To test the plausibility of this assumption we conducted a descriptive analysis using a sample of children from LSAC, who self-reported they had completed some speech pathology. We estimated the average improvement in SLCN between 4-5 years and 16-17 years of age. By measuring improvement rather than absolute values of SLCN, we implicitly control for baseline SLCN severity and other explanatory variables. The results showed that when compared to those individuals who did not have speech pathology, the average improvement for the speech pathology sample was 0.42SD (95%CI 0.34, 0.51). Compared to those individuals at SLCN -2, who did not have speech pathology, the average improvement for this group who had speech pathology was 1.07SD (95%CI 0.98, 1.16). While the LSAC provides very limited detail on individuals' speech pathology treatment, it provides a descriptive picture of the value of SP interventions in these children and provides a robustness check of our model assumption.

6 Conclusion

Youth offenders represent a particularly high priority group for research into communication disorders, as the youth justice system involves situations with high-risk or serious consequences, that rely upon the application of effective language skills (Anderson et al., 2016). A systematic review by Anderson et al (2016) found considerable evidence that youth offenders perform poorly on language measures relative to their peers. Yet, few studies have directly measured the impact of a change in speech, language and communication skills on youth anti-social behaviour and crime.

The findings from this study highlight the potential benefit of SP interventions in the reduction of youth and adult crime, through improved speech, language and communication skills. The model showed that early intervention for those individuals with the greatest speech language and communication need generated the highest cost savings, which is consistent with the literature that shows that early childhood interventions generally represent the greatest value for money (Heckman, 2008).

For individuals at a higher risk of offending culminating in adult custody, the results demonstrate the potential impact of SP intervention in reducing the number of offences and the severity of offending. Additionally, there may be mediating or distal effects of SP services. However, further scrutiny of the moderating role played by variables known to feature prominently in the lives of both those with compromised speech, language and communication skills and those who offend, for example low SES, family dysfunction and early educational disengagement and/or under-achievement, would assist in understanding these complex trajectories further. Furthermore, broader savings will likely be incurred in other sectors, to society more generally (through reduced crime) and through increased tax revenue and reduced welfare payments. This is achieved via reduced incarceration leading to increased employment and participation in the social and economic mainstream.

Sensitivity analysis indicates that these conclusions are robust under a range of plausible variations in the parameter values that underpin the costing. The benefits offered by tiered SP interventions (Tier, 1,2 3), and in particular embedded Speech Pathologists who are able to provide all three tiers of intervention, and to whom it is delivered (based on individual need and offender risk), need to be balanced against the potential resource implications, in order to determine the feasibility and practicality of implementation.

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Appendix 1: Key characteristics and findings of studies reviewed

Study	Country of study	Type of intervention	Setting of study population @ intervention	Study population @ analysis	Outcome measured	Key findings
Swain, Eadie and Snow 2020 Swain, 2017 (PhD thesis)	Australia	Tier 3	Custodial: Youth detention centre	Youth offenders N = 4	Language and literacy skills	There were medium-large improvements in the targeted communication skills. Gains in language skills were generally maintained at one month post-intervention.
Burrows et al., 2012	England	Tier 3	Non-custodial: youth offending service	Youth offenders N = 70	Speech and language skills Attitude and behaviours	No statistically significant difference between intervention and control groups. There were significant improvements in communication and language skills.
Gregory & Bryan, 2011	England	Tier 1, Tier 2, Tier 3	Non-custodial: youth offending supervision and surveillance program	Youth offenders N = 49	Language and communication skills	Improvement in language and communication skills.
Kirby et al., 2018	Australia	Tier 1, Tier 2, Tier 3	School	Children starting kindergarten N = 101	Communication skills	Improvement in communication skills. Some children were discharged with no further treatment (26%), some discharged with goals (61%) and some referred to a speech pathologist for continued treatment (13%). NB: Intervention was delivered by speech pathology students on placement.

Martin 2018	Australia	Tier 3	Prison: adult	Adult offenders N = 4	Language literacy skills	There was improvement in language literacy – speaking and writing. Participants also expressed hope due to the progress made with writing and language
Snow & Woodward, 2017	Australia	Tier 3	Custodial: Youth justice detention centre	Youth male offenders N = 6	Communication and language skills	The results showed some evidence that SP intervention has a positive impact on language and communication. However, these were not consistently observed across both clinical measures (treatment goals) and standardised tools. Of the six participants included in the trial, four participants met all the goals for the focus of their SP treatment; one fully met 1 goal, met 3 goals with support and partially achieved the remaining goal; one achieved one goal, partially met one goal and did not achieve the last goal. There were no participants who made gains in all aspects of the standardised assessments. However, all six participants made some gains in some aspects of the standardised assessments. For example, 5 participants made gains in their core language score whilst one showed no change. In addition, 3 participants made some gains in one subset of the

						self-reported LCQ, whilst 2 reported no change over time and a further 2 of the 3 who had made gains in one subset of the LCQ also reported scores that were lower than baseline. One participants made some gains in communication skills according to the self-rated setting communication goals (SCG) tool whilst 3 recorded no change and a further 2 reported scores lower than the baseline. The authors attributed the downward change in these measures to the self-reported nature of the measurement tool and to the fact that participants might have become more self-aware of their communication difficulties over the intervention period and hence have rated themselves lower than in the baseline.
Ebbels et al. 2017	England	Tier 3	School	Adolescents	Expressive and receptive language	Persons living with DLDs showed significant progress and benefited more in expressive and receptive language (statistically significant).
Martin and Barns 2015 (unpublished)	Australia	Tier 3	Prison: adult	Adult offender N = 1	Language literacy skills	Participant made improvement in his literacy skills such as reading and vocabulary.
Brownlie et al., 2004	Canada	None reported	School setting at age 5 years	Youth in the community	Delinquency Aggressive behaviour	Language impairment in boys was associated with delinquency as

				N = 168; 76 with SLI and 92 controls	Arrests Convictions	reported by parents (mean = 4.07 (SD: 4.08) compared to 1.85 (SD: 2.59) in controls). Language impaired boys reported higher rates of arrests (41.5% compared to 20.2% in controls; $\chi 2$ (1, N = 142) = 6.88, p = .009) and convictions (28.9% compared to 14.5% in controls; $\chi 2$ (1, N = 142) = 4.60, p = .032). Delinquency and aggressive behaviours were not reported for language impaired girls. Speech impairment was not associated with antisocial outcomes.
Mouridsen & Hauschild, 2009	Denmark	Not reported	Speech and hearing institute @ kindergarten (mean age @ DLD diagnosis was 5.61)	Adults in the community N = 469 DLD participants and 2,345 controls	Offending/convictions: Full account of conviction records as a measure of wide range of offending	There was no significant difference in total convictions between DLD individuals and their controls. Altogether, 19.8% of DLD individuals and 23.1% of controls had been convicted (OR = 0.82; 95% CI: 0.64 - 1.06, p = 0.13). DLD males had 5.2% lower conviction rates than males in the controls. Violations of traffic laws were sig more common in the control group (22.8% vs. 15.8%; p=0.005; OR=1.57; 95% CI: 1.14-2.16).
Snow and Powell, 2011	Australia	Reported but type unknown	Custodial: Youth detention centre	Youth male offenders	Severity of offense	Youth offenders with poorer core language scores were more likely to commit severe offenses. In addition, LI group had higher median values for

				N = 100: 46 with LI and 54 no LI		both violent and non-violent offending. There was a difference in the violent offending rates of to the LI group compared to the non-LI group but this was not significant.
Winstanley et al., 2018	England	Tier 3, Tier 2. NB: Only DLD children received intervention	School	Young adults in the community N = 84 DLD and 88 controls (AMP)	Police initiated contact Substance use Rule breaking behaviours Aggression	Adults with a history of DLD who received targeted intervention during their school years reported less contact with their local police service compared with AMPs at age 22 – risk ratio for TWP = 2.44; 95% CI: 1.20-4.97 and risk ratio for ATM = 3.13; 95% CI: 1.65 – 5.92. Group differences were found relating to alcohol use – AMP reported more days drunk with alcohol (mean days drunk in the last 6 months: DLD = 5.4 (SD=13.5) days and AMP = 12.3 (SD = 13.1) days; Mann Whitney U-test < 0.001). No group differences in rule-breaking behaviours were found (mean: DLD = 2.45 (SD = 2.59) and AMP = 2.53 (SD = 2.95); Mann Whitney U-test = 0.784). DLD group was found to have a statistically significant higher raw score on the aggressive behaviour scale (mean: DLD = 6.18 (SD = 5.58) and AMP = 4.32 (SD = 4.13); Mann Whitney U-test = 0.037).

Yew & O'Kearney, 2013	Not applicable	Not reported	Children, adolescents and young adults	Adult	Emotional and behavioural problems: externalising and internalising	Adults diagnosed with SLI at a point in their lives were about twice as likely to show disorder levels of overall internalising problems and externalising problems. These results were statistically significant.
Hartshorne 2019	Not applicable	Not reported	All SLCN persons	All	Commentary of the benefits of SP interventions for people living with SLCN	For the individual with SLCN, there are poorer education and employment outcomes, poorer social relationships and personal development, have behavioural and emotional issues and high criminal activity. SLP are seen to provide better outcomes for these population. This study also noted that reconviction rates in the first year after release among ex-prisoners who had begun a general education course was 28% compared with a national average of 44% for all offenders. The reconviction rates within the first year for those who studied the English Speaking Board's (ESB) oral communication courses were even lower at just 21%.

Abbreviations: AMP = age-matched peers; ATM = ever been told off or asked to move on by police; CI = confidence interval; DLD = developmental language disorder; LI = language impairment/impaired; NB = note; OR = odds ratio; SD = standard deviation; SLI = speech and language impairment; SAS = stopped and searched by police; SLP = speech and language pathology; SNS = stopped but not searched; TWP = ever been in trouble with police

Appendix 2: Protective and risk factors- key studies

Study	Factors reported	Methods/findings
Risk factors		
Azeredo et al 2019	Genes (5-HTTLPR, DRD2, DRD4, GABRA2, MAOA) Environmental (delinquent peer affiliation, poor school attachment and commitment, alcohol use, pubertal development and exposure to violence marital status of caregivers, divorced parents, less social control and attachment of family)	Systematic review of genetic and environmental risk factors for delinquent behaviours (defined as behaviour characterised by repeated offending and is regarded mainly in its social, but also criminal aspects). There is interaction between genetic and environmental factors to lead to delinquent behaviours. Genetics on its own do not seem to be associated with delinquency, however, the influence of these genes on delinquency is dependent on the environmental factors they are exposed to.
Braga et al 2018	Maltreatment (physical abuse, sexual abuse, emotional abuse, neglect)	Meta-analysis of longitudinal studies reporting association between maltreatment and anti-social behaviours (defined as those that violate norms and values of the society; e.g. lying, theft, and aggression. Maltreatment was significantly associated with antisocial behaviour: OR = 1.96; CI: 1.42, 2.71; p <0.000. Maltreatment assessed in both childhood and adolescence had stronger association with adult antisocial behaviour (OR = 2.30, p<0.000) than those assessed solely in adolescence (OR = 2.24, p = 0.006), followed by that assessed only in childhood (OR = 1.50, p<0.000).
Braga et al 2017	Maltreatment	Meta-analysis of prospective longitudinal studies to explore moderator effects of maltreatment and youth antisocial behaviours. Maltreatment is associated with higher rates of general antisocial behaviours (r = 0.11; 95% CI: 0.08, 0.14; p<0.000) and aggressive antisocial behaviours (r = 0.11; 95% CI:0.07,0.14; p<0.000)
Farrington et al. 2017	<u>Crime and violence</u> Broken homes, child rearing, discipline, socioeconomic status, family size, family stress, home discord, child maltreatment, parental antisocial behaviour, urban housing, parental warmth, family structure, adverse family environment, parental incarceration, attachment security, financial debt, empathy, self-esteem <u>Delinquency</u>	A review of systematic reviews and meta-analysis of explanatory risk factors for violence, offending, and delinquency. Explanatory risk factors are factors that are clearly measuring an underlying construct that is different from antisocial behaviour.

Study	Factors reported	Methods/findings
	School/employment, family, parental support, physical punishment, authoritative control, inconsistent discipline, family relationships, school relationships, physical or sexual abuse, lower stage of moral judgement.	
Cotton 2017 (Thesis)	High frequency residential mobility and housing instability	Systematic review and empirical studies using a longitudinal data: Maternal lifestyle study. Three or more moves and exposure to housing instability were significantly associated with delinquent behaviours among high risk people (children from poor background)
Jolliffe et al 2017	Personality/individual ***10-12 years*** Risk score at screening, callous/unemotional, lack of guilt, low school motivation, low academic achievement, old for grade, hyperactivity, low intelligence, high depression, high impulsivity ***8-10 years*** Low nonverbal IQ, low verbal IQ, low school attainment, high hyperactivity, psychomotor impulsivity, high daring, low popularity, Family ***10-12 years*** Child abuse, mother smoking, parental supervision, bad relationship with primary caregiver, parental stress, parental substance abuse, family police contact, living with non-biological relative, poor parental communication, large family size, single parent family, poor family management, ***8-10 years*** Disrupted family, parental disharmony, convicted parent, young mother, poor supervision Socio-demographic ***10-12 years*** Family on welfare, small house, poorly educated mother, teenage mother, bad neighbourhood impression, African American, Asian American, unemployed mother, high neighbourhood disorganisation ***8-10 years*** Large family size, low family income, low social class, poor housing, delinquent school	Systematic review that looked at risk factors for specific types of offending. Summary of risk factors Life course persistent (LCP) offender v non-offender Parent cigarette use (OR = 6.8), high depression (OR = 5.3), high impulsivity (OR = 4.5), lack of guilt (OR = 11.1), child abuse (OR = 9.7), low intelligence (OR = 5.9), convicted parents (OR = 5.2), poor supervision (OR = 5.1), disrupted family (OR = 4.4) Adolescence limited (AL) offender v non-offender Parent marijuana use (OR = 5.0), parent cigarette use (OR = 4.8), high depression (OR = 2.9), lack of guilt (OR = 6.1), hyperactivity (OR = 6.0), low intelligence (OR = 5.5), high daring (OR = 3.5), poor housing (OR = 3.4), convicted parent (OR = 3.3). Late-onset (LO) offender v non-offender Parent marijuana use (OR =5.3), parent cigarette use (OR = 4.2), high anxiety (OR = 2.1), child abuse (OR = 4.6), lack of guilt (OR = 4.4), low intelligence (OR = 4.4), disrupted family (OR = 2.7), poor housing (OR = 2.6), low school attainment (OR = 2.3). Overall, there was limited evidence to suggest specific factors was associated with a type of offending. LCP tend to have greater number of risk factors and the magnitude more than AL offenders who also had more risk factors than LO offenders
Mallet 2017	Delinquency risk factors *Individual*	Review of studies reporting risk factors for delinquency. Delinquency cases was stated to involve youthful offenders charged with criminal offenses.

Study	Factors reported	Methods/findings
	Learning disabilities, maltreatment victimization (neglect, physical abuse and sexual abuse), mental health problems (including history of early aggression, hyperactivity, substance use and dependency) *Family* Poverty, family dysfunction and instability (measured in terms of witnessing violent treatment of family members), criminal activity by parent, early parental loss, parent/child separation, residential instability *Community* Crime including drug selling, low-income housing, witnessing violence	
Assink et al 2015	Risk of life time persistent offending relative to adolescence limited offending Significant factors Criminal history, aggression, alcohol/drug abuse, sexual behaviour, relationship, emotional and behavioural problems, school/employment (work-related, poor academic achievement, poor academic behaviour), other (violent victimisation, personality related traits, experience of negative stressful life event), family (father/mother/sibling/family related), neuro-cognition/physiology (static), attitude. Factors not significant Physical health, background and neighbourhood	Meta-analysis of risk factors for persistent delinquent behaviours among youths
Case 2015, Book review	Individual Impulsivity, temperament, substance use Family Maltreatment, criminality, inappropriate parenting School Poor-performance, bullying Peer group Antisocial peers, gang membership Neighbourhood Disorganized, low socio-economic status	Review of a book that reported risk factors for youth violent offending
Shepherd and Ilalio 2016	Acculturation stressors (recurrent displacement, family and lifestyle disruption, instability, isolation, cultural disconnection, cultural shock) Educational disengagement (low levels of education) Family and cultural disintegration Job insecurity Economic disadvantage	Review of literature to identify risk factors unique about Maori and Pacific Islanders involvement in criminal behaviour

Study	Factors reported	Methods/findings
	Social service inaccessibility	
Pyle et al 2016	Individual level risk factors Mental health, personality (antisocial behaviour), psychological factors (self-esteem and perception of self and peers), social/emotional-behavioural issues (acting out behaviour, emotion, social skills and interpersonal characteristics (aggression, extroversion, hostility, impulsivity), cognitive-intellectual development (mean IQ of 70 to 100, communication deficits, ADHD), academic achievement (low grades, receive special education), victimization history (physical abuse, physical neglect, multiple forms of maltreatment, sexual abuse), substance abuse (age of onset of alcohol and drug use between the ages of 10 and 16)	Literature review to understand the individual characteristics of incarcerated youth within the major risk factor domains identified by the US office of youth justice and delinquency prevention.
Malvaso, Delfabbro and Day 2016	Maltreatment Type or timing of abuse, how welfare involvement or placement in out-of-home care influences outcomes Individual risk factors Gender, age, ethnicity, emotional and behavioural problems, education, mental health, substance misuse, marital status (being married is a protective factor) Social risk factors Characteristics of the family (family structure), parents/caregiver characteristics and peers relations Contextual risk factors Neighbourhood characteristics such as poverty, residential stability and ethnic heterogeneity	A systematic review of prospective and longitudinal studies to investigate the association between exposure to maltreatment during childhood and adolescence and subsequent delinquent or offending behaviours
Schofield et al 2012	Risk factors Individual risk factors Anti-social behaviour, impulsivity, mental health , self-worth and age (greater risk of crime as adults), aggressive behaviour before age 12, Stress and anxiety, depressive symptoms, impulsiveness, attention problems, motor restlessness, attention seeking Family risk factors Family structure, resources (poverty), parent's mental health, negative parental influence (other family members known to the police; parental drug and alcohol abuse; coerciveness; authoritarian style; harsh punitive parenting; lack of child supervision; inconsistent parenting; no reliable consistent carer; parental conflict; witnessing violence between caregivers), abuse and neglect (physical abuse, emotional abuse), family	Looked after children and offending: reducing risk and promoting resilience study

Study	Factors reported	Methods/findings
	relationships (history of family dysfunction, poor relationship with parents).Low SES, family instability, more out of home placements, Coercive/authoritarian parenting, lack of child supervision. Physical or sexual abuse, anti-social parents, Education risk factors SEN, low academic achievement, unconstructive use of leisure time Community risk factors Delinquent peers, housing, community opportunities (community crime and violence)	
Ttofi et al 2011	School bully	Meta-analysis of studies measuring school bullying and later offending Probability of offending was higher for school bullies than for non-bullies for up to 11 years later (OR = 2.50; 95% CI: 2.03-3.08) and for later offending (OR = 1.82, 95% CI: 1.55-2.14)
Protective factors		
Ttofi et al, 2016	Intelligence	Meta-analytic review of prospective studies. Higher level of intelligence predicts low levels of offending within high-risk (OR = 2.32; 95% CI:1.49-3.63; p = 0.0001) and low risk (OR = 1.33; 95% CI: 0.88-2.01; p = 0.18)
Adjorlolo 2017	Biological: high intelligent quotient, high executive functioning, high skin conductance, high resting heart rate	Systematic review

Appendix 3: Descriptive analysis of LSAC cohort

			SLCN COHORTa		TYPICAL LANGUAGE COHORT	
Variable		Measurement	Mean	SD	Mean	SD
Section A. Outcome variables						
Delinquency 12-17 years		1=Yes, 0=No	0.053	0.223	0.048	0.214
Total delinquency 12-17yrs		Number of delinquent behaviours 0 to 80	0.410	3.201	0.252	1.958
Contact with justice system 14-17yrs		1=Yes, 0=No	0.006	0.077	0.004	0.062
Total contact with YJ 14-17yrs		Number of criminal behaviours 0 to 17	0.061	0.742	0.037	0.436
Delinquent behaviours						
	Damage car	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.016	0.200	0.004	0.103
	Gang	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.025	0.275	0.009	0.167
	Suspended or expelled	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.064	0.433	0.021	0.236
	Burglary	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.013	0.206	0.005	0.107
	Steals from car	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.012	0.194	0.003	0.097
	Fire	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.019	0.223	0.012	0.180
	Threaten	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.013	0.214	0.004	0.104
	Caught by police	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.020	0.218	0.010	0.157
	Truancy	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.089	0.536	0.077	0.518
	Steals from shop	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.042	0.384	0.027	0.297
	Graffiti	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.030	0.298	0.017	0.220
	Has a weapon	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.023	0.251	0.023	0.287
	Joyride	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.021	0.253	0.011	0.177
	Stolen money	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.026	0.255	0.019	0.227
	Run away	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.032	0.305	0.017	0.214
	Damage	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.026	0.271	0.016	0.203
	Police contact	0=not at all, 1=once, 2= twice, 3= three, 4=Four times, 5=Five or more times	0.022	0.215	0.024	0.208
Criminal behaviours						
	Youth justice conference	0=not at all, 1=once, 2= twice, 3= three or more	0.011	0.142	0.003	0.073
	Police charge	0=not at all, 1=once, 2= twice, 3= three or more	0.008	0.122	0.004	0.083
	Defendant	0=not at all, 1=once, 2= twice, 3= three or more	0.008	0.122	0.003	0.071
	Convicted	0=not at all, 1=once, 2= twice, 3= three or more	0.006	0.102	0.003	0.068
	Detained on remand	0=not at all, 1=once, 2= twice, 3= three or more	0.007	0.105	0.001	0.047
	Detained	0=not at all, 1=once, 2= twice, 3= three or more	0.009	0.139	0.001	0.044

Appendix 3 continued…

		SLCN COHORT		TYPICAL LANGUAGE COHORT	
Variable	Measurement	Mean	SD	Mean	SD
Section B. Individual characteristics					
Indigenous	1=Yes, 0=No	0.07	0.25	0.03	0.16
Non-English speaking background	1=Yes, 0=No	0.15	0.41	0.12	0.37
Male	1=Yes, 0=No	0.66	0.47	0.50	0.50
Special health care needs	1=Yes, 0=No	0.37	0.48	0.15	0.36
IQ	Standardised score Matreas reasoning	-0.78	1.07	0.08	0.96
PEDS school	Range 0 to 100	76.69	20.88	84.58	17.17
SDQ-total	Sum of mean values of hyperactivity, emotional, peer and conduct problems scales 0 to 35	13.04	6.59	7.57	5.09
Section C. Family characteristics					
SEP	Quintile 2	0.21	0.41	0.20	0.40
	Quintile 3	0.19	0.39	0.20	0.40
	Quintile 4	0.15	0.35	0.20	0.40
	Quintile 5	0.09	0.28	0.21	0.41
Equivalised income	Annual gross household income equivalised	731	526	955	724
Mothers Year 12 attainment	Year 11	0.14	0.35	0.13	0.33
	Year 10	0.28	0.45	0.19	0.40
	Year 9	0.07	0.25	0.03	0.17
	Year 8	0.05	0.23	0.02	0.12
	Never attended school	0.00	0.06	0.00	0.04
Teenage mother at child's birth	1=Yes, 0=No	0.03	0.17	0.02	0.15
Mothers age squared		1673	579	1734	561
Single parent	Receiver of single parent benefit Dummy variable1=Yes, 0=No	0.10	0.30	0.05	0.23
Family hardship	Sum of 7-item questionnaire shortage of money	0.55	1.02	0.29	0.74
Stressful life events	Range 0-20	2.41	2.48	1.97	2.15
Mother's depression	Range 6-30	10.65	4.69	9.32	3.62

Appendix 3 continued…

Variable	Measurement	SLCN COHORT Mean	SLCN COHORT SD	TYPICAL LANGUAGE COHORT Mean	TYPICAL LANGUAGE COHORT SD
Section D: School and community					
School gender mix	Standardised score	1.02	0.18	1.04	0.26
School ICSEA	Range 600-1235	998	86	1034	83
Student attendance Year 1-10	Range 0 to 100	89.6	4.8	90.4	2.4
LBOTE population	Range 0 to 100	0.19	0.23	0.18	0.21
Indigenous population in school	Range 0 to 100	0.07	0.11	0.04	0.07
School recurring income (net)	$Mill	7.12	6.58	8.30	7.62
Mean School NAPLAN literacy (standardised)		-0.47	0.99	-0.05	0.98
Mean School NAPLAN numeracy (standardised)		-0.35	0.97	0.04	0.99
SEIFA education and occupation	Range 780-1240	978	74	999	80
Community employment rate	Range 19 to 94	0.62	0.08	0.62	0.08
Community earning <1K per month	Range 0 to 100	0.39	0.15	0.36	0.14
Community Year 12 achievement	Range 0 to 100	0.43	0.13	0.46	0.14
SEIFA advantage/disadvantage index	Range X Quintiles 1-5	2.75	1.43	2.96	1.41
SEIFA economic index	Range X Quintiles 1-5	2.66	1.42	3.00	1.44

a. Descriptive SLCN cohort defined as <=1.5SD SLCN. K=Kindergarten cohort, SEIFA=Socio-Economic Indexes for Areas, IQ=Intelligence quotient, SDQ= Strengths and difficulties, SEP=Socio-economic position, PEDS=parents evaluation of developmental status, ICSEA= Index of Community Socio-Educational Advantage, LBOTE=Language Backgrounds Other Than English, YJ=Youth justice

Appendix 4: Measures used to define SLCN

Language			
K	4-9.	Peabody Picture Vocabulary test Third edition (PPVT-III)[b]-short version	Australian adapted short version of the PPVT-III (Dunn & Dunn 1997) assesses a child's receptive vocabulary. The PPVT-III is a direct assessment in which children are asked to select pictures that correspond to words read out by the examiner. Forty items are administered, consisting of 20 core items and 10 base and ceilings items. Raw scores are converted to scaled scores. This adapted version has good reliability (0.76) Rothman, 2003)
K	10-13.	Academic rating scale- Language and literacy.	A 9 item teacher completed questionnaire of reading and comprehension (e.g. Conveys ideas clearly, understands and interprets text, reads and comprehends) Teachers report the proficiency of the child on a 5 point scale (Not yet; Beginning ; In progress; Intermediate: Proficient)
K	14-15	Rice Test of Grammaticality Judgement (GJT/SLI)	The GJ Task is a short, automated (administered by ACASI) task that requires the study child to distinguish between grammatical and non-grammatical utterances known to be vulnerable to SLI in English-speaking children (Rice, Hoffman & Wexler, 2009). The study child listens through earphones as 20 pre-recorded items are spoken and enters their response by clicking the appropriate radio buttons (1 for 'Right', 5 for 'Not so good', and 9 for 'Hear again'). Its sensitivity and specificity for SLI are .70 with a ROC of approximately 0.85.
K	4-7	PEDS receptive and expressive language	Parent reported question is concern about how the child talks and makes speech sounds (Expressive) and how the child understands what the parent says (receptive). (No; a little; Yes)
K	4-5, 4-13	Written language (reading, spelling, writing)	Teacher/carer reported questionnaire of reading and writing competencies (No/Yes), Rating of reading ability compared to other children in the class (1 Much better; 2 A little better; 3 About the same; 4 A little worse; 5 Much worse)
Communication			
K	6/7	Child's Communication Checklist - (speech also)	Parent reported 7 item (per construct) questionnaire of using examples of errors in syntax, speech, semantics, and coherence (1 Less than once a week (or never); 2 At least once a week but not every day; 3 Once or twice a day; 4 Several times (more than twice) a day (or always))

b. Language scores were standardised using the transformation of raw scores to Z-scores at each age group.

Appendix 5: Full assumptions of the decision analytical model

Assumptions	Value	Range		Reference
Youth				
Costs				
Youth justice conference	$1,367		A	Reeve & McCausland (2019)
Police charge	$2,244		B	Reeve & McCausland (2019)
Defendant (children's court)	$882		C	Reeve & McCausland (2019)
Convicted	subset of the above		D	Reeve & McCausland (2019)
YJ Detained on remand	$1,418		E	Reeve & McCausland (2019)
YJ Detained	$1,418		F	Reeve & McCausland (2019)
			G	Reeve & McCausland (2019)
Cost of intervention: School setting				
Tier 1	$394			SP survey
Tier 2	$1,467			SP survey
Tier 3	$1,564			SP survey
Cost of intervention: Youth justice setting				
Tier 1	$232			SP survey
Tier 2	$1,272			SP survey
Tier 3	$2,008			SP survey
Cost of intervention: Tier 2 private setting	$2,850			NDIS
Cost of intervention: Tier 3 private setting	$2,850			NDIS

Appendix 5 –continued

Assumptions	Value	Range	Reference
Frequency per incident (mean) 'Jack'			
Youth justice conference	0.40		H
Police charge	0.21		I
Defendant	0.37		J
YJ Detained on remand (first incident)	0.00		L
YJ Detained on remand (multiple incidents)	0.51		L1
Duration per incident (first and multiple incidents)	13.29		L2
YJ Detained (first incident)	0.00		M
YJ Detained (multiple incidents)	0.51		M1
Duration per incident (first and multiple incidents)	80.67		M2
Frequency per incident (upper) 'Tim'			
Youth justice conference	0.67		H
Police charge	1.00		I
Defendant	0.71		J
YJ Detained on remand (first incident)	0.00		L
YJ Detained on remand (multiple incidents)	6.29		L1
Duration per incident (first and multiple incidents)	13.29		L2
YJ Detained (first incident)	0.51		M
YJ Detained (multiple incidents)	1.28		M1
Duration per incident (first and multiple incidents)	80.67		M2

Appendix 5 –continued

Assumptions	Value	Range	Reference
Youth inputs into decision tree			
*Cost of first youth justice incidents= (A*H)+(B*I)+(C*J)+(E*L*L2)+(F*M*M2)+G*	*$3,289*	*($1,289, $3,554)*	*calculated field*
*Cost of multiple youth justice incidents=(A*H)+(B*I)+(C*J)+(E*L*L2)+(F*M*M2)+G*	*$73,383*	*($5,892, $325,152)*	*calculated field*
Probabilities [a]			
Probability of youth anti-social behaviour (proxy for childhood intervention)			
(SLCN=-3)	*0.393*	*(0.329,0.455)*	*LSAC*
(SLCN=-2) (assumed no intervention base case model)	*0.314*	*(0.272,0.356)*	*LSAC*
(SLCN =-1) (assumed intervention base case model)	*0.236*	*(0.215, 0.256)*	*LSAC*
SLCN=0	*0.158*	*(0.157, 0.158)*	*LSAC*
Probability of YJ contact following youth anti-social behaviour (proxy for intervention during school)			
(SLCN=-3)		*(0.043, 0.142)*	
(SLCN=-2) (assumed no intervention base case model)	*0.075*	*(0.041, 0.108)*	*LSAC*
(SLCN =-1) (assumed intervention base case model)	*0.057*	*(0.039, 0.074)*	*LSAC*
SLCN=0	*0.039*	*(0.030, 0.047)*	*LSAC*
Probability of youth recidivism (proxy for intervention after first YJ offence)			
(SLCN=-3)	*0.940*	*(0.123, 1)*	*LSAC*
(SLCN=-2) (assumed no intervention base case model)	*0.717*	*(0.121, 1)*	*LSAC*
(SLCN =-1) (assumed intervention base case model)	*0.494*	*(0.115, 0.872)*	*LSAC*
SLCN=0	*0.271*	*(0.092, 0.451)*	*LSAC*

Appendix 5 –continued

Assumptions	Value	Range	Reference
Adult			
Costs ($)			
Police incidents as POI	$2,111	N	Reeve & McCausland (2019)
Defendant (court costs, weighted by type of court)	$1,619	O	Reeve & McCausland (2019)
Detained (remand and sentenced) (per day)	$225	P	Reeve & McCausland (2019)
Other inputs			
Adult court appearances (Number)			
With no YJ offence	0.550	R	MHDCD databank calculations
With one YJ offence	0.790	S	MHDCD databank calculations
With Multiple YJ offences	0.930	T	MHDCD databank calculations
Adult custody episodes (Number)			
With no YJ offence	0.330	U	MHDCD databank calculations
With one YJ offence	0.400	V	MHDCD databank calculations
With multiple YJ offences	0.540	W	MHDCD databank calculations
Adult custody (days)			
With no YJ offence	53.29	X	MHDCD databank calculations
With one YJ offence	57.04	Y	MHDCD databank calculations
With multiple YJ offences	110.6	Z	MHDCD databank calculations
Life expectancy (years)			
With no YJ offence	66	A1	databank and ABS life tables
With one YJ offence	66	B1	databank and ABS life tables
With multiple YJ offences	61	C1	databank and ABS life tables
Court cost (per incident)			
With no YJ offence =R*(N+O)	$2,181	D1	
With one YJ offence =S*(N+O)	$3,133	E1	
With Multiple YJ offences= U*(N+O)	$3,688	F1	
Custody cost (per incident)			
With no YJ offence =U*X(P)	$12,732	G1	
With one YJ offence =V*Y(P)	$13,628	H1	
With Multiple YJ offences=W*Z(P)	$26,425	I1	

Appendix 5 –continued

Assumptions	Value	Range	Reference
Adult inputs into decision tree			
Costs ($)			
Court cost (lifetime)			
No YJ offence =D1*(A1-18 years)	***$104,681***		
One YJ offence =E1*(B1-18 years)	***$150,361***		
Multiple YJ offences=F1*(C1-18 years)	***$158,569***		
Custody cost (lifetime)			
No YJ offence =G1*(A1-18 years)	***$611,138***		
One YJ offence=H1*(A1-18 years)	***$654,144***		
Multiple YJ offences=I1*(A1-18 years)	***$1,136,255***		
Probabilities c			
Probability of adult court			
No YJ offence	***0.194***		Weatherburn and Ramsay (2018))*
Once YJ offence	***0.442***		Chen S et al.(2005)**
Multiple YJ offences	***0.737***		Chen S et al., 2005**
Probability of adult custody			
No YJ offence	***0.103***		Weatherburn and Ramsay (2018)*
Once YJ offence	***0.108***		Chen S et al., 2005**
Multiple YJ offences	***0.285***		Chen S et al., 2005**

Reeve, R & McCausland, R (forthcoming) Calculating the criminal justice, health and human services costs for the MHDCD Databank: updated method (2019): Costs theirin are derived from ROGS 2017 and other data sources including NSW Youth Justice Dept. Annual Report (2015-16 Year in Review) and Criminal incidents data provided by provided by BOCSAR (Reference: jh17-15041). Costs are in 2019 AUD, Adult court cost is a weighted average of local, district, supreme and drug court costs. Drug court costs obtained from Goodall, S. Norman, R. and Haas, M (2008) The costs of NSW drug court, Crime and Justice Bulletin #122, NSW Bureau of Crime Statistics and Research, LSAC= regression analysis using LSAC data, **YJ**=Youth Justice. *Derived from Weatherburn and Ramsay (2018), ** Derived from Chen S et al., 2005

Appendix 6: Costs of speech pathology in institutional settings

Assumptions	School	Justice
Average annual salary of speech pathologist	$ 90,948	$ 92,516
Salary with on-costs, 27% (a)	$ 115,504	$ 117,496
Average number of young people benefitting per year (b):		
If all Tier 1	294	507
If all Tier 2	108	113
If all Tier 3	99	66
Unit cost per Tier of intervention (a)/(b)		
Tier 1	$ 394	$ 232
Tier 2	$ 1,073	$ 1,040
Tier 3	$ 1,171	$ 1,776
Unit cost per young person receiving the service		
Tier 1	$ 394	$ 232
Tier 2 (incurs Tier 1 plus Tier 2 cost)	$ 1,467	$ 1,272
Tier 3 (incurs Tier 1 plus Tier 3 cost)	$ 1,564	$ 2,008