# Improving Outcomes for Children with Fetal Alcohol Spectrum Disorders: An Investigation of Self-Regulation as a Potential Mechanism of Change

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Abstract

Fetal alcohol spectrum disorder (FASD) is a term used to indicate the range of conditions that can arise from prenatal exposure to alcohol. The pattern of central nervous system (CNS) dysfunction is somewhat variable by individual, but often involves impairments in learning and memory, self-regulation (including executive functions), social communication, and adaptive skills. Additionally, children with FASD often experience significant behavioural difficulties that impact on their functioning at home, school, and in community settings.

As a consequence, individuals with FASD are at a high-risk of experiencing secondary conditions, such as mental health problems, school disruption, and involvement with the criminal justice system, particularly as they enter adolescence. These neurocognitive difficulties, behaviour problems, and secondary conditions contribute to the high burden for families raising children with FASD. Therefore, caregivers of children with FASD often experience higher levels of stress and increased risk of parent-child relationship difficulties.

The overarching goal of the thesis was to investigate how children with FASD and their families could be supported and whether it was possible to ameliorate some of the complex difficulties and life challenges they face. The development of the first government funded assessment and diagnostic service in Australia provided the setting for an investigation of both clinical and experimental studies that led, ultimately, to a feasibility study of a family-based intervention.

The first study in the thesis was a retrospective case-file analysis, reporting on the diagnostic and clinical outcomes of children (N=31) who had attended the FASD diagnostic service. The majority of children were diagnosed with Static Encephalopathy Alcohol Exposed (35%) or Neurobehavioral Disorder Alcohol Exposed (35%). Further, the majority of children were also diagnosed with a comorbid condition, with

approximately half having a diagnosis of ADHD. Additionally, a large proportion of children had also experienced adverse environmental events (e.g., trauma, neglect or multiple care placements). The results of this study provided the first clinic-based outcomes on a sample of Australian children diagnosed with FASD.

The first study highlighted the importance of further support for children and families post-diagnosis. In order to identify interventions that had an evidence base, a systematic review of the literature was undertaken, Study 2. Search criteria identified 2962 studies. Subsequently, 32 studies met the inclusion criteria. There was growing evidence for interventions that improve outcomes for early to middle childhood with studies showing effectiveness for children falling into two broad categories: those that focused on supporting parents through information about the effects of FASD and strategies for managing behaviour, and those that focused on improving executive functions/self-regulation.

This led to the consideration of contemporary models for improving self-regulatory functioning in children. The growing literature on mindfulness-based strategies suggests that improved self-regulation is one of the key mechanisms of change. This provides potential merit for the incorporation of mindfulness-based strategies within a treatment program for children with FASD. The next two studies in the thesis aimed to investigate the potential role of mindfulness training for children with FASD.

Study 3 used an experimental paradigm to compare the responses of children with FASD and typically developing children to a mindfulness meditation. Using a physiological measure of self-regulation, respiratory sinus arrhythmia (RSA) this study found; (i) lower RSA at baseline for children with an FASD diagnosis compared to typically developing children and (ii) an equivalent increase relative to baseline for both groups during a mindfulness exercise. This indicated that children with

FASD may be able to respond to mindfulness on a physiological level. However, caution is required, as simply providing mindfulness training to increase baseline RSA may be counterproductive. This is because previous research has found that higher RSA, an index of environmental responsiveness, is associated with maladaptive outcomes when children live in stressful family environments.

The final study then used an adaptation of an existing intervention, the Parents under Pressure (PuP) program that addresses self-regulatory processes, through improving the parent-child relationship and the use of mindfulness-based strategies for both children and parents. The evaluation assessed feasibility through considering: participant recruitment, data collection procedures and outcome measures, suitability of the intervention protocol, resources and management of the study, and the participant's responses to the intervention. The results provided preliminary support to guide further research on the utility of an adapted version of the PuP program to support the needs of children with FASD and their families. Collectively, the findings from the thesis have important implications for diagnosis and intervention practices for children with FASD. These relate to the availability of diagnostic and intervention services, the types of diagnostic and intervention services provided, the training provided for health professionals working with this population, and the importance of FASD being recognised as a disability in Australia.

## Statement of Originality

This work has not been previously submitted for a degree or diploma in any university. To the best of my knowledge and belief, this dissertation contains no material previously published or written by another person except where due reference is made in the thesis itself.

Natasha Reid

**Table of Contents**

**List of Tables**

## List of Figures

## List of Appendices

## List of Abbreviations

| | |
|---|---|
| ABAS | Adaptive Behaviour Assessment System |
| ADHD | Attention-deficit Hyperactivity Disorder |
| ASD | Autism Spectrum Disorder |
| ARBD | Alcohol-Related Birth Defects |
| ARND | Alcohol-Related Neurodevelopmental Disorder |
| BAC | Blood Alcohol Content |
| BRIEF | Behaviour Rating Inventory of Executive Function |
| CBCL | Child Behaviour Checklist |
| CDS | Child Development Service |
| CNS | Central Nervous System |
| DBC | Developmental Behaviour Checklist |
| ECG | Electrocardiography |
| EEG | Electroencephalogram |
| EF | Executive Functions |
| FAS | Fetal Alcohol Syndrome |
| FASD | Fetal Alcohol Spectrum Disorder |
| FAE | Fetal Alcohol Effects |
| FSIQ | Full Scale Intelligence Quotient |
| GAC | General Adaptive Composite |
| IOM | Institute of Medicine |
| ND/AE | Neurobehavioral Disorder, Alcohol Exposed |
| PAE | Prenatal Alcohol Exposure |
| pFAS | Partial Fetal Alcohol Syndrome |
| PuP | Parents under Pressure Program |

| | |
|---|---|
| RCT | Randomised Controlled Trials |
| REM | Rapid Eye Movement |
| RSA | Respiratory Sinus Arrhythmia |
| SD | Standard Deviation |
| SE/AE | Static Encephalopathy, Alcohol Exposed |
| SFP | Still Face Paradigm |
| SSRS | Social Skills Rating System |
| SDQ | Strengths and Difficulties Questionnaire |
| TBI | Traumatic Brain Injury |
| WISC | Wechsler Intelligence Scale for Children |
| Y-OQ | Youth Outcome Questionnaire |

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Above all else, I would first like to acknowledge the families who have taken part in this research. Without you, none of this would have been possible. It has been a privilege to meet each one of you. Thank you for being so generous with your time and willing to share your experiences. I wish each of you all the very best for the future.

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**Published Works by the Author and Acknowledgement of Published Papers Included in this Thesis**

Section 11.1 of the Griffith University Code for the Responsible Conduct of Research ("Criteria for Authorship"), in accordance with Section 5 of the Australian Code for the Responsible Conduct of Research states:

To be named as an author, a researcher must have made a substantial scholarly contribution to the creative or scholarly work that constitutes the research output, and be able to take public responsibility for at least that part of the work to which they contributed.

Attribution of authorship depends to some extent on the discipline and publisher policies, but in all cases, authorship must be based on substantial contributions in a combination of one or more of:

- Conception and design of the research project
- Analysis and interpretation of research data
- Drafting or making significant parts of the creative or scholarly work or critically revising it so as to contribute significantly to the final output.

Included in this thesis are published papers (Chapters 3 and 4) and two papers submitted for publication (Chapter 5 and Chapter 6), which are co-authored with other researchers. My contribution to each of these papers is outlined at the front of each of the relevant chapters.

The bibliographic details for these papers are:

**Chapter 3: Reid, N**., Shelton, D., Warner, J., O'Callaghan, F., & Dawe, S. (2017). Profile of children diagnosed with a fetal alcohol spectrum disorder: A retrospective chart review. *Drug and Alcohol Review.*

**Chapter 4: Reid, N.,** Dawe, S., Shelton, D., Harnett, P., Warner, J., Armstrong, E., LeGros, K., & O'Callaghan, F. (2015). Systematic review of fetal alcohol spectrum disorder intervention across the life span. *Alcoholism: Clinical and*

*Experimental Research, 39(12),* 2283 – 2295.

**Chapter 5: Reid, N.,** Harnett, P., O'Callaghan, F., Shelton, D., Wyllie, M., & Dawe, S. (under review). Physiological self-regulation and mindfulness in children with an FASD diagnosis.

**Chapter 6: Reid, N.,** Dawe, S., Harnett, P., Shelton, D., Hutton, L., & O'Callaghan, F. (revise & resubmit). Feasibility study of a family-focused intervention to improve outcomes for children with FASD. *Research in Developmental Disabilities.*

The following conference presentations have been undertaken based on the research contained in this thesis:

Dawe, S., Harnett, P., **Reid, N**., Shelton, D, & O'Callaghan, F. (November 2013). Improving outcomes for children with FASD: Time for cautious optimism and considered evaluation. *Australasian Fetal Alcohol Spectrum Disorders Conference*, Brisbane, Australia.

Dawe, S., **Reid, N**., Shelton, D., Harnett, P. (September 2016). Interventions for children with fetal alcohol spectrum disorders: Where to next? *European FASD conference*; London, England.

Shelton, D., **Reid, N**., Dawe, S., & O'Callaghan, F. (November 2016). Establishing an FASD diagnostic clinic: Who we have seen and our caregivers' views. *Gold Coast Health and Medical Research Conference,* Gold Coast, Australia.

The following conference posters have been presented or accepted based on the research contained in this thesis:

**Reid, N**., Shelton, D., Dawe, S., Warner, J., Chamberlain, K., & O'Callaghan, F. (September 2016). Establishing an FASD diagnostic clinic: Who we have seen and our caregivers' views. *European FASD conference*; London, England.

Shelton, D., **Reid, N**., Dawe, S., & O'Callaghan, F. (March 2017). Establishing an

FASD diagnostic clinic: Who we have seen and our caregivers' views. *7th International Conference on fetal alcohol spectrum disorder*, Vancouver, Canada.

**Reid, N**., Shelton, D., O'Callaghan, F., & Dawe, S. (March 2017). Improving outcomes for children with FASD: How the research literature can inform the development of a family focused treatment approach. *7th International Conference on fetal alcohol spectrum disorder*, Vancouver, Canada.

During my PhD candidature, I also made a substantial contribution to two other published papers, one paper that has been accepted for publication and one currently under review. The bibliographic details for these papers are:

Chamberlain, K., **Reid, N.,** Warner, J., Shelton, D., & Dawe, S. (2017). A qualitative evaluation of caregivers' experiences, understanding and outcomes following diagnosis of FASD. *Research in Developmental Disabilities, 16,* 99-106. (see Appendix A for a copy of this paper).

Harnett, P., **Reid, N.,** Loxton, N., & Lee, N. (2016). The relationship between trait mindfulness, personality and psychological distress: A revised reinforcement sensitivity theory perspective. *Personality and Individual Differences, 99,* 100-105.

Armstrong, E., Eggins, E., **Reid, N.,** Harnett, P., & Dawe, S. (accepted). Parenting interventions for Incarcerated parents to improve parenting knowledge and skills, parent wellbeing and quality of the parent-child relationship: A systematic review and meta-analysis. *Journal of Experimental Criminology.*

Wyllie, M., Harnett, P., **Reid, N**., & Dawe, S. (under review). Comparison of self-regulation measures and mindfulness: An investigation in young children.

# Chapter 1: Thesis Introduction

Chapter 1 outlines the main aims and rationale of the thesis, which is presented in a thesis-with-publication format. Specifically, the current chapter provides an overview of the thesis topic and an outline of the thesis structure with respect to the seven chapters.

## Overview of Thesis Topic

The research is now well established that exposure to alcohol prenatally can produce a range of adverse outcomes for individuals. Collectively, the range of disabilities that individuals can experience are referred to as fetal alcohol spectrum disorders (FASD) (Cook et al., 2016). The term FASD highlights the fact that prenatal alcohol exposure can lead to a wide spectrum of physical, cognitive and/or developmental outcomes. Of the many potential negative outcomes of prenatal alcohol exposure (PAE), the impacts on the developing brain can be the most devastating. Deficits can vary in presentation due to a range of factors. No consensus has been reached in the literature as to what may constitute a safe level of alcohol consumption during pregnancy. In general, the amount of alcohol consumed during pregnancy is correlated with severity (O'Leary, 2002). However, the pattern of alcohol exposure can moderate these effects; a pattern of episodic (binge) drinking has been found to result in more severe outcomes as it produces the highest blood alcohol concentration (BAC) and it is the high BAC that affects the developing fetus most negatively (Livy, Miller, Maier, & West, 2003).

The timing is also important as alcohol exposure during different periods of fetal development impacts the pattern and severity of the functional and structural impairments (Guerri, Bazinet, & Riley, 2009). Furthermore, maternal demographic and physical characteristics can also be important risk or protective factors. For example, May et al. (2013) found that children who had experienced PAE had the highest level of

functioning if they were born to mothers who were higher in SES status (i.e., higher education, lived in an urban setting and higher income) and had physical features, which were generally indicative of better maternal health (i.e., taller, heavier and larger head circumference).

Awareness of FASD has been increasing; however, Australian efforts to target FASD have significantly trailed behind other countries such as New Zealand, Canada, and the USA. FASD is currently not considered to be a disability in Australia, and consequently there are limited services and a lack of acknowledgement and understanding from health professionals (Chamberlain, Reid, Warner, Shelton, & Dawe, 2016). Recently, the first assessment and diagnostic service for children with FASD operating permanently within a government health service was established at the Child Development Service (CDS) at Southport, Queensland. Therefore, it was important to investigate the outcomes of the clients who had attended this service.

Subsequently, once a child receives a diagnosis there needs to be appropriate intervention services available. There have been growing attempts to improve functioning for children with FASD; however, there was a need to review the available evidence to ascertain what research had been undertaken, and to enable the development of additional ways to support individuals with FASD. Accordingly, the broad objective of this thesis was to investigate potential ways of improving outcomes for children with FASD and their families.

**Chapters and Aims of the Thesis**

The thesis consists of seven chapters: A thesis introduction (Chapter 1), general introduction (Chapter 2), four studies including; the first Australian clinic based study of children with FASD (Chapter 3), a systematic review of FASD interventions (Chapter 4), an empirical study comparing children with FASD to typically developing children on their self-regulatory abilities in response to a mindfulness exercise (Chapter

5) and a feasibility study of a family-focused intervention (Chapter 6). The thesis concludes with a general discussion (Chapter 7). To keep the format consistent for the reader, all chapters have been written in accordance with the Publication Manual of the American Psychological Association, Sixth Edition (AmericanPsychologicalAssociation, 2009), with tables and figures embedded in the text. Copies of published articles in the format of the journals are included as Appendices.

**Chapter 2: General Introduction.** This chapter provides an overview of key literature relevant to the thesis. This includes: the diagnosis and prevalence of FASD, neurobehavioural deficits typically associated with FASD, and an exploration of self-regulatory difficulties for children with FASD using a developmental framework.

**Chapter 3: Profile of Children Diagnosed with a Fetal Alcohol Spectrum Disorder: A Retrospective Chart Review (Study 1).** Chapter 3 consists of a peer-reviewed research article that is currently in press. The data for this study was collected from one of the first FASD diagnostic services available in Australia. The aims of this study were to: (i) report on the diagnostic profile of a group of children diagnosed with FASD; (ii) document the extent to which there were comorbid diagnoses; and (iii) provide information on the neurocognitive functioning of children who were diagnosed with FASD.

**Chapter 4: Systematic Review of Fetal Alcohol Spectrum Disorder Interventions across the Life Span (Study 2).** Chapter 4 is comprised of a published peer-reviewed systematic review article that aimed to provide an extensive analysis of the available intervention literature. This was an important project to undertake as following from Study 1, the implementation of the diagnostic service made it imperative to establish what evidence-based interventions were currently available to improve outcomes for individuals with FASD. A further aim was to identify any potential gaps

in the literature, so as to inform additional intervention approaches that could be incorporated to support children and families.

**Chapter 5: Physiological Self-regulation and Mindfulness in Children with an FASD Diagnosis (Study 3).** Chapter 5 consists of a research article that has been submitted for publication. The focus of this chapter was to explore new intervention strategies that could be employed for children with FASD. The first aim of the study was to explore baseline differences in physiological regulation, as indexed by respiratory sinus arrhythmia (RSA), between a group of children with an FASD diagnosis and a group of typically developing control children. The second aim of this study was to ascertain if children with an FASD diagnosis were responsive to a brief mindfulness exercise compared to typically developing children.

**Chapter 6: Feasibility Study of a Family-Focused Intervention to Improve Outcomes for Children with FASD (Study 4).** Chapter 6 is comprised of a research article that has been submitted for publication. Based on the findings from the previous chapters, the aim of this research was to evaluate the feasibility of an adaptation of the Parents under Pressure (PuP) Program. The PuP program addresses self-regulatory processes through improving the parent-child relationship and implementing mindfulness-based strategies for both children and parents. The clinical intervention work with the families that is contained in this chapter was undertaken by the thesis author. All participant information has been de-identified and any potentially identifiable demographic or clinical information has been withheld to protect the confidentiality of the families.

**Chapter 7 General Discussion.** The final chapter in the thesis summarises the key findings of the research and highlights the ways in which the current thesis has advanced the field. This includes the theoretical, clinical, and policy implications of the

research. Furthermore, this chapter discusses the methodological limitations and provides recommendations for future research.

# Chapter 2: General Introduction

## Diagnosis of FASD

The diagnosis of FASD has been constantly evolving since Lemoine, Harousseau, Borteyru, and Menuet (1968) and Ulleland (1972) first described the potential negative effects of fetal alcohol exposure. However, at this time there is no consensus on one set of diagnostic criteria and consequently, worldwide there are numerous criteria that are currently being implemented. Initially, the term fetal alcohol syndrome (FAS) was used to describe children who presented with a unique pattern of altered development. This included, characteristic facial features. That is, short palpebral fissures (small eyes), thin upper lip and smooth philtrum (groove above the lip), growth deficiency, and neurobehavioural deficits (Jones, Smith, Ulleland, & Streissguth, 1973). Soon after, the terminology of "suspected fetal alcohol effects" was used to describe children who displayed some, but not all of the features of FAS (e.g., Clarren & Smith, 1978). Although this terminology was not initially intended to be used as a diagnosis, within a few years, the diagnosis of fetal alcohol effects (FAE) began to be applied indiscriminately to children with a wide variety of difficulties based on the suspicion that their mothers drank alcohol during pregnancy (Aase, Jones, & Clarren, 1995). Consequently, due to the term FAE lacking a meaningful definition and clinical utility, it was subsequently abandoned (Aase et al., 1995).

Then in 1996 (Stratton, Howe, & Battaglia, 1996 ), and revised again in 2005 (Hoyme et al., 2005), the United States' Institute of Medicine (IOM) differentiated five possible outcomes of fetal alcohol exposure: FAS with and without confirmed alcohol exposure; partial FAS (pFAS), alcohol-related birth defects (ARBD); and alcohol-related neurodevelopmental disorder (ARND). The term pFAS was used to describe individuals with confirmed PAE; some of the facial characteristics; and either growth deficiency, neurodevelopmental abnormalities, complex behaviour or cognitive

abnormalities. ARND, however, was used to describe individuals who presented with none of the physical features, but had CNS neurodevelopmental abnormalities or complex cognitive or behavioural abnormalities. ARBD referred to individuals with congenital physical abnormalities. Both of these required confirmed PAE for diagnosis (Hoyme et al., 2005; Stratton et al., 1996 ).

Following this, in 1997, 1999 and revised again in 2004, the 4-Digit Diagnostic Code (Astley, 2004) was introduced. This provided standardised measurement scales to increase the accuracy and objectivity of diagnoses. Using the 4-Digit Code the four key diagnostic features of FASD (growth deficiency, facial phenotype, brain dysfunction and PAE) are assessed and ranked using a 4-point Likert scale, with 1 reflecting the absence of the feature and 4 indicating the strong presence of the feature. This produces 256 possible 4-Digit Codes ranging from 1111 to 4444, with each of these codes having a corresponding clinical name. Importantly, the 4-Digit Code uses terminology that reports if an individual was *exposed* to alcohol prenatally, rather than reporting that an individual's outcomes are alcohol *effects* or alcohol-*related*, which imply that the alcohol exposure caused the birth defect or impairment. This is pertinent as many of the abnormalities found for individuals with PAE, besides the full facial phenotype, frequently occur in individuals without PAE (Astley, 2004).

Subsequently, the Canadian diagnostic guidelines (Chudley et al., 2005) were published, which combined the IOM nomenclature and the 4-Digit Code methodology. However, the Canadian guidelines have since been updated (Cook et al., 2016) and no longer use the IOM nomenclature. Rather, FASD is now used as a diagnostic term and three possible outcomes following assessment are recommended: FASD with sentinel facial features; FASD without sentinel facial features; and at risk of neurodevelopmental disorder and FASD, associated with PAE. At the same time Australia was also developing a diagnostic instrument. However, it has now been

recommended in the Australian Guide to the Diagnosis of FASD (Bower & Elliott, 2016a) that the updated Canadian Guidelines be adopted.

**Prevalence of FASD**

In comparison to the wealth of information relating to the diagnosis of FASD, there is limited data available that provides accurate estimates of the prevalence of FASD and the wide variability in the diagnostic criteria being employed is one possible reason for this (Roozen et al., 2016). Additionally, prevalence studies vary widely in their methodologies (e.g., passive compared to active case ascertainment) and the populations that they assess (e.g., high risk compared to general). Recently, the worldwide pooled prevalence of FASD was estimated to be 22.77 per 1000 (range: 0 to 176.77); however, this must be interpreted with caution due to the aforementioned variability that exists between prevalence studies (Roozen et al., 2016).

The only Australian prevalence study to date to use active case ascertainment was conducted in a remote Indigenous community in Western Australia. This study reported rates of 120 per 1000 children for FAS and pFAS (Fitzpatrick et al., 2015). It is important to note that the full range of FASD diagnoses are not always assessed in prevalence studies. Consequently, it is likely that higher rates of FASD will be found in similar, highly exposed Australian populations when including the full range of diagnoses in the FASD spectrum. There have been no Australian studies to date that have used active case ascertainment to assess the prevalence of FASD in non-indigenous communities. Therefore, Australia does not currently have accurate estimates of FASD prevalence.

Furthermore, the challenges in estimating prevalence are compounded by both health professionals' reluctance to ask about alcohol consumption during pregnancy, combined with a lack of familiarity with the diagnostic features of FASD (Payne et al., 2011). Indeed, Elliott, Payne, Haan, and Bower (2006) conducted a survey

of Australian paediatricians and found that 23.3% did not routinely ask about alcohol consumption during pregnancy and only 18.9% selected all four of the essential features for a diagnosis of FAS. Furthermore, although 79.6% agreed at early diagnosis might be advantageous, 69.6% of paediatricians surveyed believed that a diagnosis would be stigmatizing for the child and family.

**Neurobehavioural deficits typically associated with FASD**

An extensive body of literature exists documenting the cognitive deficits and behavioural and emotional difficulties that children with FASD can face. Importantly, as mentioned previously there are numerous pre-and post-natal factors that can influence the severity of deficits that can be found for children (May et al., 2013; Yumoto, Jacobson, & Jacobson, 2008). Consequently, to date cognitive and behavioural profiles of children with FASD have been found to be heterogeneous. The current section will provide a brief overview of some of the main neurobehavioural difficulties children with FASD can experience.

Children with FASD can show reduced intellectual abilities (e.g., Aragon et al., 2008). Although wide discrepancies in IQ scores do exist, the majority of individuals do not meet the IQ criterion for an intellectual disability, that is an IQ score below 70 (Astley et al., 2009). For example, a large study of children and adults (N = 473) found that those with FAS obtained IQ scores as low as 29 and as high as 120 ($M$ = 79). However, IQ scores for those without all the physical features of FAS were found to range from 42 to 142 ($M$ = 90) (Streissguth, Barr, Kogan, & Bookstein, 1996). This variability may be in part related to the varying doses of PAE, as some studies have found dose-dependent decreases in IQ scores (Streissguth, Barr, Sampson, Darby, & Martin, 1989). Significantly lower IQ scores have been found for individuals with high PAE, regardless of whether they present with the physical features of FAS (Mattson et al., 1997). For individuals diagnosed with FASD however, those with FAS have been

found to have the most severe impairments in intellectual abilities (Chasnoff, Wells, Telford, Schmidt, & Messer, 2010). Although much research has compared verbal and non-verbal IQ scores in this population, no consistent pattern of deficits has been found (Mattson & Riley, 1998).

Children with FASD have also been found to have deficits in learning and memory (Kaemingk, Mulvaney, & Halverson, 2003; Willoughby, Sheard, Nash, & Rovet, 2008); language (McGee, Bjorkquist, Riley, & Mattson, 2009); quantitative reasoning (Howell, Lynch, Platzman, Smith, & Coles, 2006); and visual perception (Mattson, Gramling, Riley, Delis, & Jones, 1996). Furthermore, attention and executive functioning deficits have both been extensively studied in children with FASD and are considered to be common domains of impairment (Davis, Gagnier, Moore, & Todorow, 2013). Attention-deficit/hyperactivity disorder (ADHD) has been found to be one of the most prevalent comorbid mental health conditions for children with FASD (Fryer, McGee, Matt, Riley, & Mattson, 2007). However, a number of studies have reported specific differences in attentional profiles for children with FASD compared to children with ADHD. For example, Coles et al. (1997) found that children with ADHD had more problems with tasks involving sustaining and focusing, whereas children with fetal alcohol exposure had more difficulty with tasks involving encoding (as measured by a number recall task) and shifting (as measured by the Wisconsin Card Sorting Test).

## Exploring Self-Regulatory Difficulties for Children with FASD Using a Developmental Framework

As previously described, exposure to alcohol prenatally can be associated with a range of physical, cognitive, and behavioural impairments (for reviews see Davis et al., 2013; Kodituwakku, 2009; Kodituwakku & Kodituwakku, 2011). Of the range of negative outcomes that children with FASD can experience, these deficits are often largely underpinned by pervasive difficulties in self-regulatory processes that impair an

individual's ability to manage behavioural, emotional, and internal sensory states (Wells, Chasnoff, Schmidt, Telford, & Schwartz, 2012b). Consequently, Kodituwakku (2010) proposed that interventions targeting self-regulation may lead to greater generalizable results than interventions aimed at domain-specific skills. Subsequently, there have been a number of successful studies that have employed a range of approaches to improve aspects of self-regulation for children with FASD (e.g., Nash et al., 2015; Soh et al., 2015; Wells et al., 2012b). However, it is possible that the field would be advanced by the adoption of a developmental self-regulatory framework proposed by Calkins and colleagues (e.g., Calkins, 2007; Calkins & Fox, 2002). This would provide an underlying theoretical approach to assist in the understanding, development and implementation of interventions for children with FASD.

Calkins and Fox (2002) propose a multi-level theoretical approach that informs the understanding of the development of self-regulation during early childhood and the role that it plays in the formation of early adjustment problems. Within this model, the individual can be considered as a self-regulating system that is comprised of multiple, progressively differentiated levels of self-regulatory skills. These skills are both developmentally ordered and domain-specific such that the earliest skills in *physiological regulation* provide the foundation for the development of self-regulatory skills in *attentional regulation*. This, in turn, lays the foundations for *emotional regulation* and *behavioural regulation* with the final component of self-regulatory skills leading to *executive or cognitive control* (Calkins, 2007).

The current chapter aims to provide an overview of the domains of self-regulation according to the developmental theoretical framework and provide examples of research studies that have reported impairments for children with FASD in each of these self-regulatory domains. A systematic review of the literature was undertaken and articles were included if: (i) they were published in a peer-reviewed journal; (ii)

children were aged 0 – 8years i.e., infancy through to early childhood; (iii) children had documented prenatal alcohol exposure (PAE) or a FASD diagnosis; and (iv) the article measured an area of self-regulation (i.e. physiological, attentional, emotional, behavioural or executive control). Articles were excluded if: (i) the aim of the study was to compare PAE/FASD to other disorders e.g., ASD or ADHD; (ii) the aim of the study was to compare PAE to other prenatal exposes e.g., cocaine, marijuana; and (iii) if the aim of the study was to investigate low level effects of PAE. See Table 2.1 for a summary of the studies that have been included in this chapter. When self-regulatory processes are viewed in this manner, opportunities and processes for potential intervention emerge and allow for a more systematic and theoretically driven approach to remediation programs for children with FASD.

**Physiological regulation**. The development of regulatory processes commences prenatally and continues throughout childhood, beginning with the development of basic autonomic regulation (Calkins, 2007). These underlying physiological processes play an important role in the development of early regulatory behaviours and as such, researchers have used measures of heart rate, brain electrical activity and adrenocortical activity to study the relations between physiology and self-regulatory behaviour (Calkins & Fox, 2002). This has also been the case for children with PAE or diagnosed with FASD, as a number of studies have assessed varying aspects of early physiological regulatory abilities.

For example, two studies have assessed infant arousal pre-and-post the Still Face Paradigm (SFP i.e., a stressful event for infants) using salivary cortisol (Jirikowic, Chen, Nash, Gendler, & Carmichael Olson, 2016) or heart rate and salivary cortisol (Haley, Handmaker, & Lowe, 2006). Jirikowic et al. (2016) compared nine infants with moderate/high PAE to nine infants with low/no PAE and found that infants with high PAE had significantly higher cortisol levels at the baseline assessment, however neither

group showed an increase post-SFP. On the other hand, (Haley et al., 2006)) reported that in a group of 55 infants, whose mothers reported risky pre-pregnancy drinking who were enrolled in an alcohol intervention study during pregnancy, PAE was related to increased cortisol and heart rate following the SFP.

Another two studies also investigated infant arousal in relation to stressful events, one pre-and-post a heel lance (Oberlander et al., 2010) and the other pre-and-post a routine inoculation (Ramsay, Bendersky, & Lewis, 1996). Oberlander et al. (2010) compared heavily exposed newborn infants to light/non-exposed infants (14 in each group) on measures of heart rate, respiratory sinus arrhythmia (RSA) and salivary cortisol. RSA is the variability in heart rate that occurs at the frequency of breathing and reflects the parasympathetic influence on heart rate variability via the vagus nerve (Calkins, 2007). Importantly, RSA may serve as a peripheral index of prefrontal cortex (PFC) functioning, a notion that is articulated in Thayer and Lane's neurovisceral integration model (Thayer, Hansen, Saus-Rose, & Johnsen, 2009; Thayer & Lane, 2000) and supported by mounting research (Beauchaine, 2015; Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012).

Oberlander et al. (2010) found that infants with PAE showed no significant changes in RSA during the stressful procedure, whereas unexposed infants showed a significant decrease 20 seconds following the lance and then a significant increase during the recovery period. In regards to cortisol levels, there was no baseline difference between groups; however, the control group did not change significantly during the procedure. In contrast, the exposed group decreased significantly over time. Overall, the authors suggested that PAE "blunts" the stress reactivity of infants. Conversely, Ramsay et al. (1996) found higher pre-stressor cortisol levels for five exposed infants compared to nine non-exposed infants at two months of age. Consequently, more research is

needed to clarify potential cortisol differences between children with PAE and unexposed children.

Another study investigating physiological regulation was conducted by Kable and Coles (2004) who compared heart rate and behaviourally rated arousal between a group of infants at high-risk of PAE (N = 18) to a low-risk group (N = 100) following the presentation of auditory and visual stimuli. High-risk infants were found to take longer to respond to the start of the stimuli. The authors suggested that high-risk infants had difficulties regulating their arousal system, which may have resulted in slower processing speed in response to the environmental stimuli and significant disruption in the initiation of attention and encoding of information. It was further suggested that this disruption may interfere with all subsequent learning and may be associated with significant changes in development.

Other studies have utilised a combination of caregiver reports and physiological measures to investigate sleep difficulties for infants with PAE or children with FASD. Many problems have been reported including: more sleep disturbances/fragmented sleep (Chen, Olson, Picciano, Starr, & Owens, 2012; Havlicek, Childiaeva, & Chernick, 1977; Troese et al., 2008; Wengel, Hanlon-Dearman, & Fjeldsted, 2011); significantly lower quality of quiet sleep, that is, non-rem sleep (Rosett et al., 1979); decreased active-REM sleep time (Troese et al., 2008); decreased total sleep time (Rosett et al., 1979); EEG hypersynchrony during all three states of sleep, that is, quiet, indeterminate and active sleep (Havlicek et al., 1977); and caregivers of children with FASD reported higher rates of sleep complaints (e.g., Chen et al., 2012).

Taken together, studies in this area show that overall, infants and children display a range of difficulties in physiological self-regulation, as indexed by measures of cortisol, heart rate, sleep monitoring/ECG and parent report. This demonstrates that

early in life, these aspects of physiological processes can be assessed and can be impaired for children with PAE. Notably, many studies have been conducted in this area that assess physiological outcomes for infants with PAE. Conversely, as will be presented in Chapter 4, our systematic review of intervention studies (Reid et al., 2015) found only two studies that focused on improving developmental outcomes for infants with PAE. Further, only one study was found that aimed to improve physiological regulation for children with FASD (Keiver, Bertram, Orr, & Clarren, 2015), with no studies investigating improving physiological regulation for infants with PAE. Consequently, these are essential areas for future intervention studies to investigate.

Importantly, previous research in other clinical populations shows the strong link between the quality of maternal relationship and a child's physiological self-regulatory abilities. For example, Calkins, Graziano, Berdan, Keane, and Degnan (2008) found that children with a high-quality maternal relationship displayed higher physiological regulation across all challenging tasks compared to children with a low quality maternal relationship. It was concluded that a supportive warm relationship aids the development of self-regulation skills at a biological level. Currently, parenting interventions for children with FASD tend to focus on teaching skills or providing behavioural strategies to assist parents with managing challenging behaviours. The evidence for the parent-child relationship as a mechanism of change in self-regulatory processes is important and highlights the possibility for interventions that include a focus on enhancing the quality of this relationship.

**Attentional regulation**. Following the foundational development of physiological regulation, development of voluntary control of attention takes place during an infant's first year of life, corresponding with the development of three associated but anatomically separate attentional systems. These consist of the reticular activating system which is suggested to be involved in maintaining and varying

alertness (Derryberry & Rothbart, 1997); the posterior attentional system which is involved in the engagement and disengagement of attention; and the anterior attentional system which is thought to regulate sensory information and is proposed to underlie the development of effortful control (Posner & Rothbart, 2009). The growth and integration of these attentional systems enables children to regulate reactivity through orienting, redirecting and maintaining attentional focus (Calkins, 2007). A substantial amount of previous research has identified difficulties for children with FASD in the domain of attentional regulation (e.g., Aragon et al., 2008; Brown et al., 1991; Chiodo et al., 2010; Kodituwakku, Coriale, et al., 2006). Notably, a number of studies report that children display more difficulties with inattention, compared to hyperactivity (e.g., Aragon et al., 2008; Kodituwakku, Coriale, et al., 2006). These findings are in line with the findings from some of the physiological studies, that documented consistent difficulties for children with PAE in modulating arousal levels, which may underlie these later inattention difficulties (Kable & Coles, 2004).

Importantly, some studies of attentional regulation for children with PAE have also emphasized the potential influence of maternal factors on child attentional regulation. For example, Brown et al. (1991) found that once current maternal drinking was controlled for the sustained attention difficulties were no longer significant. These findings and other broader studies that investigate the maternal and wider environmental factors (e.g., May et al., 2013) are important for understanding the developmental role played by characteristics of caregivers and early postnatal experiences, supporting the potential efficacy of early interventions that could influence these extrinsic factors to the child. Thus, understanding the processes and potential influences of the development of self-regulation for children with FASD may provide important insights into how early attentional self-regulatory processes are underpinned by physiological processes and how these relate to later emotional and behavioural functioning.

**Emotional regulation.** The next important domain of regulatory processes to develop is emotional regulation, which involves the modification of the intensity, quality and duration of an emotional experience in the service of achieving one's goals (Thompson, 1994). Emotional self-regulation and displays of affect influence interpersonal relationships and socioemotional development during the first few years of life (Calkins, 2007). Initially, infants are completely reliant on caregivers for their emotional regulation and then gradually across the next two years of life children become increasingly more capable of independent control over their own affective states. There is an emphasis during the development of emotional regulation on the process of mutual regulation, which is where the infant's temperament and ability to regulate their own state interacts with a caregiver's ability to meet the infant's needs (Tronick, 1989).

A number of studies have reported emotional regulation difficulties for infants with PAE or children with FASD. Using the SFP, Lowe, Handmaker, and Aragón (2006) assessed 76 six-month-old infants, whose mothers were part of a larger alcohol reduction intervention for pregnant women. They found that female infants with PAE displayed greater negative affect following the procedure. Notably, all infants displayed more positive affect when their mothers were more responsive. Savonlahti et al. (2005) evaluated 14 infants at high-risk of PAE and 12 low-risk infants during free play, and feeding with their mothers using an objective coding assessment. High-risk infants were rated as being more withdrawn/depressed, less alert/interested and as having a reduced level of exploratory play. Further, Motz et al. (2013) assessed 46 infants and children with PAE and found that almost one-third met criteria for a mental health diagnosis and that the majority of dyads exhibited disordered relationship features.

Additionally, there have been five studies conducted by O'Connor and her colleagues (O'Connor, 2001; O'Connor, Kogan, & Findlay, 2002; O'Connor & Paley, 2006; O'Connor, Sigman, & Kasari, 1992, 1993). All of these studies point to the possibility of a dynamic interplay between PAE, child negative affect or depressive symptomatology, and the potential influence (positive or negative) of the parent-child relationship. Higher PAE was found to be related to higher child negative affect or depressive symptomatology. Then, negative affect displayed by infants was found to influence the way some mothers interacted with their children, which can then impact on the parent-child relationship. For example, mothers of infants who displayed more negative affect were less elaborative and stimulating in their interactions, and insecure attachment was more prevalent for these children (O'Connor et al., 1992). Also, mothers of children with more negative affect were less emotionally connected to their child, and those children had higher levels of depressive symptomatology (O'Connor et al., 2006). However, when mothers of children with PAE provided high levels of support these children had better coping skills and more secure attachments (O'Connor et al., 2002). Consequently, this highlights the potential protective role that caregivers can play in assisting children to develop emotional regulation skills. Caregivers may implement specific strategies that enhance the child's development of emotional regulatory skills by providing responsive caregiving environments for their child (Calkins & Fox, 2002).

**Behavioural regulation.** Previously developed physiological, attentional and emotional regulatory processes are essential for behavioural regulation. As for children to be able to control their behaviour they need to be able to control their arousal levels to meet their external demands. Behavioural regulation is critical for children to transition successfully into the school and social environment (Calkins, 2007). Many studies have documented the wide range of behavioural regulation issues that children

with FASD may present with. For example, Bailey et al. (2004) found that children with PAE were more likely to have clinically significant levels of delinquent behaviour as reported by their teachers. Another study (Alvik, Aalen, & Lindemann, 2013) used the Strengths and Difficulties Questionnaire (SDQ), and found that PAE predicted Abnormal/Borderline scores on the SDQ Total and one study (Steinhausen, Willms, Metzke, & Spohr, 2003) employed the Developmental Behaviour Checklist (DBC), comparing children with PAE to those without, finding that children with PAE scored higher on the majority of the scales of the DBC.

Furthermore, many studies have used the Child Behaviour Checklist (CBCL), for example two studies found that parents reported more behavioural problems for children with FASD compared to typically developing children (Janzen, Nanson, & Block, 1995; Nayak, Murthy, Girimaji, & Navaneetham, 2012). Also, using the CBCL, Knudsen et al. (2014) found using a longitudinal study design that PAE was associated with internalising and externalising behaviour problems at 18 and 36 months of age. However, once maternal drinking and psychopathology were controlled for, this relationship was only significant for internalising behaviour problems (i.e., emotional regulation) at 36 months of age. Again, highlighting the importance of considering the impact of extrinsic child factors, such as parent psychopathology on child self-regulation.

Accordingly, behavioural difficulties are frequently reported sources of stress for caregivers of children with FASD (e.g., Paley & O'Connor, 2011). Although the behavioural regulation difficulties are frequently observed by caregivers and teachers, it is clearly evident when viewing self-regulation from a developmental perspective that there are a number of underlying areas that may be impacting on a child's ability to regulate their behaviour. Therefore, for interventions to be effective,

these underlying self-regulatory domains need to be taken into consideration in assessment and treatment planning for children with FASD.

**Executive regulation**. The final domain of self-regulatory development is executive functions (EFs). EFs encompass a variety of interrelated processes involved in planning and carrying out regulated goal-directed actions (Garon, Bryson, & Smith, 2008). The most common components are: inhibition, the ability to override a tendency to produce a more dominant or automatic response; mental set shifting, being able to switch back and forth between tasks; and working memory, the ability to hold and actively manipulate information rather than just passively storing it (Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Miyake et al., 2000). Importantly, these higher-level skills are supported from the earlier developed self-regulatory skills. Consequently, children with FASD have also been found to be significantly impaired in this domain of self-regulation. For instance, a number of researchers have reported that PAE was associated with poorer working memory (e.g., Burden, Jacobson, Sokol, & Jacobson, 2005; S. W. Jacobson, Jacobson, Sokol, Chiodo, & Corobana, 2004; Rasmussen & Bisanz, 2010). Additionally, Kodituwakku, Adnams, et al. (2006) found that children with FAS performed worse on fluency tasks compared to control children and that children with FAS had more difficulty with letter fluency compared to category fluency. The authors suggested this may be a result of the letter fluency task being more sensitive to frontostriatal dysfunction.

Further, Fuglestad et al. (2015) found children with FASD had impairments on the EF Scale for Early Childhood, a measure of cognitive flexibility and more difficulties with impulse control on a delay of gratification task compared to non-exposed control children. Thus, the studies in this self-regulatory domain demonstrated that EF difficulties can be identified in young children with PAE. Identification and remediation of EF deficits is extremely important, as deficits in this area may impact

many other areas including, social skills, adaptive functioning, and academic performance (Davis et al., 2013). For instance, Schonfeld, Paley, Frankel, and O'Connor (2006) found that both parent and teacher ratings of social behaviour using the Social Skills Rating System (SSRS) were predicted by ratings of EF. Furthermore, problem behaviours such as lying, stealing, and cheating found among children with FASD are thought to relate to problems with understanding cause and effect and inhibiting inappropriate behaviours, due to deficits in EF (Rasmussen, Talwar, Loomes, & Andrew, 2008).

Overall, the application of Calkins and colleagues' developmental self-regulatory framework has implications for understanding normative and compromised development, as found for children with FASD. An important goal of the framework is to identify the role that different levels of self-regulation may play in limiting subsequent development (Calkins, 2007). Furthermore, across all the self-regulatory domains it is imperative to consider the relationship between intrinsic and extrinsic factors for children with FASD, and importantly how these factors can be targeted for each individual child to improve their outcomes.

Table 2.1

*Summary of Self-Regulatory Studies Reviewed for Chapter Two*

| Author & Location | Design and Sample | Relevant Measures | Key Findings |
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| **Physiological regulation** | | | |
| Chen et al. (2012)<br><br>USA | *Case-control.* 33 children FASD using 4-digit Code (2 FAS; 3 pFAS; 7 SE/AE; 21 ND/AE), currently enrolled in a behavioural intervention ($M_{age}$ = 7.5). Comparison data drawn from a separate study N=418 of typically developing children ($M_{age}$ = 7.6). Alcohol use assessed retrospectively. | All caregivers completed Children's Sleep Habits Questionnaire (CSHQ); Sub-group (5 children with FASD who had elevated CSHQ scores) completed Polysomnography sleep assessment (PSG) | Caregivers of children with FASD reported higher levels of sleep complaints. 85% of children with FASD attainted a Total Score above the clinical cut-off for sleep dysfunction compared with 30% of the community sample. Fragmented sleep was seen among the 5 children with FASD who completed the PSG. |
| Haley et al. (2006)<br><br>USA | *Single group.* Part of a larger intervention study to reduce alcohol use during pregnancy. 55 infants 5 – 7mths of age. Separated into high (>2 d/wk) and low (1-2 d/wk) frequency drinking groups. Alcohol use assessed during and after pregnancy via interview. | Modified SFP Salivary Cortisol before, 20mins & 30mins after procedure. Heart rate and behavioural coding of negative affect during the procedure | PAE from conception to pregnancy recognition was related to increased cortisol reactivity, elevated heart rate and negative affect. Effects of PAE on cortisol activity was more pronounced for boys than girls. The effects of PAE on infant responsiveness were still sig. after controlling for maternal depression and annual income. |
| Havlicek et al. (1975)<br><br>Canada | *Case-control.* 3 day old infants, 26 heavy PAE (20 mothers diagnosed with "alcoholism" &14 infants displayed morphological abnormalities) & 26 without PAE matched for gestational age. Not described when alcohol use was collected. | EEG taken during spontaneous sleep. Compared across quiet sleep, indeterminate sleep and active-REM sleep. | Infants with PAE were reported to be more irritable, jittery and tremulous; displayed EEG hypersynchrony in all 3 stages of sleep and had more interrupted REM sleep compared to control infants. |

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| Jirikowic et al. (2016)<br><br>USA | *Case-control.* 9 moderate – heavy PAE (F-BAS binge score ≥4 or F-BAS daily score ≥ 24) & 9 no/low PAE. 6 – 15-month-old infants. Alcohol use assessed retrospectively. | SFP; Salivary cortisol taken at baseline, 15mins & 30-mins post SFP; Infant Toddler Symptom Questionnaire & Infant Behaviour Questionnaire-Revised | PAE group showed sig. higher cortisol at baseline & sig. decrease in cortisol from T1 to T2 compared to controls. During play and reunion infants with PAE showed sig. fewer social monitoring behaviours than control. No sig. difference in care-giver reports |
| Kable & Coles (2004)<br><br>USA | *Case-control.* Participants were part of a larger prospective cohort study. 6-mth old infants; 18 high risk PAE, 100 low risk defined using Maternal Substance Abuse Checklist. Alcohol use assessed retrospectively. | Heart rate and infant arousal using a scale adapted from the BNAS following presentation of auditory and visual stimuli. | High-risk infants took longer to respond to onset of visual and auditory stimuli. No differences in ability to sustain a decelerative HR response or in HR reactions to stimulus offset i.e. basic physiological reactions to register the event, initiation of the orienting response was slower in infants categorised as high-risk. High-risk infants were also rated as having higher arousal levels after all tasks. |
| Oberlander et al. (2010)<br><br>South Africa | *Case-control.* 3 day old infants heavy PAE (2 standard drinks/d or 14 drinks/wk or 1 incident of binge drinking i.e. more than 4 drinks per occasion); 14 No or light PAE (<7 standard drinks/w & did not binge drink). Alcohol use collected during 3rd trimester of pregnancy. | Salivary cortisol, heart rate, RSA and videotaped facial reactions collected before, during and after a heel lance blood collection & BNAS | Both groups HR increased with heel lance and decreased during the post-lance period. PAE group had lower mean HR than controls throughout & showed no change in RSA over time. Cortisol no change over time in controls but decreased in PAE infants. BNAS showed less arousal in the PAE group. |
| Ramsay et al (1996)<br><br>USA | *Prospective cohort.* 5 PAE & 9 no PAE tested at 2-mths. 6 PAE & 5 no PAE tested at 6-mths. Assigned to groups based on maternal report or meconium screen. Qualified for PAE group if any amount of alcohol was used during pregnancy. Alcohol use assessed retrospectively. | Salivary cortisol at baseline and 20-minute post a routine inoculation | Higher pre-stressor cortisol level found in PAE infants compared to the non-exposed infants at 2-mths of age. Trend for this also at 6-mths but was not sig. |

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| Rosett et al. (1979)<br><br>USA | *Case-control.* 3 day old infants. 14 heavy PAE (at least 5/6drinks on some occasions no less than 45drinks/mth); 8 heavy PAE but then reduced to moderate or abstained in 3rd trimester; 9 no PAE. Alcohol use assessed during pregnancy. | Bassinet sleep monitor that recorded sleep-wake states over a 24-hour period. | Continued heavy PAE group had sig. lower quality of quiet sleep and less duration between major body movements compared to unexposed group and sig. less sleep time compared to infants in the reduced exposure group. |
| Troese et al. (2008)<br><br>USA | *Single group.* 13 infants 6 – 8 wks of age. Alcohol use assessed during and after pregnancy using MAST, TWEAK & T-ACE split median to create high and low groups based on scores of pre-and pregnancy drinking. | EEG, videography and actigraphy<br><br>Mothers completed the Mother and Baby Scales | Pre-pregnancy rates of alcohol consumption correlated with maternal report of poor infant alertness and irritability. High PAE group showed increased sleep fragmentation e.g. frequency and duration of wakefulness and decreased active sleep and reductions in duration of sleep-related spontaneous movements |
| Wengel et al. (2011)<br><br>Canada | *Case-control.* 19 children FASD using Canadian guidelines (6 FAS; & 7 pFAS; 6 ARND); Recruited from FASD community support programs; 12 age-matched control children. 3 – 6 years of age. Alcohol use assessed retrospectively | Actigraphy<br><br>Sleep log<br><br>Children Sleep Habits Questionnaire<br><br>Sensory Profile | Overall sensory processing differences correlated with actigraphy for FASD and control group. FASD group had sig. more sleep disturbances, including bedtime resistance, shortened sleep duration, increased sleep anxiety and night awakenings compared to control children. Actigraphy revealed sig. longer sleep onset latency for FASD group compared to control group. |
| **Attentional regulation** | | | |
| Aragon et al. (2008)<br><br>Italy | *Case-control.* Part of larger prevalence study. 23 children FASD using revised IOM criteria (19 pFAS; 4 FAS) ($M_{age}$ = 6.13). 57 randomly selected control children in same grade at school ($M_{age}$ = 6.15). Alcohol use assessed retrospectively. | Items assessing Inattention, Hyperactivity/Impulsivity from Disruptive Behaviour Disorder Rating Scale translated to Italian. Completed by parents & teachers | Only teachers reported sig. more inattentive behaviours in the classroom compared to control children. Teacher ratings of hyperactivity/ impulsivity were not sig. different. |

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| Brown et al. (1991)<br><br>USA | *Case-control.* Part of a larger prospective study. 25 PAE throughout pregnancy; 22 PAE 1st trimester but stopped after an intervention in 2nd trimester; 21 randomly selected no PAE; ($M_{age}$ = 5yrs 10mths). Alcohol use assessed retrospectively. | CBCL & TRF. Observations during free play interaction between mother & child: assess child activity levels & interactional style. CPT & Impulsivity using matching familiar figures test. | Continued PAE group demonstrated deficits on the CPT task (higher omission errors) however when current maternal drinking was controlled for this was no longer sig. Hyperactivity and impulsive behaviour not found. Teachers reported children had attentional difficulties, however mothers did not report this. |
| Chiodo et al. (2010)<br><br>USA | *Prospective cohort.* 462 children tested at 7yrs. Mothers with known alcohol use Interviewed at each prenatal visit. | Sustained attention – Conners CPT<br><br>TRF | Children born to mothers 30yrs or older showed sig. deficits in attention on the CPT but not children born mothers <30yrs. No sig. relation between PAE and the TRF attention problems scale was found. |
| Jacobson et al. (1993)<br><br>USA | *Prospective cohort.* 403 infants assessed at 6.5, 12 and 13mths. Interviewed at each prenatal visit about alcohol use. Women who consumed alcohol reported av. 1.1oz AA/day (SD = 2.1, range = 0.01 – 24.8) | Mean Fixation during a novelty preference test and during a cross-modal transfer procedure | PAE was associated with longer fixation duration during both tasks. Suggesting slower information processing or impairments in the ability to disengage attention. |
| Kodituwakku et al. (2006)<br><br>Italy | *Case-control.* Part of larger prevalence study. 22 children with FASD using revised IOM criteria; 4 FAS, 17 pFAS & 1 ARND ($M_{age}$ = 6.8), 60 control children ($M_{age}$ = 6.7). Alcohol use assessed retrospectively. | Items assessing Inattention, Hyperactivity/Impulsivity from Disruptive Behaviour Disorder Rating Scale translated to Italian. completed by parents and teachers | Teachers and parents rated FASD group as having sig. more inattention and hyperactivity/impulsive behaviours than controls. Sig. greater proportion of children with FASD met DSM-IV criteria for ADHD inattentive type (2%control vs 55%FASD). Inattentive behaviours in FASD group were negatively correlated with teacher-rated language and math skills. No association found between hyperactivity and achievement scores. |
| Korkman et al. (1998)<br><br>Finland | *Case-control.* 46 children with PAE; 7 FAS, 13 FAE (criteria modified from Rosett, 1980) separated into 3 groups: stopped or reduced trimester 1 N = 16 ($M_{age}$ = 7); PAE during trimesters 1 & 2 N = 16 ($M_{age}$ = 6yrs, 8mths); PAE | NEPSY subtests: 5 that assessed Inhibition and Control; 1 subtest that assessed Sustained Concentration – Combined to | Children with PAE throughout pregnancy were found to display more difficulties on the Attention composite measure compared to the control group. |

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| | throughout pregnancy N = 14 ($M_{age}$ = 6yrs 11mths); 26 unexposed control children. Alcohol use assessed during pregnancy. | create an Attention composite score | |
| Sayal et al. (2009) England | *Prospective cohort.* 6355 children tested at 3.92yrs & then 5599 at 6.75yrs. 24% of mothers reported at least 1 occasion of binge drinking (≥4drinks/day). Alcohol use assessed during pregnancy. | SDQ | Consumption of ≥ 4drinks in a day during pregnancy was associated with greater risk of attention/hyperactivity problems for girls at 1st assessment and for both genders at second assessment. |
| Steinhausen et al. (1998) Germany | *Prospective cohort.* 2 subsamples of children diagnosed with FAS or FAE using Sokol & Clarren, 1989 recommendations. Group1 N= 29 $M_{age}$ = 5.6yrs; Group 2 n = 28 $M_{age}$ = 5.74yrs at 1st assessments. Alcohol use assessed during pregnancy. | Structured psychiatric interviews for preschool children | Attention deficits were the leading problem that was reported. |
| Streissguth et al. (1984) & (1986) USA | *Prospective cohort.* 452 children at 4yrs (1984) & 475 children at 7yrs (1986). Alcohol use assessed during pregnancy. | Sustained attention – CPT | *1984* – PAE was sig. associated with errors of omission, errors of commission & the ratio of correct/total responses *1986* – PAE was sig. associated with errors of commission, reaction time and vigilance errors summary scores. |
| **Emotional regulation** | | | |
| Lowe et al. (2006) USA | *Single group.* Part of larger alcohol reduction intervention study. 76 six-month old infants. Recruited if had risky drinking (cutoff ≥2 on TWEAK or ≥5 on AUDIT). Alcohol use assessed during pregnancy. | SFP coded for infant affect and maternal interaction | Infants had more positive affect when their mothers were more responsive. Female infants whose mothers drank more during pregnancy shower greater negative affect following the still-face procedure. |

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| Motz et al. (2013)<br><br>Canada | *Single group.* Part of larger longitudinal treatment evaluation study. 46 infants & children; 10 – 41mths ($M_{age}$ = 19.87mths); 54.35% had PAE. Mean 4.83 drinks/occasion during pregnancy. Alcohol use reported retrospectively. | Diagnostic Classification of Mental Health and Development Disorders of Infancy and Early Childhood Revised (DC:0-3R) | Almost 1/3 (32.6%) of children met criteria for an Axis I mental health diagnosis (with a total of 8 different diagnoses given); 2 children met criteria for multiple Axis I diagnoses. The majority of dyads (76.1%) were classified as exhibiting features of a disordered relationship, 4 dyads met criteria for an Axis II relationship disorder. |
| O'Connor et al. 1992, (1993) & (2001)<br><br>USA | *Prospective cohort.* 44 children 1yr old. Alcohol use reported retrospectively via questionnaire. 55% reported 2 or more drinks; 14% reported 4 or more drinks per occasion. 2001- Follow-up when children 5/6yrs of age. 41 mothers consented to participate. ($M_{age}$ = 5yrs 11mths) 27% 2 – 3 drinks; 27% 4 or more drinks max per occasion during pregnancy. | Strange situation & 4 mother-infant interactions (child playing with toys, child & mother playing together with toys; learning task & pack-up task) coded using the Mother-Child Rating Scales.<br><br>2001 - Child Depressive symptoms - Pictorial Depression Scale (PDS) | (1992) Children who were exposed to more alcohol prenatally displayed more negative affect in the parent-child interactions. Mothers of infants who displayed more negative affect were less elaborative and stimulating in their interactions and insecure attachment was more prevalent for these children. (1993) extended previous findings by adding influence on infant cognitive development. PAE was associated with negative infant affect, which influenced the mother-infant relationship and then related to infant cognitive performance.<br><br>(2001) Higher levels of PAE were related to higher levels of depressive symptoms when children reached 6yrs of age. Also, higher levels of PAE were related to higher levels of negative affect in 1yr old infants, who then showed higher levels of depression at 6yrs. |
| O'Connor et al. (2002) & (2006)<br><br>USA | *Single group.* 42 children 4-5yrs of age ($M_{age}$ = 4yrs 9mths). Mean maximum drinks per occasion during pregnancy was 4.55 drinks (SD = 6.11). Alcohol use reported retrospectively via an interview. | The family interaction puzzle task *2002* examined: mother supportive presence child negative affect & child coping; *2006* examined maternal emotional connectedness & child negative affect<br><br>The Attachment Q-Set (2002) Child Depressive symptoms - | (2002) PAE was highly related to attachment insecurity 80% of exposed children were insecure vs 36% of unexposed children were rated as having insecure attachment. PAE also predicted child negative affect, which was related to lower levels of maternal emotion support. (2006) PAE associated with more negative child affect, mothers of children with more negative affect were less emotionally connected to their child and those children had higher levels of depressive symptomatology. |

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| | | Pictorial Depression Scale; Mothers completed Beck Depression Inventory (2006) | |
| Savonlahti et al. (2005) Finland | *Case-control.* 14 high risk infants. Mothers were in residential treatment; 78% of mothers in the high-risk group reported using alcohol and/or drugs during pregnancy; 12 low-risk infants with no clinical risk factors reported. 6-mths of age. 10 reported alcohol use prospectively and 4 retrospectively. | Observations during free-play and feeding situations rated using the Parent-Child Early Relational Assessment | High risk infants displayed more withdrawn/depressed mood; less alertness/interest, reduced quality of exploratory play, attention abilities and focus on parent's emotional state. Dyadic difficulties were found particularly during the feeding situation, high-risk dyads had less Mutuality – considered important for infants to learn to improve self-regulation capacities through responsive interactions between mother and child. |
| **Behavioural regulation** | | | |
| Alvik et al. (2013) Norway | *Prospective cohort.* Drinking data available for 1003 mothers. Children tested at 5.5yrs of age. Drinking variable coded as binge drinking during 0-6wks (never; < once a wk, or ≥ once a wk). 222 children exposed to binge drinking > once a wk; 33 children exposed at least once per week. Alcohol use assessed during pregnancy. | SDQ completed by the mother. | Exposure to infrequent binge drinking (<once a wk) predicted Abnormal/Borderline scores on the SDQ Total and Hyperactivity/Inattention subscale. Exposure to frequent early binge drinking (≥once a wk) predicted Abnormal/Borderline Scores on SDQ Total, Emotional Problems, Conduct Problems and Hyperactivity/Inattention. |
| Bailey et al. (2004) USA | *Prospective cohort.* 556 children $M_{age}$ = 6.9yrs at testing. 56 children exposed to binge drinking. Alcohol use assessed during pregnancy. | Aggressive and delinquent behaviour scales from the TRF | Children who were exposed to binge drinking (≥ 5 drinks per occasion at least once every 2wks) were 2.5 times more likely to have clinically significant levels of delinquent behaviour |
| Chen et al. (2012) | *Prospective cohort.* 1618 children 23mths – 4yrs old (Mean age not reported) Mothers classified as non-drinkers, light to moderate drinkers (<3/4 days/mth) and | Modified version of the Rothbart Infant Behaviour Questionnaire produced three outcomes: | PAE was associated with an increase in infant difficultness. No associations found between positive mood and fearfulness. |

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| USA | heavy drinkers (>1/2 days/wk). Alcohol use reported retrospectively. | positive mood; fearfulness & difficultness | |
| Janzen et al. (1995)<br><br>Canada | *Case-control.* 10 children with FAS (using Sokol & Clarren, 1989 guidelines) $M_{age}$ = 4.39yrs; 10 typically developing children matched for age, gender & race. $M_{age}$ = 4.37yrs. Alcohol use reported retrospectively. | CBCL | Parents of FAS children endorsed a mean of 47.6 behaviour problem items compared to 17.9 items in the control group. Due to small sample size, few sig. differences on subscales. FAS girls were rated sig. higher on Social Withdrawal Scale. |
| Knudsen et al. (2014)<br><br>Norway | *Prospective cohort.* 56 682 18-month old infants & 46 756 36-month old toddlers. Risky drinking (T-ACE score ≥ 3 reported by 4% of mothers). Alcohol use assessed during pregnancy. | T-ACE obtained at gestation wk 17/18, 30wks, when child was 6mths, 18mths & 36mths<br><br>CBCL at 18mths or 36mths | PAE was associated with internalising and externalising behaviour at both 18 and 36mths. Controlling for pre-and-post-natal drinking & maternal psychopathology significant associations were only found for internalising behaviour problems at 36mths. |
| Nayak et al. (2012)<br><br>India | *Case-control*. 26 children diagnosed with FASD using 4-digit code 2 FAS; 4 pFAS ($M_{age}$ = 6.21) (rate of other diagnoses not reported), 27 control children ($M_{age}$ = 6.16). Alcohol use reported retrospectively. | CBCL 4yrs+<br><br>MINI international Neuropsychiatric Interview for Children 2 – 3yr olds. | FASD group had sig. higher mean score on CBCL Total<br><br>Conduct Disorder diagnosis higher in FASD group, but did not reach sig. (42.6% vs 22%, respectively) |
| Nulman et al. (2004)<br><br>Canada | *Case-control.* 51 children exposed to binge drinking during 1st trimester; 51 unexposed children. Drinking variable coded as 0 drinks, 1-5binges & >6 binges. 52 children 37mths or under; 44 were 7yrs or below & 6 children were 7yrs or over (mean age not reported). Alcohol use assessed retrospectively. | Toddler Temperament Scale for children 1 – 3yrs and Behavioural Style Questionnaire for older children. Both provide 9 scales: Activity, Regularity of Routines, Approach, Adaptability, Intensity of Response, Mood, Persistence, Distractibility and Response Threshold. | The >6 binge group displayed sig. higher scores on 3 of the scales compared to the other groups which did not differ. Approach scale found high binge group were more likely to approach unfamiliar people; Adaptability scale found that high binge group were more willing to go to strangers and more easy-going; Distractibility scale found high binge group had more difficulty disengaging from tasks. |

| | | | |
|---|---|---|---|
| Steinhausen et al. (2003)<br><br>Germany | *Case-control.* 12 children FAS ($M_{age}$ = 6yrs 7mths); 26 children FAE ($M_{age}$ = 6yrs 2mths) (Sokol & Clarren, 1989 diagnostic criteria used); 15 matched control children ($M_{age}$ = 6yrs 7mths). Alcohol use assessed retrospectively. | Developmental Behaviour Checklist (DBC) completed by primary caregiver | Sig, differences between alcohol-exposed children and controls on 5 of the 6 subscales of the DBC. Alcohol exposed children in both groups scored higher on Disruptive, Self-absorbed, Anxiety, Antisocial Behaviour and Communication Disturbance scales. No differences between any groups on the Autistic scale. DBC profile for the 2 alcohol exposed groups did not differ. |
| **Executive regulation** | | | |
| Burden et al. (2005)<br><br>Jacobson et al. (2004)<br><br>USA | *Prospective cohort.* 337 mothers assessed. 20 heavy PAE (at least 1 oz AA/day); 25 moderate (at least 0.5oz AA/day); 54 reportedly no PAE. Mothers interviewed at each prenatal clinic visit regarding alcohol use. Neuropsychological tests conducted at 7.5yrs of age. Alcohol use assessed during pregnancy. | *Burden:* Sustained attention – CPT; Focused attention – Digit Cancellation & Coding; EF – WCST Category Fluency & Tower of London; Working Memory – Digit Span, Arithmetic, Corsi, Seashore Rhythm. *Jacobson:* WISC-III Freedom from Distractibility (FD) i.e. working memory | *Burden:* PAE was associated primarily with poor Working Memory and EF scores i.e. Digit Span, Tower of London, Arithmetic, Seashore Rhythm and. These scores were still sensitive to PAE after controlling for IQ. With the exception of the Tower of London test, effects of PAE were on WM were stronger for mother aged 30yrs and older. *Jacobson:* PAE was related to FD scores in the overall sample and stronger effect among women over 30yrs was reported with each additional ounce of AA/day during pregnancy was associated with a 5.6 decrease on FD. |
| Fuglestad et al. (2015)<br><br>USA | *Case-control.* 39 children with FASD using revised IOM criteria. 5 FAS; 18; pFAS; 16 ARND. 50 age-matched non-exposed controls 3 – 5.5yrs; $M_{age}$ = 4.4. EF scale also compared to separate normative data set N= 1400. Alcohol use assessed retrospectively. | EF scale for Early Childhood – assesses Cognitive Flexibility<br><br>Delay of Gratification task | Children with FASD had impairments on the EF scale and more impulsivity on the Delay of Gratification task compared to age matched control group. FASD group performed below mean on EF scale compared to normative data set. Children with FAS had largest EF deficits, followed by those with pFAS and then ARND. |
| Kodituwakku et al. (2006)<br><br>South Africa | *Case-control.* 62 children with FAS using revised IOM criteria ($M_{age}$ = 7.63); 61 control children matched for age, gender, | Letter and category fluency tasks from the NEPSY – adapted for Afrikaans language. | FAS group generated fewer words in both conditions compared to control group. FAS group had greater difficulty with letter fluency compared to category fluency. |

| | | | |
|---|---|---|---|
| | ethnicity and SES ($M_{age}$ = 7.55). Alcohol use assessed retrospectively. | | FAS group demonstrated linear age-related changes in both fluency conditions. |
| Rasmussen & Bisanz (2011)<br><br>Canada | *Case-control.* 21 children with FASD using 4-digit code (break down of diagnoses not reported) ($M_{age}$ = 5.8); 20 typically developing control children ($M_{age}$ = 5.1). Alcohol use assessed retrospectively. | Working memory test battery for children<br><br>2 mathematics subtests from the Woodcock-Johnson-III Test of Achievement | FASD group performed sig. lower on Digit Recall, Word List Recall, non-word list recall and on the 2 math subtests compared to control group. Measures of math performance were frequently correlated with working memory and these were sig. more often in the FASD group. |

*Note:* BNAS = Brazelton Neonatal Behavioural Scale; PAE = Prenatal Alcohol Exposure; CBCL = Child Behaviour Checklist; TRF = Teacher Report Form; SDQ = Strengths and Difficulties questionnaire; EEG = electroencephalogram; WISC-III = Wechsler Intelligence Scale for Children – Third Edition; BNAS; RSA= Respiratory Sinus Arrhythmia; HR = Heart Rate; SFP = Still Face Paradigm; PSG = Polysomnography sleep assessment; CPT = Continuous Performance Test; WCST = Wisconsin Card Sorting Test

## Chapter 3: Statement of Contribution and Co-Authored Published Paper

This chapter includes a co-authored paper which has published in a peer reviewed journal. See Appendix B for the published version of this paper. The bibliographic details of the co-authored paper are:

**Reid, N**., Shelton, D., Warner, J., O'Callaghan, F., & Dawe, S. (2017). Profile of children diagnosed with a fetal alcohol spectrum disorder: A retrospective chart review. *Drug and Alcohol Review.*

The candidate's contribution to the paper involved conception of the study design, data collection and analyses, and writing of the manuscript. Co-author three provided assistance with collecting participant consent and critical review of drafts. All other co-authors provided supervisory advice and critical review of drafts.

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5. Professor Sharon Dawe

# Chapter 3
# Profile of Children Diagnosed with a Fetal Alcohol Spectrum Disorder: A Retrospective Chart Review

The term fetal alcohol spectrum disorder (FASD) is used to describe the broad spectrum of disabilities that can result from prenatal alcohol exposure (Cook et al., 2016). Prevalence estimates of FASD vary considerably due to methodological differences across studies (Roozen et al., 2016). Recent estimates in the USA suggest a total FASD prevalence of 24 to 48 per 1000 children (May et al., 2014), although for particular sub-populations these rates are considerably higher (Fitzpatrick et al., 2015; Ospina & Dennett, 2013). Over the past 20 years, multidisciplinary FASD diagnostic clinics have been established in many countries including, Canada, USA, New Zealand and most recently, Australia. Diagnostic processes have evolved over time and there are now a number of published diagnostic guidelines available. These include, the 4-Digit Diagnostic Code (Astley, 2004), the updated Institute of Medicine guidelines (Hoyme et al., 2005), the updated Canadian Guidelines (Cook et al., 2016) and most recently the Australian Guide to the Diagnosis of FASD (Bower & Elliott, 2016). The 4-Digit Code (Astley, 2004) is a widely used diagnostic system in which FASD is viewed as an umbrella term to encompass the diagnostic categories (e.g., FAS, pFAS, static encephalopathy). The Australian Guide (Bower & Elliott, 2016), following the updated Canadian guidelines (Cook et al., 2016), now uses FASD as a diagnostic term and divides diagnosis into two categories: (i) FASD with three sentinel facial features and (ii) FASD with less than three sentinel facial features.

Growing recognition of FASD across policy and service delivery platforms in Australia led to the establishment of a specialist service for young children within a state government-funded health care system. The service was the first of only four services currently available in Australia, and the only publically provided service in Queensland. The aim of the current study was threefold: (i) to report on the diagnostic

profile of a group of children diagnosed with FASD; (ii) to document the extent to which there were comorbid diagnoses; and (iii) to provide information on the neurocognitive functioning of children who were diagnosed with FASD.

## Method

### Assessment process

Children were referred to the service by general practitioners if there were concerns regarding behaviour or development and reports from caregivers or documented evidence of prenatal alcohol exposure. The multidisciplinary team provides assessment, diagnosis and follow-up as follows: (1) a comprehensive clinical intake with the family, liaison with health care providers, education and, if necessary, statutory child protection services and review of all available medical, developmental and educational records; (2) an assessment of the key FASD features to derive a diagnosis using the 4-Digit Code (one and a half to two days of assessment per child); (3) a comprehensive report written by the multi-disciplinary team and discussed with caregivers and health care providers; (4) a school meeting to develop an educational support plan; and (5) long-term follow-up by the paediatrician as required. The clinic had the capacity to assess two children per month.

### Diagnosis using the 4-Digit Diagnostic Code

This study predated the release of the Australian Guide to the diagnosis of FASD. The 4-Digit Code was one of the most extensively researched diagnostic guidelines available. One Clinical Psychologist attended training with the Washington State FAS Diagnostic Prevention Network and all other members of the multi-disciplinary team completed the 4-Digit Code online training course and training in North America in harmonisation of the 4-Digit Code and the Revised IOM criteria. The four digits of the code reflect the four key diagnostic features of FASD: (1) growth deficiency, (2) facial phenotype, (3) central nervous system (CNS) structural/functional

abnormalities, and (4) prenatal alcohol exposure. The degree of expression of each of these features is ranked independently on a 4-point Likert scale, with 1 reflecting the absence of the feature and 4 reflecting the strong presence of the feature. Further, facial phenotype was assessed using FAS Facial Photographic software (Astley, 2015). See Appendix C for the Supplementary Tables S1, S2, S3 and S4 for further explanation regarding diagnosis using the 4-Digit Code.

**Procedure**

This was a retrospective study approved by the Queensland Health Human Research Ethics Committee and conducted by the diagnostic service. This was a convenience sample; families who had previously been assessed by the service or current clients provided written consent to be included in the study. A pre-formulated spreadsheet detailing the relevant demographic and diagnostic data was designed, a chart review was performed by the first author, and the required data was extracted.

## Results

There were 37 children assessed between March 2014 and December 2015, and 31 families consented to be included. Six families could not be contacted due to a range of difficult life circumstances (e.g., placement breakdowns, death of family members). The mean age of the children was 8.5 years (range 6 – 13 years; *SD* = 1.71). Seventeen children were Caucasian Australian, 10 children from Aboriginal or Torres Strait Islander backgrounds and four children from other varied backgrounds. Eleven caregivers were foster parents, eight were legal guardians (i.e., foster or kinship caregivers who had long-term full parental responsibilities for a child), five were adoptive or kinship caregivers and the remaining seven were biological parent(s). The majority of children in the current sample had experienced one care placement (16); the remaining eight had experienced two or more placements. Fourteen caregivers reported that their child had experienced trauma or neglect during their lifetime.

**Diagnostic profile**

All children received a diagnosis of FASD; eleven children were each diagnosed with Static Encephalopathy Alcohol Exposed (SE/AE; 35%) or Neurobehavioral Disorder Alcohol Exposed (ND/AE; 35%). One child was diagnosed with Fetal Alcohol Syndrome (FAS); five children with pFAS; and one child was diagnosed with Sentinel Physical Findings/ND/AE. Two other diagnoses were "alcohol exposure unknown" (ND/alcohol exposure unknown & SE/alcohol exposure unknown), thus a Rank 2 (Unknown Risk) was given (Table 3.1).

**Comorbid diagnoses**

Twenty-six children (84%) had a comorbid diagnosis, of which the most common was attention-deficit hyperactivity disorder (19 children). The next most prevalent comorbid conditions were Intellectual Disability (7 children) and Autism Spectrum Disorder (4 children).

**Neurocognitive functioning**

Although the majority of children were not found to display growth deficiency or significant facial features, 18 children (58%) were found to have significant CNS dysfunction, thus receiving a Rank 3 on the 4-Digit Code (see Tables 3.1 & 3.2). Mean Full Scale Intelligence Quotient (FSIQ) on the Wechsler Intelligence Scale for children (WISC-IV) was found to be 85.7 [Low Average] (*SD* = 17.9, range 49 [Extremely Low] – 123[Superior]). The Mean General Adaptive Composite (GAC) on the Adaptive Behaviour Assessment System-Second Edition (ABAS-2) was 67.5 [Extremely Low] (*SD* = 15.3, range 41[Extremely Low] – 104[Average]). This indicates a significant difference between children's general cognitive and adaptive abilities, $t(27) = 5.2$, $p < 0.01$. Over 90% of children scored in the Clinical Range for behaviour problems (T score > 63) on the Child Behaviour Checklist (see Table 3.3).

Table 3.1.

*Growth, Facial, CNS Outcomes and Alcohol/other Substance Exposure*

| Characteristic | | Frequency |
|---|---|---|
| Growth deficiency Rank | | |
| | Rank 1 | 24 |
| | Rank 2 | 4 |
| | Rank 3 | 3 |
| FAS facial phenotype Rank | | |
| | Rank 1 | 9 |
| | Rank 2 | 15 |
| | Rank 3 or 4 | 7 |
| Philtrum Smoothness Rank | Rank 1-very deep | <3 |
| | Rank 2- somewhat deep | 3 |
| | Rank 3- normal | 15 |
| | Rank 4- moderately smooth | 13 |
| | Rank 5- completely smooth | <3 |
| Upper Lip Thinness Rank | | |
| | 1-very thick or 2 moderately thick | 5 |
| | 3- normal | 18 |
| | 4- moderately thin or 5- very thin | 8 |
| Z-scores for Mean Palpebral Fissure Lengths | ≤ -2 SD | 11 |
| | >-2SD and ≤ -1SD | 7 |
| | > -1SD | 13 |
| Probability of CNS dysfunction Rank | | |
| | 1 No evidence of damage | <3 |
| | 2 - Mild to Moderate | 13 |
| | 3 Significant or 4 Definite Dysfunction | 18 |
| Prenatal alcohol exposure rank | | |
| | 2 –unknown level of exposure | <3 |
| | 3- confirmed moderate | 14 |
| | 4 – confirmed high | 15 |
| Source of alcohol information | | |
| | Biological mother | 10 |
| | Person who directly observed mother | 8 |
| | Other source (e.g. medical, legal records) | 11 |
| Exposure to other substances in-utero | | |
| | tobacco | <3 |
| | cannabis | <3 |
| | solvents | <3 |
| | Polydrug use (e.g., methamphetamine, cannabis, tobacco) | 17 |
| | no known other exposure | <3 |
| | unknown | 8 |

Table 3.2.

*Functional CNS Outcomes*

| Domain | Level of dysfunction – Frequency | | |
|---|---|---|---|
| | Rank 1 – Normal Range | Rank 2 – Mild to Moderate impairment | Rank 3- Significant impairment |
| Soft neurological signs | 12 | 16 | 3 |
| Cognitive | 11 | 6 | 14 |
| Communication | 11 | 8 | 12 |
| Academic | 8 | 9 | 14 |
| Memory | 11 | 12 | 8 |
| Executive Functioning | <3 | 16 | 15 |
| Attention | <3 | 12 | 17 |
| Adaptive, Social behaviour | 0 | 16 | 15 |

*Note:* Ranking based on scores on standardised assessments; Rank 1 = scores falling within 1 Standard deviation (SD) either side of the mean; Rank 2 = Scores > 1 but < 2 SDs below the means; Rank 3 = Scores equal to or > 2 SDs below the mean.

Table 3.3.

*Frequency of Child Behaviour Checklist Outcomes*

| Scales and Subscales | Clinical Range | Borderline Range | Normal Range |
|---|---|---|---|
| Total | 28 | 0 | <3 |
| Internalising Problems | 16 | 6 | 8 |
| Externalising Problems | 27 | <3 | <3 |
| Anxious/Depressed | 8 | 7 | 14 |
| Withdrawn/Depressed | 7 | 7 | 15 |
| Somatic Complaints | 6 | 4 | 19 |
| Social Problems | 16 | 6 | 7 |
| Thought Problems | 19 | <3 | 9 |
| Attention Problems | 19 | 5 | 5 |
| Rule-breaking Behaviour | 14 | 6 | 10 |
| Aggressive Behaviour | 17 | 5 | 8 |

*Note:* Total, Internalising & Externalising: Clinical Range = T-score > 63, Borderline Clinical Range = T-score 60 – 63; Subscales: - Clinical Range = T-score > 69, Borderline Clinical Range = T-score 65 – 69; All scales/subscales N = 30 except Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems & Attention Problems N = 29; Note there was 1 missing CBCL report and 1 report missing some data that that could not be included.

## Discussion

The current study describes the profile of children who have been referred to the first FASD diagnostic service permanently operating within a public Australian health service. The diagnostic profile and associated features were consistent with previous reports that have also implemented the 4-Digit Code (e.g., Astley, 2010, 2013).

Notably, the majority of children did not have the physical features of FASD, a finding that is markedly similar to a major US study of 1,400 individuals with prenatal alcohol exposure, where 4% were diagnosed with FAS; 7% pFAS; 28% SE/AE; and 52% ND/AE (Astley, 2010). It is important to note that the range of diagnoses found in this and other studies of clinical outcomes are not always assessed in prevalence studies. For example, the only published Australian prevalence study to date, using active case ascertainment, reported only FAS and pFAS (Fitzpatrick et al., 2015). It is likely that higher rates of FASD will be found in similar, highly exposed Australian populations when including the full range of diagnoses in the FASD spectrum.

Comorbid diagnoses are frequently found for children with FASD (e.g., Astley, 2010) with approximately half having a diagnosis of ADHD (e.g., Popova et al., 2016). Similar results were obtained in this Australian sample, highlighting the importance of considering both diagnoses when children present to a range of health professionals. Again consistent with overseas findings (e.g., Astley, 2010), the majority of children experienced significant CNS dysfunction and significant delays in their adaptive behaviour compared to their IQ performance. Notably, having fewer physical features of FASD and a higher IQ has been associated with more behavioural problems (Fagerlund, Autti-Rämö, Hoyme, Mattson, & Korkman, 2011) and poorer long-term outcomes (Streissguth et al., 2004).

Additionally, children performed poorly on a range of tests assessing executive functions (EF) with none receiving a ranking in the normal range. As these difficulties may underpin adaptive functioning impairments (Schonfeld et al., 2006), identification and remediation is extremely important to avoid life-long difficulties across multiple domains. The growing evidence base indicates that amelioration of these difficulties is possible (Reid et al., 2015), highlighting the importance of accurate diagnosis and access to appropriate supports.

Finally, it is important to consider the potential compounding effects of other negative psychosocial risk factors (Henry, Sloane, & Black-Pond, 2007). In keeping with previous studies (e.g.,Streissguth et al., 2004), a large proportion of children in the current study had also experienced exposures to other substances prenatally, childhood trauma or neglect, and sometimes multiple care placements. Thus, service development and treatment planning needs to consider the range of adversities children and their families may have experienced. Importantly, receiving an early FASD diagnosis has been found to be an important protective factor for children against potential adverse life outcomes, such as incarceration, drug/alcohol, and mental health problems (Streissguth et al., 2004).

The strengths of the current study are that it involved a well-validated diagnostic system, which included a comprehensive multi-disciplinary assessment and provided the first clinic-based outcomes on a sample of Australian children diagnosed with FASD. However, the total number of children reported in this study is small and patterns may change with a larger sample. Detailed information regarding specific patterns of alcohol consumption during pregnancy was not available as many children were in foster care.

While prevention of FASD remains a vital public health concern, it is imperative that the assessment and diagnosis of FASD is expanded in Australia. The recent release of the Australian Guide to the Diagnosis of FASD (Bower & Elliott, 2016b) may provide the impetus for future development of services. Importantly, the current study demonstrates that the establishment of a multi-disciplinary FASD assessment and diagnostic service can be embedded within an existing Child Development Service, once appropriate training in diagnosis has been obtained.

## Chapter 4: Statement of Contribution and Co-Authored Published Paper

This chapter includes a co-authored paper which has been published in an international peer reviewed journal. See Appendix D for a copy of the published paper in its original format. The bibliographic details of the co-authored paper are:

**Reid, N.,** Dawe, S., Shelton, D., Harnett, P., Warner, J., Armstrong, E., LeGros, K., & O'Callaghan, F. (2015). Systematic review of fetal alcohol spectrum disorder interventions across the life span. *Alcoholism: Clinical and Experimental Research, 39(12),* 2283 – 2295.

The candidate's contribution to the paper involved conception of the study design, systematic searching and screening of articles, extraction of study data, quality ratings of studies and writing of the manuscript. Co-author two provided supervisory advice, quality ratings of studies and critical review of drafts. Co-authors three, four and eight provided supervisory advice and critical review of drafts. Co-authors five and six provided critical review of drafts and co-author six provided assistance with screening of articles and critical review of drafts.

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# Chapter 4: Systematic Review of Fetal Alcohol Spectrum Disorder Interventions across the Life Span

Fetal alcohol spectrum disorder (FASD) is an umbrella term that refers to the spectrum of damage that can occur due to prenatal alcohol exposure (Chudley et al., 2005). The consequences can be profound for affected individuals, with impairments experienced in all areas of social, behavioural and cognitive functioning. Prevalence rates vary; with the most recent review suggesting that 2-5% of the US population were affected by FASD (May et al., 2014). Ospina and Dennett (2013) highlighted the high rates of FASD in foster care settings (305 to 520 per thousand) and the considerable variability in rates in Aboriginal populations. This finding was reflected in a recent Australian study of a remote Indigenous population; prevalence rate of 120 per 1,000 (Fitzpatrick et al., 2015). While primary prevention is critically important in reducing the incidence of FASD, there is a growing recognition that diagnosis and intervention may ameliorate some of the difficulties that result from prenatal alcohol exposure (Kodituwakku & Kodituwakku, 2011). In many high income countries such as Australia (Australian Government, 2013), Canada (Public Health Agency of Canada, 2005) and the USA (Olson, Ohlemiller, et al., 2009) policy development has emphasized the importance of secondary prevention through better diagnosis and intervention for individuals with FASD.

Despite this clear imperative, relatively few treatment studies exist in the field. A systematic review by Peadon, Rhys-Jones, Bower, and Elliott (2009) evaluated the impact of pharmacological (n = 2) and non-pharmacological (n = 10) interventions for children. This review included randomised controlled trials (RCT), quasi RCTs, non-randomized controlled trials, and cohort studies with pre-and post-intervention measurements. Meta-analysis was not possible because of the highly variable nature of the interventions, leading the authors to conclude that there was currently a lack of good

quality evidence for specific interventions for children with FASD. Subsequently, there has been a number of narrative reviews of interventions for children and adolescents with FASD (Kodituwakku, 2010; Olson, Oti, Gelo, & Beck, 2009; Petrenko, 2015). Importantly, Olson, Oti, et al. (2009) and Kodituwakku (2010) proposed theoretical frameworks to guide the development of interventions. Olson, Oti, et al. (2009) integrated developmental and family systems theory and Kodituwakku (2010) presented a neurodevelopmental framework in which it was proposed that early intervention in self-regulation and attention is likely to have more far-reaching effects than specific training in other domains. More recently, Petrenko (2015) has called for a unification of these conceptual frameworks and the inclusion of information from the lived experiences of parents and individuals with FASD.

The current systematic review expands upon these previous reviews in three ways. First, we include intervention studies that were identified by Peadon et al. (2009) as in progress or recently completed at the time of their review. Second, we assess the methodological quality of interventions using a standardised assessment rating tool. Third, we take a lifespan developmental perspective, rather than restricting our focus to children. Since the impact of prenatal alcohol exposure is life-long, there is a growing consensus that the needs of individuals should be considered from such an approach in order to investigate the potential to ameliorate difficulties and to improve wellbeing for all individuals with FASD.

## Methods

This systematic review has been reported in line with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Liberati et al., 2009; Moher et al., 2009). Details of the protocol for this systematic review were registered with PROSPERO (CRD42014015188).

**Inclusion Criteria**

Studies were considered for the review if (a) the target population consisted of individuals of any age with prenatal alcohol exposure that included Fetal Alcohol Syndrome (FAS); partial Fetal Alcohol Syndrome (pFAS); Alcohol-Related Neurodevelopmental Disorder (ARND) or prenatal alcohol exposure (PAE); (b) the intervention could be classified as primarily focusing on improving well-being and functioning through the provision of behavioural treatment, advocacy or support (thereby excluding pharmacological interventions); (c) quantitative measures of functioning were reported in order that comparisons could be made about potential gains. No restrictions were placed on the type of outcomes or study design.

**Search Strategy and Study Selection**

Studies were identified during December 2014 from the following electronic databases: PsycInfo, Medline, Scopus, Web of Knowledge CINAHL, ERIC and The Cochrane Central Register of Controlled Trials. Search terms were [‘fetal alcohol spectrum disorder’ OR ‘fetal alcohol syndrome’ OR ‘alcohol-related neurodevelopmental disorder’] AND [‘intervention’ OR ‘treatment’ OR ‘therapy’]. No date, document type or language restrictions were placed on the searches. Forty FASD organisations were identified and webpages searched to locate non-peer reviewed intervention trials that could be included (see Appendix E for the included supplementary table).

Two reviewers independently screened the title and abstract of each reference identified by the searches and determined the potential relevance of each article. For potentially relevant articles or, in cases of disagreement, the full article was obtained, independently inspected and inclusion criteria applied.

**Study Quality Assessment**

The methodological rigor of the included studies was assessed using the Effective Public Health Project (EPHPP) assessment tool. The tool was developed to assess primary studies in public health (Thomas, Ciliska, Dobbins, & Micucci, 2004) and is based on guidelines set out by Mulrow and Oxman (1994) and Jadad et al. (1996). The EPHPP tool consists of six quality components: selection bias, study design, confounders, blinding, data collection methods and withdrawals and drop-outs. Each study was rated on these components as “strong”, “moderate”, or “weak” (see Table 4.1 for an overview of the EPHPP tool). Jüni, Witschi, Bloch, and Egger (1999) recommend that relevant methodological aspects of studies should be individually assessed and a total score should not be used. Therefore, an overall rating of the quality of the studies was not carried out. The quality assessment was undertaken independently by two reviewers and any disagreements were resolved by discussion.

Table 4.1

*Quality Assessment Components and Ratings for EPHPP Instrument*

| **Components** | **Strong** | **Moderate** | **Weak** |
|---|---|---|---|
| Selection bias | Very likely to be representative of the target population and greater than 80% participation rate | Somewhat likely to be representative of the target population and 60 – 79% participation rate | Not likely to be representative (i.e. self-referred), less than 60% participation rate or not stated |
| Design | RCT and CCT | Cohort analytic, case-control, cohort, or an interrupted time series | All other designs or designs not stated |
| Confounders | Controlled for at least 80% of confounders | Controlled for 60 – 79% of confounders | Confounders not controlled for, or not stated |
| Blinding | Blinding of outcome assessor and study participants to intervention status and/or research question | Blinding of either outcome assessor or study participants or blinding is not described | Outcome assessor and study participants are aware of intervention status and/or research question |
| Data collection methods | Tools are valid and reliable | Tools are valid but have not been shown to be reliable | No evidence of validity or reliability |
| Withdrawals and dropouts | Follow-up rate of >80% of participants | Follow-up rate of 60-79% of participants | Follow-up rate of <60% of participants or withdrawals and dropouts not described |

*Note:* RCT = randomised controlled trial; CCT = Controlled Clinical Trial

**Data Extraction and Synthesis**

Considerable heterogeneity in both the nature of the interventions and the measures used in the studies precluded the use of meta-analysis (Higgins & Green,

2011); therefore, a narrative synthesis method was used. Data were extracted systematically using a pre-formulated tool consisting of study design, sample size and population, intervention approach and main results. The studies were subsequently grouped according to key outcome domains and reported within a lifespan perspective by looking first at those studies focusing on early infancy, then early to middle childhood and, finally, adolescence and adulthood.

## Results

### Study Characteristics

The electronic database search located 2962 citations (after duplicates were removed) which then underwent title and abstract screening. An additional five sources were included after an examination of reference lists and another two reports were found from the Internet searches of relevant FASD organisations' publication libraries. A full text review by two reviewers was undertaken for 51 studies; 29 met study inclusion criteria (see Figure 4.1 for detailed information). An updated database search conducted prior to submission identified an additional three studies, resulting in a final total of 32 studies (Table 4.2).

The vast majority of studies investigated the effectiveness of interventions that targeted aspects of neurocognitive functioning. Of these, two studies aimed to improve developmental outcomes in infants. Six studies targeted underlying self-regulatory deficits, or attentional control. Nine studies focused on specific areas of dysfunction, such as math skills (n = 3), language and literacy skills (n = 2), fire/street safety skills (n = 2), memory rehearsal (n = 1) and motor skills (n = 1). Six studies addressed social skills and three studies aimed to improve children's behaviour and reduce parental stress by providing structured parenting programs. A further four studies provided education and advocacy knowledge for parents and caregivers (n = 2),

teachers (n =1) and child welfare workers (n = 1) and the final two studies were both aimed at supporting parents who were themselves affected by PAE.

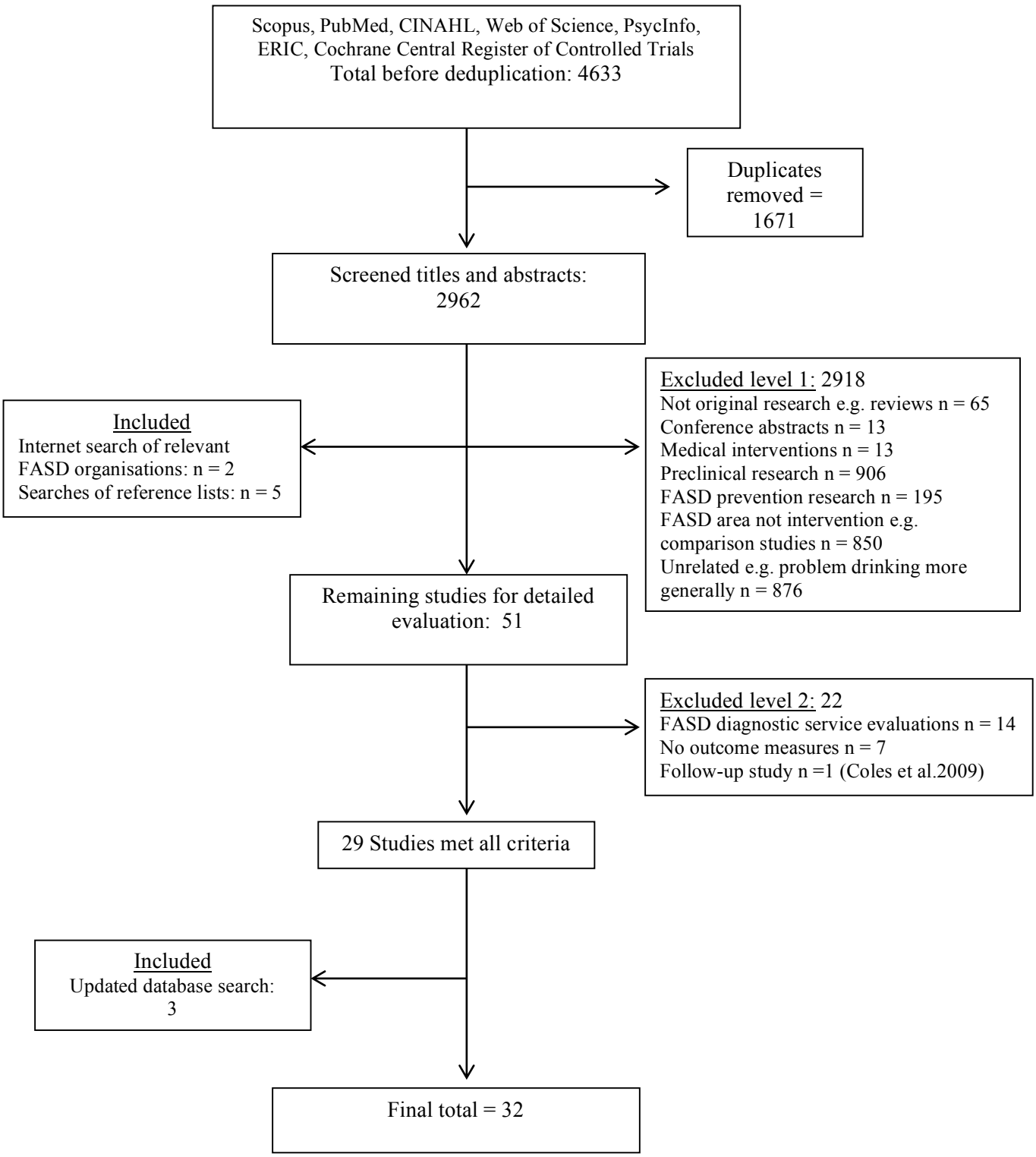


*Figure 4.1* Study Selection Flow Chart

**Quality Rating**

The details of the quality ratings for the included studies are shown in Table 4.3. It is notable that none of the studies received a rating of "strong" for the component of "selection bias" or "blinding." Nineteen of the studies were rated "strong" in study design; this reflects the number of RCTs and CCTs in the identified studies. Twenty-seven of the studies, across all study design types, used measures that were reliable and valid. Seventeen studies reached the criteria to be scored as "strong" for Withdrawal/drop-outs.

Table 4.3

*Quality Assessment Results for Included Studies*

| Author/Date | Selection Bias | Study Design | Confounders | Blinding | Data collection methods | Withdrawals /drop outs |
|---|---|---|---|---|---|---|
| *Developmental Outcomes in Infants* | | | | | | |
| Kartin et al. (2002) | Moderate | Strong | Strong | Moderate | Strong | Strong |
| Yazdani et al. (2009) | Moderate | Weak | Strong | N/A | Strong | N/A |
| *Self-regulation and Attentional Control* | | | | | | |
| Nash et al. (2014) | Weak | Strong | Strong | Moderate | Strong | Strong |
| Wells et al. (2012) | Moderate | Strong | Strong | Moderate | Strong | Strong |
| Soh et al. (2015) | Weak | Strong | Strong | Moderate | Strong | Moderate |
| Kerns et al. (2010) | Weak | Moderate | N/A | N/A | Strong | Strong |
| Vernescu. (2008) | Moderate | Strong | Strong | Moderate | Strong | Strong |
| Adnams et al. (reported in Riley et al., 2003) | Moderate | Strong | Weak | Moderate | Strong | Strong |
| *Specific Skills* | | | | | | |
| Kable et al. (2007) | Weak | Strong | Strong | Moderate | Strong | Strong |
| Kable et al. (2015) | Weak | Strong | Strong | Moderate | Strong | Strong |
| Millians et al. (2014) | Moderate | Weak | N/A | N/A | Strong | N/A |
| Coles et al. (2007) | Weak | Strong | Strong | Moderate | Moderate | Strong |
| Padgett et al. (2006) | Moderate | Weak | N/A | N/A | Moderate | N/A |
| Adnams et al. (2007) | Moderate | Strong | Strong | Moderate | Strong | Strong |
| Loomes et al. (2008) | Moderate | Strong | Strong | N/A | Strong | Strong |
| Gryiec et al. (2004) | Moderate | Moderate | N/A | N/A | Strong | N/A |
| Keiver et al. (2015) | Weak | Strong | Strong | N/A | Strong | Strong |
| *Social Skills* | | | | | | |
| Timler et al. (2005) | Moderate | Weak | N/A | N/A | Strong | N/A |
| O'Connor et al. (2006) | Weak | Strong | Strong | Moderate | Strong | Strong |
| Keil et al. (2010) | Weak | Strong | Strong | Moderate | Strong | Strong |

| | | | | | | |
|---|---|---|---|---|---|---|
| O'Connor et al. (2012) | Moderate | Strong | Strong | Moderate | Strong | Moderate |
| Meyer (1998) | Weak | Weak | N/A | N/A | Strong | N/A |
| Sparks-Keeney et al. (2011) | Moderate | Moderate | N/A | N/A | Strong | Moderate |
| *Parenting Skills* | | | | | | |
| Olson et al. (reported in Bertrand, 2009) | Moderate | Strong | Weak | Moderate | Strong | Strong |
| Gurwitch et al (reported in Bertrand, 2009) | Weak | Strong | Weak | Moderate | Strong | Weak |
| Kable et al. (2012) | Moderate | Strong | Weak | Moderate | Strong | Moderate |
| *Support, Education and Advocacy* | | | | | | |
| Leenaars et al. (2012) | Moderate | Weak | N/A | N/A | Moderate | N/A |
| Pelech et al. (2012) | Moderate | Moderate | Strong | Moderate | Strong | Moderate |
| Clark et al. (2014) | Moderate | Strong | Weak | Moderate | Strong | Strong |
| Hume et al. (2009) | Weak | Moderate | N/A | N/A | Moderate | Weak |
| *Supporting Parents who have FASD* | | | | | | |
| Denys et al. (2011) | Moderate | Weak | N/A | N/A | Moderate | N/A |
| Grant et al. (2004) | Moderate | Moderate | N/A | N/A | Strong | Strong |

*Note:* Confounders were not assessed for one-group studies; Blinding was not assessed for one-group studies, case file analyses or studies that did not require interaction with participants when collecting outcome assessments; Withdrawals/drop-outs were not assessed for case-studies or retrospective case file analyses.

**Efficacy of Interventions Targeting Individuals with FASD across the Lifespan**

**Developmental Outcomes in Infants.** Two studies (Kartin, Grant, Streissguth, Sampson, & Ernst, 2002; Yazdani, Motz, & Koren, 2009) primarily focused on helping mothers to provide an optimal environment to promote their infant's development. Yazdani et al. (2009) found that following their home visiting service, children with PAE scored in the average range on developmental tests, which may be interpreted to suggest that deficits were ameliorated through an intensive early intervention service. However, in a study with a considerably stronger design, Kartin and colleagues (2002) found no effect of the home visiting service on the same measures of developmental outcome, with children scoring significantly below age-expected norms.

**Self-regulation and Attentional Control**. A range of approaches and intervention studies aimed to improve cognitive functioning in early to middle

childhood. Three studies investigated the effectiveness of ALERT (Williams & Shellenberger, 1996), a program specifically adapted for children with FASD, and designed to improve executive functioning (EF). These studies were methodologically robust albeit with small sample sizes and limited follow-up data. Nonetheless, gains were made in all three studies (Nash et al., 2015; Soh et al., 2015; Wells et al., 2012b) on measures of EF, such as parent report using the Behaviour Rating Inventory of Executive Functioning (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) and selected neuropsychological tests. Most recently, Soh et al. (2015) found changes in grey matter volume in critical regions for self-regulation in children in the immediate treatment group compared to children in the delayed treatment group who showed modest growth in one related area.

There is also some evidence that gains can be made on attention and that these gains can generalise to other areas. Kerns, MacSween, Wekken, and Gruppuso (2010) found improvements in the immediate post-treatment assessment on measures of sustained and selective attention, and improvements also extended to math and reading fluency. In an unpublished thesis, Vernescu (2008) found that children showed significant improvements in auditory and visual sustained attention and on tasks assessing non-verbal reasoning. However, gains in cognitive functioning were not obtained in a pilot study by Adnams (reported in Riley et al., 2003) using cognitive control therapy to enable children to learn metacognitive skills. This intervention was, however, limited by the small sample size, and the authors suggested that the duration was less than required.

**Specific Skills.** Nine studies focused on remediation of specific skills. Three demonstrated that children were able to benefit from a mathematical skills program specifically designed for children with FASD. The first intervention trial carried out by Kable, Coles, and Taddeo (2007) found that six weeks of The Math Interactive Learning

Experience (MILE) program resulted in significant gains in both math knowledge and parent reports of problem behaviour, which were maintained at six months compared to control children (Coles, Kable, & Taddeo, 2009). More recently, Kable, Taddeo, Strickland, and Coles (2015) conducted a community translation of the MILE program and found that compared to a parent instruction group, children in the intervention groups (centre-based or community-based) showed more positive gains in math skills immediately post-test. Finally, findings from a case study series (n = 5) provide preliminary evidence for the use of components of the MILE program to improve nonverbal reasoning, reading comprehension and mathematics reasoning in children and in adolescents aged 10 to 13 years (Millians & Coles, 2014).

Two studies (Coles, Strickland, Padgett, & Bellmoff, 2007; Padgett, Strickland, & Coles, 2006) demonstrated that children with FAS or pFAS were able to learn a sequence of safety commands after playing computer games designed to teach safety skills relating to either fire or street safety. Adnams et al. (2007) tested the effectiveness of a classroom-based literacy training intervention of 38 hours of therapy over a nine-month period. Children with FASD improved in specific language and literacy skills, although no parallel improvements in general scholastic skills were found compared to control children.

Loomes, Rasmussen, Pei, Manji, and Andrew (2008) found short-term improvements in digit span in children receiving rehearsal training across ten days, while Gryiec, Grandy, and McLaughlin (2004) found improvements in the number of words spelt correctly, following six weeks of practicing a ‘cover, copy and compare’ spelling procedure by a seven-year-old child. Finally, Keiver et al. (2015) embedded an evaluation of a motor skills program in a study of the regulation of the stress response in typically developing children and children with FASD. Cortisol levels were found to be higher in children with FASD in the afternoon and evening compared to that of control

children. No changes were associated with participation in the motor skills program. Overall, these studies suggest that early cognitive remediation for school-aged children shows promise in improving some specific areas of difficulty for children with PAE.

**Social Skills**. In light of the well-established difficulties faced by children with FASD in understanding social cues and problems in peer relationships, research has addressed whether interventions with a specific focus on social skills result in improvements. Six studies were identified, all targeting children in the 3 to 12-year age group. The earliest of these was a single case study showing improvements in social communication in the short-term (Timler, Olswang, & Coggins, 2005). Subsequently, three CCTs (Keil, Paley, Frankel, & O'Connor, 2010; O'Connor et al., 2006; O'Connor et al., 2012) evaluated an adaptation of the Child Friendship Training (CFT) program. Children were taught simple rules of social engagement, including modelling, which they rehearsed and practised across settings while being coached by parents. In the first of these studies, O'Connor and colleagues (2006) found parents who received the intervention reported improvement in their children at post-intervention, while parents in the wait-list group did not. Importantly, an analysis of clinical significance indicated that children in the intervention group scored in the lower end of the normal range at follow-up. In a later study, Keil et al. (2010) found that the children in the CFT group demonstrated improved social skills and lower rates of hostile attribution (as measured by a cartoon story task) compared to a delayed treatment group. Furthermore, these gains were maintained at a three-month follow up for the group receiving CFT first.

Last, O'Connor and colleagues (2012) found post-treatment gains in social skills and self-esteem for children who received CFT compared to a standard care condition in a community mental health setting. Notably, the intervention was equally effective for children with PAE compared to those without PAE. This indicates that children with PAE can be treated effectively in community settings if therapists are

trained and treatments are appropriately adapted to the needs of children with PAE. Gains in parent-rated social skills were also seen in a small (n = 11) trial of a community-based social skills group (Sparks-Keeney, Jirikowic, & Deitz, 2011). Conversely, a case study (n = 4) found that children with PAE were not able to imitate a block building task after viewing a videotape of a boy of a similar age completing the same task (Meyer, 1998).Taken together, these studies provide strong evidence for the utility of structured programs that include children and parents in helping to improve social skills.

**Efficacy of Interventions that Support Parents, Caregivers and Others**

**Parenting Skills**. Three studies provided explicit instruction in parenting skills. Olson et al. (reported in Bertrand, 2009) found a significant improvement in parental self-efficacy, parent needs and parent self-care, and a reduction in child behaviour problems in families receiving the Families Moving Forward (FMF) program. One study evaluating Parent-Child Interaction Therapy (PCIT) compared to a parent-only Parenting Support and Management (PSM) program, found reductions in child behavioural problems and parenting stress. The observed changes for both programs were clinically significant with mean scores on child behaviour problems moving from the clinical to the non-clinical range for both groups (Gurwitch et al., reported in Bertrand, 2009).

Kable, Coles, Strickland, and Taddeo (2012) carried out a controlled trial comparing parent education delivered in three formats: an information packet (i.e., community standard care), group workshops, and internet training. All three groups showed increases in knowledge of behavioural learning principles. Some indication of differential improvement in behaviour occurred across groups, with the workshop and the community group showing improvement but the Internet group showing none. Overall examination of the pattern of behavioural change found that approximately a

quarter of the sample demonstrated clinically significant behavioural gains. In summary, the parent-based intervention studies provide promising evidence that parents and caregivers benefit from support in managing their children's behaviour and that this improvement is accompanied by improvements in parent/caregiver well-being.

**Support, Education and Advocacy**. Four studies have investigated the effectiveness of specially designed education, support and advocacy services. Leenaars, Denys, Henneveld, and Rasmussen (2012) conducted a retrospective case-file analysis of the Coaching Families (CF) program that provides support for families across childhood and adolescence. Significant decreases in needs (e.g., housing and transport) and caregiver stress, and increases in goals (e.g., improving parenting skills, self-care and health) were found. The greater the duration of engagement with CF, the greater the goals attained and needs reduced.

Additionally, Promising Practices, an intervention for children and youth suspected or diagnosed with FASD in out-of-home-care (Pelech, Badry, & Daoust, 2013) found that specialised FASD training for workers and foster caregivers was associated with a significant decline in the number of placement changes compared to standard care. In a study of students with FASD and their teachers, improvements were found in classroom behaviour, although the finding was limited by a small sample size (Clark et al., 2014). Nonetheless, this adds to a body of literature that supports the role of training in advocacy and knowledge as a way of potentially improving outcomes for individuals with FASD.

Hume, Rutman, Hubberstey, Lentz, and Van Bibber (2009) prepared a summative report for the British Columbia Ministry of Children and Family Development on the Key Worker and Parent Support Program. This program provided support, education and liaison to existing intervention services for families with children or youth affected by FASD. Qualitative findings provided evidence for

improvements following the intervention (e.g., parents and caregivers reported that they had a better understanding of FASD, increased emotional and practical support). However, limited pre-post data was available on caregiver stress, parenting self-confidence and child behaviour and no statistically significant changes were found, although trends towards improvements were noted.

**Supporting Parents with FASD**. Two case management studies indicated a reduction in secondary disabilities in parents with FASD. Step by Step was a three year, goal driven, mentoring program aimed at increasing parents' access to resources and support that targets parents affected or suspected of FASD (i.e., the parents did not have access to an assessment during their time in the program to confirm the diagnosis). A retrospective case-file analysis conducted by Denys, Rasmussen, and Henneveld (2011) found that following the program, parents reported significant reductions in needs (e.g., housing) and increases in goals (e.g., improving parenting skills). A second case management program that assisted mothers to address environmental difficulties and connect with available support services was implemented by (Grant et al., 2004)). This pilot intervention of the Parent-Child Assistance Program (PCAP) was modified to accommodate clients with FASD. The participants were 19 women diagnosed with or suspected of having FASD (i.e., "had characteristics of prenatal alcohol damage in the presence of prenatal alcohol exposure" Grant et al., p. 502). Following the intervention, the participants decreased their alcohol/drug use, increased use of contraception and health services and were more likely to have obtained stable housing. These studies suggest that longer term case management during the transition to parenthood reduces the likelihood of secondary disabilities in young women with PAE.

Table 4.2.

*Intervention Studies across the Lifespan*

| Author & Design | Sample size & population | Approach and follow up | Results |
|---|---|---|---|
| *Developmental Outcome in Infants* | | | |
| Kartin et al. (2002) CCT | 65 home visiting advocacy service, 31 controls; women reported heavy substance use during pregnancy. Recruited within 1-month of delivery; children tested at 3-years | 3-year home visitation program to assist mothers with drug/alcohol treatment and support | No differences between the groups although all children performed below developmental age. |
| Yazdina et al. (2009) Retrospective case-file analysis | 28 children primary PAE & 15 no alcohol use recruited. All mothers reported use of cocaine. Children tested at 2/3years | Intensive home visiting program with liaison with ancillary services, addiction, parenting. | No differences between groups<br>All children scored in normal range. |
| *Self-regulation and Attentional Control* | | | |
| Nash et al. (2014) CCT | 14 treatment,15 delayed; pFAS & ARND; Canadian Guidelines or 4-digit code<br>Mean age 10-years (8-12 range) | ALERT Program for self-regulation; 12 weeks; Individual 1 hour sessions<br>Pre-post & 6 mth follow up | Sig. improvement for treatment compared to delayed on the Inhibition-Naming & Affect Recognition (NEPSY-II) and the BRIEF |
| Wells et al. (2012) RCT | 40 treatment, 38 control; FAS or ARND; Canadian Guidelines or 4-digit code<br>Mean age 8 years (6-11 range) | ALERT; 12 weeks, 75 min group sessions for children and parents run separately. Pre-post &2/3-month follow-up | Treatment group showed significant improvement compared to control group on the BRIEF and the RATC |

| | | | |
|---|---|---|---|
| Soh et al. (2015)<br>CCT | 20 treatment, 18 delayed; 27 control, FAS, pFAS, ARND; Canadian Guidelines or 4-digit code. Mean age 9 years (8-12 range) | ALERT 12 weeks; Individual 1.5 hourly sessions; pre-post testing; post-2 weeks after treatment | Improvements on BRIEF and NEPSY-II for treatment group.<br>Some evidence of increase in gray matter for treatment relative to delayed treatment |
| Kerns et al. (2010)<br>Cohort | 10 children previous diagnosis of FASD (diagnostic categories/criteria not stated)<br>Mean age 12 years (8-15 range) | The Computerised Progressive Attention Program; 16 hours over 9 weeks at school; pre-post testing | Significant decrease in reaction times and distractibility; Significant improvement in auditory sustained attention<br>and maths and reading fluency |
| Vernescu (2008)<br>CCT | 10 treatment,10 control; pFAS & FAS; Canadian guidelines<br>Mean age 9-years (6 – 11 range) | Activities from the Pay Attention training protocol & additional visual search tasks; 12 daily individual 30 min sessions; pre-post testing | Intervention group showed: Sig. improvements in non-verbal reasoning, auditory & visual sustained attention. Trend for improved performance on alternating attention |
| Adnams et al. reported in Riley et al., 2003<br>CCT | 5 treatment; 5 control; identified from previous study (N=64) diagnosed with FAS criteria not stated. Mean age 8 years | Cognitive Control Therapy 1 hour session each week for 10 school-term months; pre-post testing | Improvement in behaviour ratings in intervention group<br>No differences on neuropsychological tests |
| *Specific Skills* | | | |
| Kable et al. (2007)<br>CCT | 28 treatment; 26 comparison. FAS or pFAS using IOM criteria or significant alcohol-related dysmorphology. Mean age 6-years (3- 10 range) | All parents attended 2 x 2hr workshops on FASD. All children received individual learning plan; Treatment group received adapted tuition for maths MILE program. Pre-post testing | Sig. gains in caregiver knowledge of FAS, behaviour regulation and advocacy; decrease in problem behaviours. sig. higher gains found for intervention group on maths knowledge |

| | | | |
|---|---|---|---|
| Kable et al. (2015) CCT | 20 centre-based treatment; 19 community treatment; 21 parent instruction group, FAS or pFAS; IOM criteria or significant alcohol-related dysmorphology Mean age 6 years | All parents attended 2 x 2hr workshops on FASD and provided manual on math learning (parent instruction group received no further intervention) Community translation of the MILE program, expanded to 15 weeks & incorporated metacognitive control techniques Pre-post testing. | Participants in both the MILE groups showed greater gains in math skills at post-test compared to Parent instruction group. |
| Millians et al. (2014) Case study | 5; affected or suspected of PAE in foster care; 2 FAS; 1 no diagnosis, 1 deferred, 1 pFAS, IOM criteria 10 to 13 years. | Individualised interventions using the MILE program adapted for use with older children Pre-post testing | Three of five adolescents made gains in one cognitive domain although these differed for each child. Two showed no changes. |
| Coles et al. (2007) CCT | 16 children allocated to street safety & 16 to fire safety computer games, FAS or pFAS; IOM criteria. Mean age 7 years (4- 10 range) | Played a virtual reality game of fire safety and street safety Pre-post testing and follow-up test at 1 week | Post-test children showed sig. greater knowledge of fire and street safety; 1-week follow-up- children who played the fire safety game showed sig. knowledge gain while street safety didn't; majority of children in both groups were able to demonstrate the skills they learnt immediately and at 1-week post |
| Padgett et al. (2006) Case study | 5 children; FAS or pFAS; IOM criteria<br>5 to 7 years | Played a virtual reality game of fire/street safety. Pre-post testing & 1 week follow up | All 5 children reached 100% accuracy on the fire safety game; at 1 week post-test, able to perform steps in the correct sequence |

| | | | |
|---|---|---|---|
| Adnams et al. (2007) CCT | 18 exposed treatment; 18 exposed control; 23 non-exposed control; FAS pFAS or "deferred diagnosis category"; revised IOM criteria Mean age 10 years (9-10 range) | Language and literacy intervention, 1 hour per week in groups of 5 children 38 hours of therapy over 9 mths; pre-post testing | Treatment group sig. improved on pre-literacy, reading and spelling; No sig. difference between intervention and control on general scholastic tests; Scores of exposed children (intervention and control) remained lower than non-exposed children |
| Loomes et al. (2008) CCT | 17 Experimental, 16 controls; previously diagnosed with ARND, Neurobehavioural, or Static Encephalopathy. Mean age 7 years (4 – 11 range) | Experimental group -rehearsal training across 10 days Pre-post testing | Experimental group showed significant increase in digit span scores over the 3 sessions compared to the control group who showed no significant increase |
| Gryiec et al. (2004) Interrupted time series | 1 child; 7-year-old female; diagnosed with FAS (criteria not stated) and learning disabled | Cover, copy and compare spelling procedure; 6 wks with 2 to 3 sessions per week; 10 to 20 minutes per session; multiple baselines & measures at each session | Increase in number of words spelt correctly |
| Keiver et al. (2015) CCT | 24 FASD, 32 control, ARND, pFAS & FAS; 4-digit code & Canadian Guidelines Mean age 10 years (6-13 range) | FAST Club 8-week group motor skills intervention – 2 1.5 hr sessions per week for 8 weeks. Pre-post testing | Cortisol levels were higher in children with FASD compared to control children in the afternoon & evening; The program did not significantly affect cortisol levels in children with FASD |
| *Social Skills interventions* | | | |
| Timler et al. (2005) Case Study | 1 child; Girl aged 9 years 8 months, previous diagnosis of FASD (diagnostic category not stated); 4-digit code | Social communication intervention 6 weeks – 2 weeks of individual sessions (1 hr each) & 4 weeks of group | Increased use of mental state verbs (e.g., know, thought) |

| | | | |
|---|---|---|---|
| | | sessions with 2 peers (2 hrs each) Pre-post testing | Increased knowledge of social script strategies that were used during the intervention (e.g., plan & take action) |
| O'Connor et al. (2006) & Keil et al. (2010) CCT | 51 treatment, 49 delayed, FAS, pFAS & ARND, 4-digit code & IOM criteria. Mean age 8 years (6 – 12 range) | CFT; 12 sessions, 90 mins and separate concurrent parent sessions. Pre-post & 3 mth follow-up | O'Connor et al. - CFT group showed sig. improvement in social skills and decreased problem behaviours compared to delayed CFT at post treatment & follow-up Keil et al. - CFT group made fewer hostile attributions in the peer group entry scenarios than delayed treatment group; maintained at follow-up. |
| O'Connor et al. (2012) CCT | 41 treatment, 44 standard care, PAE (n = 32) FAS, pFAS, ARND, 4-digit code & IOM criteria; 53 control children without PAE Mean age 8 years (6 – 12 range) | CFT in a community setting 12 sessions, 90 minutes and separate concurrent parent sessions. Pre-post & 3 mth Follow-up | CFT group sig. improvement on Test of Social Skills Knowledge & self-esteem compared to standard care CFT equally effective for children with PAE as for those without |
| Meyer (1998) Case Study | 4 children identified with FAE Mean age 8 years | Required to imitate a 4-minute videotape of a block building task. Pre-post observation | None of the children were able to imitate the block building task |
| Sparks-Keeney et al. (2011) Cohort | 11 children with FASD (diagnostic categories not stated); 4-digit code. 7 – 12 years | Community based social skills group 90 min sessions for 7 weeks, concurrent sessions with parents. Pre-post testing. | 8 out of the 11 children's parents completed an adapted 25-item SSRS at pre-and post-testing. Of those 7 showed improved ratings |

*Parenting Skills*

| | | | |
|---|---|---|---|
| Olson et al. reported in Bertrand (2009) RCT | 26 treatment; 26 standard care diagnosed with FASD (diagnostic categories not stated) 4-digit code, all had significant challenging behaviours. 5 to 11 years | Families Moving Forward (FMF) Behavioural consultation fortnightly sessions of 90 mins for 9 to 11 months. Pre-post testing. | Improved parental self-efficacy, parental self-care and parent report of child behaviour problems in FMF compared to standard care; No differences in child-related parental stress |
| Gurwitch et al. reported in Bertrand (2009) RCT | 23 treatment & 23 comparison; diagnosed with FASD (diagnostic categories not stated); modified IOM criteria and 4-digit code 3 to 7 years | Group adaptation of PCIT; Comparison - parent-only support and management; Both weekly 1 hr sessions x 14 weeks; Pre, mid & post testing | Approx 50% attrition for both groups within the 14 weeks of treatment; No group differences observed, although reductions found across both groups on parenting stress and child behavioural problems |
| Kable et al. (2012) CCT | 24 community standard; 23 workshop; 29 internet training Parents of a child with FAS or pFAS; IOM criteria or significant alcohol-related dysmorphology. Mean age 7 years. | Information only (community standard), workshop or internet support 2 x 2hr sessions covering behaviour, information and advocacy Pre-post testing. | All groups reported improvement in knowledge of behavioural learning principles; Internet & Workshop sig. improvement in knowledge of FASD and parent advocacy; Some indication that sig. differences reported on child behaviour in community and workshop groups but not internet group |
| *Support, Education & Advocacy* | | | |
| Leenaars et al. (2012) Retrospective case-file analysis | 186 families parenting at least 1 child with FASD (diagnostic categories not stated); 4-digit code Mean age 10 years (1– 23 range) | Coaching Families Program provides support, education and advocacy for families with a child with FASD Program length not stated Pre-post testing | Reduction in numbers of daily needs and parenting stress Length of time in program associated with a greater reduction in needs and number of goals met |
| Pelech et al. (2012) | | | |

| | | | |
|---|---|---|---|
| Cohort analytic | 98 intervention, 84 comparison; out-of-home-care; diagnosed (categories or criteria not stated) or suspected (i.e. documented PAE). Mean age 11 years | Promising practices- enhanced child welfare practices to improve placement stability. Tracked placement changes during 15-month period prior and compared to placement changes during project implementation | Sig. decline in number of placement changes among children in the intervention group |
| Clark et al. (2014) CCT | 6 teachers & 7 children treatment; 6 teachers & 6 children and their teachers' comparison group; FAS, Gestalt diagnostic guidelines. Mean age 7 years (6 – 12 range) | Professional development for teachers focused on classroom environment. Over 1 school year. Included 2 full-day & 4 half-day workshops and weekly mentor-teacher meetings. Pre, mid & post testing | Sig. improvements in Adaptive Skills and sig. decreases in School Problems (both measured by the BASC-2 completed by teachers) reported for the intervention group; No sig. changes found for the comparison group; No sig. changes in academic achievement for intervention students |
| Hume et al. (2009) Cohort | 81 parents/caregivers completed both intake and exit questionnaires; families with children or youth with FASD (Diagnostic categories not stated); 0 – 19 years. | "key worker" program assist parents/caregivers and service providers understand child's deficits and help develop environmental accommodations Program length not stated. Pre-post testing | Trends in direction of increased parenting confidence, parents experiencing less stress, reduction in parent/caregiver challenges, childcare was significant; changes reported in parent/caregivers' ratings of child problem behaviours – overall no statistical difference from pre-to post |
| *Supporting Parents who have FASD* | | | |
| Denys et al. (2011) Retrospective case file analysis | 24 parents with FASD or suspected FASD (1 male, 23 | Step by Step – 3-year program; mentors work with families to | Sig. reduction in client's needs (e.g., housing, financial issues, mental health issues, addiction) Sig. increase in client's |

| | | | |
|---|---|---|---|
| | female), (diagnostic categories/guidelines not stated) Mean age 30 years (19-47 range) | help access support and services. Pre-post testing | goals (e.g., parenting, personal skills management, assessment, self-care and health) |
| Grant et al. (2004) Cohort | 19 women diagnosed with or suspected FASD; enrolled in standard PCAP for women at risk of giving birth to a child with FASD-with at least 1y remaining in the program; 4-digit code Mean age 22 years (14-36 range). | 12-month pilot of PCAP-home visitation case management program modified to accommodate clients with FASDs. Pre-post testing | Decreased alcohol and drug use Increased use of contraception, medical and mental health care services Increases in obtaining stable housing |

*Note.* CCT = Controlled Clinical Trial; RCT = Randomised Controlled Trial; FAS = Fetal Alcohol Syndrome; pFAS = Partial Fetal Alcohol Syndrome; ARND = Alcohol-related neurodevelopmental disorder; BSID-II = Bayley Scales of Infant Development Second Edition; WPPSI = Wechsler Preschool and Primary Scale of Intelligence; BRIEF =Behaviour Rating Inventory of Executive Function; RATC= The Roberts Apperception Test for Children; MILE = Math Interactive Learning Experience; CFT = Children's Friendship Training; FAE = Fetal Alcohol Effects – child displays characteristics of FAS but not full syndrome; PCIT= Parent Child Interaction Therapy; SSRS = Social Skills Rating System; BASC-2= Behaviour Assessment System for Children Second Edition.

## Discussion

This systematic review extended previous literature reviews (Kodituwakku, 2010; Paley & O'Connor, 2011; Petrenko, 2015) and the most recent systematic review (Peadon et al., 2009) by adopting a broader set of search criteria to capture studies that extended across the lifespan. Thirty-two studies were identified and methodological quality was assessed. The studies were grouped according to the primary focus of the intervention to enable comparisons across studies to be made and conclusions regarding effectiveness to be drawn.

Four key findings from the assessment of study quality were found. The first point relates to selection bias. None of the reviewed studies randomly selected cases from a target population, so selection bias was rated as "moderate" (participants recruited from a clinic) or "weak" (self-referred participants). Future research should aim to select participants from geographical regions known to have high rates of FASD in the general population rather than only clients who have attended FASD diagnostic clinics. Second, no studies were rated "strongly" with respect to "blinding," as none of the two-group studies described blinding of both outcome assessors and study participants.

The third issue relates to the information required in order for a study to be classified as a RCT. While many of the studies classified as CCTs reported that randomisation had taken place, many had not included information on how this had occurred. While this reduced the overall number of studies classified as RCTs, both RCTs and CCTs are rated as "strong", meaning that nearly two-thirds of the included studies were given a "strong" rating on study design. Last, one of the strongest findings to emerge was the rigor concerning outcome measurement. Twenty-seven studies received a rating of "strong" because they used reliable and valid measures.

Turning to the results of the studies, despite some studies with small samples and limited follow-up, the body of literature reviewed showed that it is possible to make improvements across many domains of functioning. In early infancy, mixed evidence was found for the potential to improve the developmental outcomes (Kartin et al., 2002; Yazdani et al., 2009) highlighting the importance of further systematic, rigorous research. Importantly, researchers need to consider measuring intervention effects using other tools in addition to standard developmental measures for infants and toddlers. If the focus of the intervention is to improve self-regulatory capacity and developmental outcome physiological measures such as heart rate, heart rate variability and salivary cortisol could be used, as there is evidence that infants with PAE show compromised autonomic nervous system development (e.g., Oberlander et al., 2010). Additionally, measurement of the infant's environment that includes the quality of the caregiving relationship needs to be considered, given the evidence that a supportive warm relationship aids the development of self-regulatory skills (e.g., Calkins et al., 2008)

The importance of providing an optimal environment to promote development provides the impetus for early intervention (Dalziel & Segal, 2012), and is of particular relevance for children with FASD whose early environmental experience is often less than optimal. Thus program developers need to attend to the particular needs of families and children with FASD and ensure that programs are adapted to suit the needs of this population.

Despite the mixed evidence for effectiveness in early infancy, the studies that focused on improving self-regulation and attentional control in early to middle childhood provided strong evidence for gains, demonstrated by improvement using parent/caregiver report, neuropsychological testing, and MRI scans (e.g., Kerns et al., 2015; Nash et al., 2015; Soh et al., 2015; Wells et al., 2012). However, as the studies

did not include, or only had a limited follow-up, the extent to which such changes are enduring has not been established.

The evidence for changes in specific skills was more variable. Notably, only one study (Kable et al., 2007) had a follow-up period that extended beyond the post-treatment period. The greatest gains were found in the studies that evaluated the MILE program (Kable et al., 2007; Kable et al., 2015; Millians et al., 2014). Gains extended beyond math skills and included improvements in child behaviour. The one study that investigated the stress-response in children with FASD found no changes in cortisol levels. The most plausible reason for this was that the level of exercise intensity (i.e., improving motor skills rather than fitness) was not sufficient to influence the stress response (Keiver et al., 2015). While the study did not achieve its aims, there are sound theoretical reasons for carrying out further research on the physiological underpinnings of PAE (e.g., Calkins, Propper, & Mills-Koonce, 2013). More research is needed to see if interventions could lead to physiological changes, which importantly, may underlie some of the self-regulatory difficulties for individuals with FASD.

The studies aimed at improving social skills showed consistently strong results. The controlled trials of the CFT program (Keil et al., 2010; O'Connor et al., 2006, 2012) were methodologically strong and importantly included a three-month follow-up demonstrating some enduring benefit. Intervention at this developmental stage may help to prevent the development of further dysfunction, given that social skills deficits become more pronounced with age in young people with FASD (Mattson, Goodman, Caine, Delis, & Riley, 1999; Whaley, O'Connor, & Gunderson, 2001). Further research is required to evaluate the impact of programs such as CFT with adolescents and adults. In summary, there is much to be optimistic about regarding the potential for improving aspects of children's functioning. However, currently the lack of

long-term follow-up limits any conclusions on whether the observed changes would endure over time.

Studies that included a specific focus on parenting skills found that helping parents understand and manage the complex set of behaviours they see in their children helped them feel less stressed (Gurwitch et al., reported in Bertrand, 2009), and improves their well-being and perceived capacity to cope (Olson et al. reported in Bertrand, 2009). Notably, however, all studies targeted younger children and none had a follow-up beyond post-testing, so it is not possible yet to ascertain whether the programs provide the skills required to help parents revise their strategies in response to the changing needs of the developing child.

The evidence was mixed for studies that took a support, education and advocacy focus or that targeted parents with FASD. First, studies that employed a case-management style approach found that supporting and educating families resulted in a reduction in needs (Leenars et al., 2012) and reduced secondary disabilities in parents with FASD (Denys et al., 2011; Grant et al., 2004). Second, an important emerging area of intervention research is targeting education and advocacy for people outside the family. For example, improving child welfare practices (Pelech et al., 2012), and assisting teachers to understand the cognitive deficits associated with FASD (Clark et al., 2014) resulted in improved outcomes for those with FASD. Overall, considering the support, education, and advocacy interventions and parenting support interventions together, while interventions focused on case management were effective in improving outcomes for parents with FASD, it remains unclear if such interventions can result in improvements for children and youth who are affected by FASD.

**Implications for research and policy**

The interventions included in the current review highlight both the potential for improving many different aspects of functioning for individuals with FASD as well

as methodological shortcomings. The majority of interventions are currently focused on improving outcomes for school-aged children. Future research is suggested to explore early intervention for infants and young children, ensuring that programs are informed by the evidence for clinical- and cost-effectiveness in high-risk families. Supporting adolescents and adults also needs to be considered as there is evidence that problems compound as children become older (e.g., Mattson et al., 1999; Whaley et al., 2001). It is also clearly evident that the difficulties facing individuals with FASD do not lie in single domains of functioning. Thus, it would seem that the way forward for intervention research is to consider the dynamic interplay between individual characteristics and the wider ecological context in which the individual lives. Consequently, the available evidence provides support for a proposed unified conceptual framework (Petrenko, 2015). Such a framework brings together models proposed by Kodituwakku (2010) and Paley and O'Connor (2011) and takes into account the lived experiences of individuals and families with FASD to guide intervention development. Taken together with the current review, this provides strong support for future interventions to address multiple domains of functioning for individuals with FASD.

**Conclusions**

A number of interventions have been implemented with individuals and their families affected by prenatal alcohol exposure. The studies identified in this review differed considerably in their focus of the deficit(s) addressed. Further, there was considerable variability in their methodological rigor and the time frame for follow-up. Nonetheless, such attempts are critically important in propelling the field towards more rigorous and systematic intervention trials. We propose that considering the extensive deficits and the complexity of the life circumstances of many individuals, a deficit-or-domain specific focus for intervention is of limited utility. Rather, an approach that

takes an ecological stance and looks at the multiple factors that may be at play will lead to more effective and enduring benefits. Ultimately, this is an empirical question and can only be answered by systematic and rigorous research trials.

## Chapter 5: Statement of Contribution and Co-Authored Submitted Paper

This chapter includes a co-authored paper which has been submitted for publication to an international peer-reviewed journal. The bibliographic details of the co-authored paper are:

**Reid, N.,** Harnett, P., O'Callaghan, F., Shelton, D., Wyllie, M., & Dawe, S. (under review). Physiological self-regulation and mindfulness in children with an FASD diagnosis.

The candidate's contribution to the paper involved conception of the study design, collecting and analysing data and writing of the manuscript. Co-author two assisted with conception of the study design, supervisory advice and critical review of drafts. Co-author five assisted with data collection and critical review of drafts. Other authors provided supervisory advice and critical review of drafts.

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# Chapter 5

## Physiological Self-Regulation and Mindfulness in Children with an FASD Diagnosis

A wide range of environmental factors have been shown to impact on the developmental outcomes of children and there is extensive evidence that these impacts can begin prenatally (Yumoto et al., 2008). Substantial research has found that children exposed prenatally to alcohol have difficulties in many areas of functioning (Davis et al., 2013; Kodituwakku, 2010) and these difficulties may result in a child receiving a diagnosis of fetal alcohol spectrum disorder (FASD). The fetal patterning of disease model proposes that prenatal exposure to substances can increase vulnerability to environmental risk factors and can result in individuals being at greater risk for pathology later in life (Gluckman & Hanson, 2004; Yumoto et al., 2008). Indeed, children with prenatal exposure to alcohol and/or cocaine show greater vulnerability to lower levels of environmental risk, in comparison to non-exposed children (Yumoto et al., 2008). Consequently, children who are biologically vulnerable, due to prenatal substance exposure and who are also exposed to post-natal environmental risk are at "double jeopardy" for poorer outcomes (Yumoto et al., 2008).

One biological vulnerability relates to the impact of exposure to early life stressors on the autonomic nervous system (ANS). The ANS has two major branches, the sympathetic nervous system (SNS) that controls the body's responses to perceived threats and the parasympathetic nervous system (PNS) that controls homeostasis. Respiratory sinus arrhythmia (RSA) has been used a physiological index of PNS functioning. RSA refers to the observation that the intervals between successive heart beats (inter-beat intervals) are shorter during inspiration than during expiration. Higher values of RSA reflect greater variability in inter-beat intervals, which in turn has been found to be associated with performance on executive functioning tasks (Beauchaine,

2015). It has been proposed that non-specific vulnerability to psychopathology is the result of poor executive (i.e., prefrontal) control over behavior, which is reflected in the measure of RSA, given the structural and function connections between the prefrontal cortex and the PNS via the vagus nerve (Beauchaine, 2015).

Baseline (i.e., resting) RSA has been found to be particularly sensitive to early environmental experiences (Conradt et al., 2016). In typically developing populations, higher baseline RSA has been associated with a range of positive outcomes for children, such as, greater empathy, social competence, cognitive functioning and lower levels of psychopathology (Conradt et al., 2014). However, higher baseline RSA may not always predict positive outcomes for children. Several theoretical approaches suggest that individual differences in autonomic nervous system responses interact with the level of environmental stress a child experiences during childhood (see Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2007; Boyce & Ellis, 2005; Del Giudice, Ellis, & Shirtcliff, 2011).

For instance, Conradt, Measelle, and Ablow (2013) found that infants with high baseline RSA who were raised in poverty showed more problem behaviour than infants with high baseline RSA raised in safe environments. The problem behaviour of infants with high baseline RSA who lived in poverty was also more severe than that displayed by infants with low baseline RSA. The authors proposed that high baseline RSA allows infants to engage more fully with their environment. Thus, infants raised in the context of security are buffered from the deleterious effects of environmental adversity, as their physiological susceptibility (high baseline RSA) enables these infants to be more attuned to and responsive to a sensitive caregiver, and thus can more readily use the caregiver to develop effective self-regulatory skills (Ostlund, Measelle, Laurent, Conradt, & Ablow, 2017). On the other hand, infants with high baseline RSA living in a disorganised environment with an insensitive caregiver will be more engaged with and

affected by the negative parenting experiences this entails (Conradt et al., 2013). Thus, infants raised in threatening environments learn to allocate attentional resources to monitor their unpredictable environment and in the absence of a caregiver to promote self-regulatory skills, develop maladaptive physiological mechanisms to regulate their emotional state. This in turn leads to emotional, behavioural and physical health problems later in childhood (Conradt et al., 2016; Hostinar & Gunnar, 2013).

The current literature regarding prenatal alcohol exposure and/or other substances and RSA (specifically baseline RSA) is limited, particularly for school-aged children. Hickey, Suess, Newlin, Spurgeon, and Porges (1995) and Suess, Newlin, and Porges (1997) both conducted studies investigating differences in autonomic nervous system functioning in boys (aged 7 – 12 years), with or without prenatal opiate exposure. A number of children in each of the groups had also experienced prenatal alcohol exposure. Hickey et al. (1995) found that the control group of boys (i.e., those without opiate exposure) showed a decrease in RSA in response to changing environmental conditions (i.e., between a basic attention task and a more complex task). In contrast, the opiate-exposed boys showed no significant change in RSA.

Importantly, a group of boys who were not prenatally exposed to opiates, but whose mothers used opiates following birth, showed a reduction in RSA that was smaller, although not significantly different to the control group. The authors interpreted their results as suggesting that the physiological responses to increased attentional demand may be impaired in the children exposed to opiates prenatally. However, the change in RSA between the environmental control and opiate-exposed groups only approached significance ($p = 0.1$). This suggests that the impact of prenatal exposure to opiates on the child's autonomic functioning may be related, at least in part, to the environmental conditions created by parental opiate misuse postnatally.

In a follow-up study, Suess et al. (1997) investigated the hypothesis that these results may be due to differences in motivation or interest in tasks rather than differences in attentional deficits or autonomic regulation. In contrast to Hickey et al. (1995), they did not find differences in RSA on the same attention task between groups. However, for the sample as a whole, greater prenatal exposure to alcohol was associated with greater RSA reductions if also exposed to opiates. This result is counter-intuitive if a decrease in RSA is assumed to represent an adaptive process that allows an individual to meet challenging environmental demands. The authors speculated that the amount of RSA decrease may have been excessive to the demands of the task. Alternatively, the substance-exposed boys may have responded appropriately because they found the task to be harder, a possibility given they also made more errors in the attention task. Further, the authors speculated that the results were attributable to alcohol exposure rather than opiate exposure as the alcohol-exposed only group showed the same pattern of physiological response as the alcohol plus opiate-exposed group.

Subsequently, (Conradt et al., 2014) assessed both baseline RSA and RSA reactivity (i.e., changes in RSA in response to an environmental challenge) at four time points (3, 4, 5 & 6 years of age). The children had experienced prenatal polysubstance exposure and/or some form of early adversity (e.g., poverty, maternal psychopathology). Substance exposure and early adversity were measured using summative risk indexes (i.e., higher scores reflecting greater pre-or post-natal risk exposure). Consistent with other studies of typically developing children, they found baseline RSA increased over time across the sample. Interestingly, at age 3, greater prenatal exposure to substances was related to higher baseline RSA, but exposure to environmental risk was unrelated.

The authors speculated that prenatal substance exposure may affect a biological set-point, or functional range, by which the body responds to environmental

challenges (Conradt et al., 2014). The impact of prenatal substance exposure and environmental risk varied as a function of age. For three year olds, greater RSA reactivity was associated with greater prenatal substance exposure and lower environmental risk. However, by age 6, higher prenatal exposures and greater exposure to adversity were associated with greater RSA reactivity. This suggests children exposed to greater adversity develop a pattern of hypervigilance and physiological reactivity in their adaptation to an unpredictable environment. To date, there has been no systematic study of baseline RSA in children diagnosed with FASD.

Notably, previous research has highlighted the potential role of mindfulness in changing an individual's resting level of RSA (e.g., Burg, Wolf, & Michalak, 2012; Tang et al., 2009; Thayer et al., 2009). Mindfulness is a form of meditation that requires conscious effort to maintain awareness of the present moment. There is growing evidence supporting the benefits of mindfulness for adults (Khoury et al., 2013) and children (Harnett & Dawe, 2012; Kallapiran, Koo, Kirubakaran, & Hancock, 2015) with a range of psychological conditions (e.g., anxiety, depression, posttraumatic stress disorder, substance abuse). Importantly, there is also increasing research showing improvements in self-regulation for children, including those from economically disadvantaged backgrounds (Neville et al., 2013; Poehlmann-Tynan et al., 2016). Further, a recent systematic review of neuroimaging studies evaluating brain changes following mindfulness-based interventions reported increased activity, connectivity and volume in the prefrontal cortex (PFC), cingulate cortex, insula and hippocampus. Decreased activity in the amygdala and improved connectivity between the amygdala and PFC were also found (Gotink, Meijboom, Vernooij, Smits, & Hunink, 2016). To date, there have been no studies that have assessed the capacity of children with FASD to engage in, and their physiological response to, mindfulness meditation.

Therefore, given that baseline RSA has not been previously investigated in children diagnosed with FASD. The first aim of the present study was to explore differences in baseline RSA between school-aged children with FASD, many of whom also had experienced other pre- and/or post-natal exposures, and a group of typically developing children. Given the significant executive functioning difficulties that children with FASD typically demonstrate, it was hypothesised that the children with FASD would show lower baseline RSA compared to the typically developing children. Second, given that the possible physiological responses to mindfulness meditation, a technique that has been found to increase baseline RSA has not been investigated in children diagnosed with FASD. The second aim of the current study was to investigate if children with FASD would be able to engage in a brief mindfulness exercise, indexed by their compliance with the mindfulness task instructions and a subsequent increase in RSA. Further, it was explored whether their capacity to engage in and benefit from the mindfulness exercise would differ from a typically developing comparison group. It was hypothesised that children with FASD would be able to effectively engage with a brief mindfulness task, indexed by an increase in RSA and behavioural compliance with the task. Notably, some previous studies have reported that the protective effects of RSA may vary based on gender (El-Sheikh, Harger, & Whitson, 2001). Although a detailed examination of gender differences and how this may influence the potential effects of mindfulness was beyond the scope of the current study, it was important examine the possibility of gender differences in RSA in response to the mindfulness task.

## Method

### Participants

Participants consisted of 16 children diagnosed with FASD and 25 typically developing comparison (TDC) children. Data from two children in the FASD group and one child in the typical group were excluded due to artifact in the electrocardiography

(ECG) data, resulting in a final sample of 14 FASD and 24 TDC children. Table 5.1 provides descriptive information about the two groups of participants and Table 5.2 provides additional descriptive information about the FASD group specifically.

Participants for the FASD group were recruited from an FASD diagnostic clinic. All children had received an FASD diagnosis using the 4-Digit Diagnostic Code (Astley, 2004). Parents were provided with information about the study and interested parents completed a referral form to allow their details to be provided to the researchers. Inclusion criteria were: aged 6 – 10 years and an IQ > 50. As all children had recently completed the Wechsler Intelligence Scale for Children – 4th Edition (WISC-IV) as part of their diagnostic assessment, the Full Scale Intelligence Quotient (FSIQ) from that assessment was used for the current study.

Participants for the TDC group were recruited from a local primary school. Information about the study was posted in the school newsletter and in the school office. Parents completed a referral form to allow their details to be provided to the researchers. Inclusion criteria were: aged 6 – 10 years, no diagnosis of neurodevelopmental (e.g., autism, attention-deficit hyperactivity disorder, intellectual disability) or other mental health conditions (e.g., anxiety), and no prenatal exposure to alcohol or other drugs as reported by parents. All children in the TDC group were in the care of their biological parents.

Table 5.1

*Participant Demographics*

| | FASD<br>n = 14 | TDC<br>n = 24 |
|---|---|---|
| Age (years), Mean (*SD*), Range * | 8.29 (1.2), 6 - 10 | 6.75 (.74), 6 - 8 |
| Gender ratio (male: female) | 9:5 | 10:14 |
| Racial background, Frequency (%) | | |
| Caucasian | 9 (64.3%) | 21(87.5%) |
| Bi-racial parentage | 5 (35.7%) | 3 (12.5%) |
| Estimated FSIQ, Mean (*SD*), Range* | 89.29 (15.76), 54 - 116 | 110.88 (10.29), 94- 134 |

*Note:* * Significant differences between groups, $p < .01$; FASD; fetal alcohol spectrum disorder; TDC = typical developing control; FSIQ = Full Scale Intelligence Quotient; SD = standard deviation.

Table 5.2

*Additional Demographic Information for the FASD Group*

| Measure | FASD Group |
|---|---|
| FASD diagnosis | |
| pFAS | 2 (14.3%) |
| Static Encephalopathy | 5 (35.7%) |
| Neurobehavioural | 7 (50%) |
| Caregiver | |
| Biological parent/s | 4 (28.6%) |
| Kinship care | 2 (14.3%) |
| Legal guardian | 4 (28.6%) |
| Foster parent | 3 (21.4%) |
| Adoptive parent | 1 (7.1%) |
| Number of care placements | |
| 1 | 7 (50%) |
| 2 | 1 (7.1%) |
| 4 | 2 (14.3%) |
| Exposure to other substances prenatally | |
| Cannabis | 2 (14.3%) |
| Polydrug use | 7 (50%) |
| Unknown | 4 (28.6%) |
| Exposure to neglect and/or trauma | 9 (64.3%) |

*Note:* FASD = fetal alcohol spectrum disorder; pFAS = partial fetal spectrum disorder.

**Measures**

**Wechsler Abbreviated Scale of Intelligence (WASI).** The WASI is a standardised abbreviated measure of intelligence. The measure has been shown to be reliable and valid, with high correlations with other established measures of intelligence (Wechsler, 1999). Children in the TDC group completed the WASI to provide an estimate of their intellectual functioning.

**Physiological Self-Regulation - Respiratory Sinus Arrhythmia (RSA).** Children's cardiac activity was collected using an eMotion Faros 180° heart rate monitor cable set (Mega Electronics Ltd., Kuopio, Finland) with a standard two lead electrode placement. The ECG data was imported into the Biopac AcqKnowledge 4.1 software package (Biopac Systems Inc., USA) and corrected for artifacts (e.g., missed or extraneous heart beats) as appropriate. The tachogram data was then imported into CardioEdit and CardioBatch Software (Brain-Body Centre, University of Illinois at Chicago, 2007). RSA was calculated by summing the variances of heart rate activity

across the band of frequencies associated with spontaneous breathing of both children and young adults (i.e., .12 – 1.00 Hz). RSA is the natural logarithm of the extracted variance for each successive 30-second epoch for each of the conditions (i.e., pre-mindfulness, mindfulness, post-mindfulness).

To limit movement artifact in the HR data, the pre-and post-mindfulness periods involved children sitting watching five-minute neutral video segments of Spot the Dog. The mindfulness exercise was a five minute and forty second task designed for children by the Smiling Mind organisation (www.smilingmind.com.au). The exercise was played on an Apple iPad. Children were instructed to follow the directions in the audio as best they could. The mindfulness task administered could be considered as a child version of a 'body scan,' as it required children to focus their breath and attention on different parts of their body.

**Mindfulness compliance checklist.** There were six instructions that took place in the first half of the mindfulness exercise that required the children to perform small physical movements (e.g., "close your eyes", "put your hands on your belly"). These movements were recorded on a 6-item checklist by the primary researcher during the mindfulness exercise.

**Procedure**

Assessment took place in a quiet room free from distractions. Children were connected to the heart rate equipment and given a brief free play adjustment period. The TDC group then completed the WASI, followed by a five- minute rest period. The FASD group completed drawing-based attention tasks at the table, followed by a five-minute rest period. Both groups then completed a pre-mindfulness baseline, sitting watching the neutral video. They then completed the mindfulness exercise, followed by the post-mindfulness period, again watching a five-minute segment of video. HR data was collected continuously during each of the tasks and rest periods. The heart rate

monitor was restarted between conditions to timestamp the data. Upon completion, mothers received a $20 gift voucher to a retail outlet and children were invited to select a small toy from a "prize box."

**Data analysis**

Group and condition effects were examined with a mixed model analysis of variance (ANOVA). Box's *M* test of homogeneity of covariance was not significant ($p = .30$). Levene's test for equality of variances was also not significant ($ps < 0.05$); however, Mauchly's test of sphericity was violated. Consequently, multivariate statistics have been provided. Given the gender and age differences between the two groups, another mixed ANOVA was conducted with only the males from both groups ($N = 19$), who did not significantly differ in age ($p = .80$). The findings from this analysis did not differ significantly from the main analysis. See Appendix F for the Supplementary material containing the full results of this analysis. Additionally, an independent sample t-test was conducted, to assess for group differences on the mindfulness compliance checklist.

It is typical for individuals with FASD to have lower overall intellectual abilities than non-exposed typically developing children (Davis et al., 2013). As anticipated, this was also found for the current sample (FASD: $M = 89.29$; Controls: $M = 110.88$, $p < .01$). While lower IQ was associated with FASD, including IQ as a covariate violates the assumptions of analysis of covariance (ANCOVA) as the groups were not randomly selected and IQ is a pre-existing group difference that did not occur by chance (Dennis et al., 2009; Kerns, Siklos, Baker, & Müller, 2016). Thus, the analyses of group differences are presented without covarying for IQ.

## Results

A mixed ANOVA was conducted to explore the differences between the two groups (FASD and TDC) on RSA across the three conditions (pre-mindfulness,

mindfulness and post-mindfulness). There was no significant interaction between group and condition, Wilks' Lambda = .99, $F$ (2, 35) = .24, $p$ = .79, partial eta squared = .01. There was a main effect of condition, Wilks' Lambda = .50, $F$ (2, 35) = 17.64, $p$ <.001, partial eta squared = .50. Both groups showed an increase in RSA during the mindfulness condition (see Table 5.3). The main effect comparing the two groups was also significant, $F$ (1, 36) = 7.87, $p$ < .05, partial eta squared = .18. The FASD group showed significantly lower RSA across all three conditions. An independent-samples t-test was conducted to compare children's compliance rates during the mindfulness task. There was no significant differences between the FASD group ($M$ = 4.64, $SD$ = 1.55) and the TDC group ($M$ = 4.88, $SD$ = 1.42); $t$ (36) = .47, $p$ = .64, eta squared = .006.

Table 5.3

*RSA Means and Standard Deviations for Pre-, During and Post-Mindfulness*

| | FASD ($n$ = 14) Mean ($SD$) | TDC ($n$ = 24) Mean ($SD$) |
|---|---|---|
| Pre-mindfulness RSA | 6.89 (.84) | 7.69 (1.06) |
| Mindfulness RSA | 7.38 (.74) | 8.23 (.90) |
| Post-Mindfulness RSA | 6.81 (.72) | 7.70 (1.12) |

*Note:* RSA = respiratory sinus arrhythmia; FASD = fetal alcohol spectrum disorder; TDC = typical developing control; $SD$ = standard deviation.

## Discussion

The first aim of the current study was to investigate if school-aged children with a diagnosis of FASD differed in baseline RSA from a group of typically developing children. The results demonstrated that children with an FASD diagnosis showed lower baseline levels of RSA compared to a typically developing group of children. Although this result did not differ when comparing a sub-sample of boys who did not differ significantly in age, given the preliminary nature of the findings caution is recommended in the interpretation of the results. The results of the current study

differed from Conradt et al. (2014), who found that six-year old children with prenatal exposure to substances showed higher baseline RSA. A possible explanation of this result is the poorer neurocognitive functioning, including lower IQ, observed in the FASD group. It has been suggested that baseline RSA increases with the development of executive processes (Thayer et al., 2009) and in the current clinic-based sample, there were no children who scored a 1 on the 4-Digit Code assessment of executive functions (i.e., all children in the sample had some level of dysfunction in the EF domain). Further, in Conrad at al.'s (2014) study, the higher baseline RSA in substance-exposed children was tentatively attributed to the greater recruitment of the parasympathetic nervous system to adapt to adverse environmental conditions. Although just over half of the children in the current sample had experienced neglect or abuse, many of the children had not experienced this adversity. Further, the majority of the children were now in foster or adoptive care.

The second aim of the current study was to investigate if children with a diagnosis of FASD had the capacity to engage in a mindfulness exercise. The results showed children with FASD could comply with the task instructions to a similar level as the typically developing children. Further, children in the FASD group showed a similar increase in RSA. Again, the same results were found when comparing a sub-sample of boys who did not differ significantly in age. Although, only preliminary findings, these results are encouraging, as previous research has found that children, including those from disadvantaged backgrounds (Neville et al., 2013; Poehlmann-Tynan et al., 2016), can experience improvements in self-regulatory abilities following mindfulness practice.

These findings are also consistent with previous adult studies of mindfulness and RSA. In these studies, it was observed that engaging in mindfulness meditation resulted in increased RSA, leading to a physiologically calmer state

compared to baseline functioning (e.g., Burg et al., 2012; Nesvold et al., 2012; Tang et al., 2009). Notably, this is also consistent with previous research that has reported changes in the prefrontal cortex (PFC) following mindfulness-based interventions. This is due to RSA being considered as a peripheral marker of PFC functioning (Beauchaine, 2015; Thayer et al., 2012). Consequently, given that children with FASD were able to engage with a mindfulness-task and experienced physiological changes, some of the self-regulatory difficulties that children with FASD experience could potentially be ameliorated through the implementation of mindfulness-based strategies.

However, caution is required, as the answer is not as simple as implementing mindfulness-based strategies to increase RSA for children with FASD. Previous research (e.g., Conradt et al., 2014) indicates that both high and low RSA may be adaptive given the environment in which a child is raised. Consequently, simply increasing RSA for children with FASD who are living in unsafe caregiving environments would be counterproductive. As a result, it will be important when planning treatment for children with FASD that assessments of the caregiving environment are included to guide subsequent interventions. Further, if children are found to be living in stressful environments (e.g., poverty and/or receiving inconsistent caregiving), it is important that any mindfulness-based strategies are provided in conjunction with approaches targeting the broader family environment.

**Limitations and Suggestions for Future Research**

Specialist FASD diagnostic services have only recently been established in Australia, and given that these were some of the first children referred to one of the first available services in Australia, they may not be representative of the wider population of children with FASD. Clinically, the results of the study point to the importance of considering both individual and family factors in planning interventions for children with FASD. The results show that children diagnosed with FASD can show an increase

in RSA by engaging in a mindfulness-based technique to a similar extent to typically developing children. This suggests that further research be conducted to establish whether prolonged practice could lead to permanent increases in baseline RSA over time, or whether introducing children with FASD to mindfulness practice from an early age could improve growth in RSA over time. However, in light of research showing that higher RSA can be associated with more emotional and behavioural problems in children living in stressful family environments, this would need to be in the context of an intervention aimed at improving the quality of family functioning more generally.

## Chapter 6: Statement of Contribution and Co-Authored Submitted Paper

This chapter includes a co-authored paper which has been submitted for publication to an international peer-reviewed journal. The bibliographic details of the co-authored paper are:

**Reid, N.,** Dawe, S., Harnett, P., Shelton, D, Hutton, L., & O'Callaghan, F. (revise and resubmit). Feasibility study of a family-focused intervention to improve outcomes for children with FASD. *Research in Developmental Disabilities.*

The candidate's contribution to the paper involved conception of the study design, implementation of the treatment, collecting and analysis of data and writing of the manuscript. Co-author two provided supervisory advice regarding conception of the study design, implementation of the treatment and data collection and critical review of drafts. Co-authors three, four and six provided supervisory advice and critical review of drafts. Co-author five assisted with the qualitative data analysis and critical review of drafts.

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# Chapter 6
# Feasibility Study of a Family-Focused Intervention to Improve Outcomes for Children with FASD

Fetal alcohol spectrum disorder (FASD) refers to the physical, cognitive, behavioural and/or learning disabilities that can be associated with prenatal alcohol exposure (Cook et al., 2016). While there is large variability in prevalence estimates (Roozen et al., 2016), evidence suggests that at least 2.4 – 4.8% of children in the United States have FASD (May et al., 2014). With substantially higher estimates for children in out-of-home care (e.g., Lange, Shield, Rehm, & Popova, 2013) and communities with high levels of alcohol consumption (e.g., Fitzpatrick et al., 2015). The costs to society and individuals and their families are considerable. Thus, ongoing efforts to both prevent the occurrence of FASD and to ameliorate difficulties for those with FASD are essential.

Importantly, growing evidence suggests that children with FASD are able to benefit from interventions aimed at enhancing self-regulatory capacity (Reid et al., 2015). For example, benefits have been reported on the use of the ALERT program (Williams & Shellenberger, 1996), a 12-week manualised program that teaches children to recognise and change their arousal levels using sensory strategies, based on their current environmental needs. Three studies reported improvements in aspects of self-regulation, such as emotional problem-solving (Wells, Chasnoff, Schmidt, Telford, & Schwartz, 2012); inhibitory control and social cognition (Nash et al., 2015); parent-reported executive functioning skills in everyday life (Nash et al., 2015; Wells et al., 2012); and increases in cortical gray matter in regions underlying self-regulatory processes (Soh et al., 2015).

More recently, Kable, Taddeo, Strickland, and Coles (2016) conducted a pilot study that implemented Phase 1 of the GOFAR program. The broad goals of the

program are to improve self-regulation skills using a computer program to teach problem-solving and adaptive life skills. In the GOFAR program, children are taught metacognitive learning strategies (e.g., Focus and Plan, Act and Reflect) to solve problems. Parents are provided with information about the metacognitive learning strategies and taught skills to manage children's heightened arousal states, in addition to behavioural management techniques. Children showed an improvement in their ability to sustain attention, with the effect more pronounced when parents received the same information as the children during the training and when they reported higher levels of engagement in the therapeutic process.

Consequently, previous interventions have focused on teaching children and parents mind-body awareness and sensory coping strategies (Nash et al., 2015; Soh et al., 2015; Wells et al., 2012) and/or metacognitive control strategies (Kable et al., 2016) to improve children's self-regulatory capacity. An additional approach to the enhancement of self-regulatory capacities is drawn from the growing literature on the incorporation of mindfulness-based strategies into psychological therapies for both adults (e.g., Khoury et al., 2013) and children (Harnett & Dawe, 2012; Kallapiran et al., 2015). Mindfulness training has been proposed as a method to improve self-regulation through improving top-down executive processes associated with frontal lobe structures, such as sustained attention and cognitive flexibility. At the same time, diminishing bottom-up influences associated with the limbic areas of the brain involved in the regulation of emotional arousal, such as stress or physiological dysregulation (Shapiro, Carlson, Astin, & Freedman, 2006; Zelazo & Lyons, 2012). Thus, we propose that a strong case can be made for the potential of mindfulness-based approaches to enhance self-regulatory capacities in children with FASD.

Furthermore, one of the proposed benefits of mindfulness meditation is that it produces a physiologically calmer state. (e.g., Burg et al., 2012; Tang et al., 2009).

This has been measured using respiratory sinus arrhythmia (RSA), a physiological measure of self-regulation. RSA refers to the observation that the intervals between successive heart beats (inter-beat intervals) are shorter during inspiration than during expiration (Beauchaine, 2015). Previous research with adults and our own research with children with FASD (Reid et al., under review) has found that RSA increased either during or following mindfulness practice (e.g., Burg et al., 2012; Tang et al., 2009). Higher values of RSA reflect greater variability in inter-beat intervals, which in turn has been found to be associated with more effective vagal control of emotional states in the face of environmental challenges (Beauchaine, 2015). Consequently, increasing RSA would be viewed as a positive outcome of therapy.

However, this would not necessarily be the case for children who continue to live in stressful home environments. As emerging research has demonstrated, higher RSA can actually be associated with more behavioural difficulties for children who are living in poverty and/or experiencing inconsistent caregiving (e.g., Conradt et al., 2013). This may be due to children allocating additional attentional resources to monitor their unpredictable environment. Also, in the absence of a caregiver to promote self-regulatory skills, these children may develop maladaptive physiological mechanisms to regulate their emotional state, leading to emotional, behavioural, and physical health problems later in childhood (Conradt et al., 2016; Hostinar & Gunnar, 2013). Consequently, mindfulness training for children with FASD needs to be provided in conjunction with an intervention that aims to improve the quality of family functioning more generally. This is particularly important for children with FASD as they often live in families facing a range of psychosocial risk factors (Chamberlain, Reid, Warner, Shelton, & Dawe, 2017; Yumoto et al., 2008).

Therefore, we are proposing an adaptation of the Parents under Pressure (PuP) program. The PuP program was developed as a home-based program for high-risk

vulnerable families. The program targets multiple domains of family functioning including: (i) the quality of the caregiving relationship; (ii) the parents' capacity to manage emotions and (iii) the broader ecological context in which the child is living. Consequently, the PuP program differs from previous interventions targeting self-regulation (i.e., Nash et al., 2015; Wells et al., 2012) as previous research focused more exclusively on improving self-regulatory skills for the child alone, without targeting the parent-child relationship or the wider family context. Further, this would be the first intervention study to include mindfulness-based strategies for children with FASD.

The PuP program has a growing evidence base (e.g., Frye & Dawe, 2008; Harnett & Dawe, 2008), and has been identified by a range of reviews as an evidence-based program for high-risk vulnerable families with children from pre-birth mothers to families with children in middle childhood. A randomised control trial conducted with parents on methadone maintenance found significant reductions in child abuse potential, parenting stress, and related constructs in those who received PuP compared to standard care and a brief intervention group (Dawe & Harnett, 2007). A quasi-experimental study of high-risk pregnant mothers found greater improvement in child protection outcomes for those mothers who took part in a pre-birth pathway that included the PuP program compared to routine care (Harnett, Barlow, Dawe, Coe, & Newbold, Accepted). Finally, the PuP program is currently subject of a randomised controlled trial based in the UK (Barlow et al., 2013).

Importantly, many parents experience multiple difficulties that extend beyond parenting knowledge and skills and this is also true for many families parenting a child with FASD. The treatment foci of PuP are aligned with many of the challenges facing families with a child with FASD. For example, the capacity to manage emotions in the context of parenting a child with self-regulatory difficulties has been identified as a significant difficulty (Chamberlain et al., 2017). Helping children develop self-

regulatory skills is also a key treatment focus of the PuP program and a key area of deficit for children with FASD and adapting both the home and educational settings to support children with FASD has been widely acknowledged as a key target of interventions (Reid et al., 2015).

Consequently, in the current study we have adapted the PuP program for children with FASD who had previously attended a diagnostic service. Reid, Shelton, Warner, O'Callaghan, and Dawe (2017) recently conducted a retrospective chart review of the diagnostic service, which found that while the majority of children were not found to display growth deficiency or facial features, 58% of children still had significant central nervous system dysfunction and 90% had significant behavioural difficulties.

The aims of the current study were to assess key elements of feasibility (Orsmond & Cohn, 2015) as follows: (1) recruitment, (2) data collection procedures and outcome measures, (3) suitability of the intervention protocol, (4) resources and management of the study, and (5) the preliminary evaluation of participant responses to the intervention.

## Method

### Design

This is a mixed methods feasibility study that utilised a phenomenological approach (Carpenter, 2007) to obtain qualitative information from caregivers, and a single-case experimental design with a minimum of three baselines as recommended by Beeson and Robey (2006) to assess the preliminary quantitative treatment effects.

### Participants

Three families were recruited from an FASD diagnostic service. The only inclusion criteria were that the children received an FASD diagnosis and lived locally. All children had received a 4-Digit Diagnostic Code (Astley, 2004) diagnosis of

Neurobehavioural Disorder. See Table 6.1 and Table 6.2 for a description of the participant characteristics.

Table 6.1

*Child Characteristics*

| Characteristics | Child 1 | Child 2 | Child 3 |
|---|---|---|---|
| Age | 9 | 12 | 11 |
| Gender | Female | Female | Female |
| Siblings | 0 | 3 | 0 |
| Time since diagnosis | 12 months | 4 months | 12 months |
| FSIQ (WISC-IV) | Low Average Range | Average Range | Average Range |
| Adaptive behaviour (ABAS-II) | Extremely Low | Extremely Low | Extremely Low |
| Child Behaviour (CBCL) | Clinical Range | Clinical Range | Clinical Range |

*Note*. Assessment results from initial FASD diagnostic assessment. FSIQ = Full Scale Intelligence Quotient; ABAS-II = Adaptive Behaviour Assessment System, 2nd Edition; CBCL = Child Behaviour Checklist

Table 6.2

*Parent Characteristics*

| Characteristics | F1, P1 | F1, P2 | F2, P1 | F2, P2 | F3, P1 | F3, P2 |
|---|---|---|---|---|---|---|
| Age | 53 | 52 | 57 | 51 | 43 | 47 |
| Level of education | High school | University | High school | High school | High school | High school |
| Caregiver type | Kinship | Kinship | Adoptive | Adoptive | Biological | Biological |
| Existing mental health diagnosis | Depression | - | - | PTSD | Depression | Panic Disorder |

*Note.* F = Family; P = Parent; PTSD = Post-traumatic stress disorder.

## Measures

**Feasibility questionnaire.** After treatment follow-up, the researchers completed a survey to assess program feasibility, based on Orsmond and Cohn (2015) guiding questions for feasibility. The survey required the researchers to reflect on five key objectives: (1) recruitment, (2) data collection, (3) acceptability of intervention procedures, (4) resources and management, and (5) participant responses to the intervention. See Supplementary Table 1 for the questionnaire details (Appendix G).

**Parent interviews.** Semi-structured interviews were conducted by the therapist (NR) with the parents (each couple together) at the completion of treatment and then again at three-months post-treatment. The initial interview focused on the parents' experiences of treatment; specifically, which aspects of treatment they found helpful or unhelpful. The subsequent interview focused on what the parents' experiences had been in the months following the intervention. Specifically, this consisted of any changes that they had observed or areas that they thought had remained the same following treatment; also, if there had been any specific barriers encountered by their family during that three-month period; and their outlook for the future.

**Parent–report measures.** The 86-item *Behaviour Rating Inventory of Executive Function* (BRIEF; Gioia et al., 2000) was used to evaluate children's executive functioning abilities in their daily activities. The BRIEF provides eight non-overlapping clinical scales. These form two indexes: The Behavioural Regulation Index (BRI; three scales: Inhibit, Shift, Emotional Control); and the Metacognition Index (MI; five scales: Initiate, Working Memory, Plan/Organise, Organisation of Materials and Monitor). Also, an overall Global Executive Composite (GEC) score is provided. The BRIEF has been used with a variety of clinical populations including those with FASD (e.g.,Nash et al., 2015), and internal consistency and test-retest reliability of the parent report is high (Gioia et al., 2000). The BRIEF was completed by both parents in each family at three time points (pre, post and three-month follow-up).

The 64-item *Youth Outcome Questionnaire – parent report* (Y-OQ-PR; Burlingame et al., 2001) was used as a repeated measure to evaluate the children's psychosocial distress. Items are rated on a 5-point Likert-type scale and summative scoring produces six subscales (Intrapersonal Distress, Somatic, Interpersonal Relations, Social Problems, Behavioural Dysfunction and Critical Items). The total score was reported in the current study. The Y-OQ Total score has a test-retest reliability of .83, an

internal consistency of .95 for an outpatient population, and concurrent reliability has been reported with a range of other child behaviour measures (Burlingame et al., 2001). The Y-OQ-PR was completed by both parents in each family.

**Child measures.** Children's *Respiratory Sinus Arrhythmia* was used as a repeated measure, at the same time-points the Y-OQ parent report was administered. At each time-point, a baseline measure (i.e., sitting watching a 5-minute video) and a mindfulness measure (i.e., sitting listening to a 5-minute mindfulness exercise) was taken and a simple change score was calculated between each condition. Children's cardiac activity was collected with an eMotion Faros 180° heart rate monitor cable set (Mega Electronics Ltd., Kuopio, Finland) with two electrodes affixed to the child's chest. The ECG data was imported into the Biopac AcqKnowledge 4.1 software package (Biopac Systems Inc., USA) and corrected for artifacts. The tachogram data was then imported into CardioEdit and CardioBatch Software (Brain-Body Centre, University of Illinois at Chicago, 2007). RSA was calculated by summing the variances of heart rate activity across the band of frequencies associated with spontaneous breathing of both children and young adults (i.e., .12–1.00 Hz). RSA was calculated as the natural logarithm of the extracted variance for each successive 30-second epoch.

The *NEPSY, Second Edition* (NEPSY-II; Korkman, Kirk, & Kemp, 2007) is a standardised neuropsychological battery for children aged 3–16 years. The NEPSY-II has been used with a variety of clinical populations including children with FASD (e.g., Nash et al., 2015). For the current study, one subtest (Inhibition) from the Attention and Executive Functioning domain was administered. This subtest was designed to assess the ability to inhibit automatic responses in favour of novel responses and the ability to switch between response types. Three conditions were used: (1) Naming, where the child simply names the shape or direction of the arrow; (2) Inhibition, where the child must provide the opposite response (e.g., "say circle when you see a square"); and (3)

Switching, where the child switches between providing the correct response and the opposite response depending on the colour of the shape or arrow. The time taken to complete each task and the number of self-corrected and uncorrected errors were recorded. The NEPSY was completed at three time points (i.e., pre, post and three-month follow-up).

The 64-item *Youth Outcome Questionnaire – Self Report* (Y-OQ SR; Burlingame et al., 2001) is the parallel form of the Y-OQ for adolescents aged 12 to 18 years. The internal consistency of the Total score is reported as .95, a re-test reliability of .89, and it has moderate to good concurrent validity with other child self-report measures of behaviour (Ridge, Warren, Burlingame, Wells, & Tumblin, 2009). The Y-0Q SR was completed at three time points (i.e., pre, post and three-month follow-up).

**Procedure**

The current study was approved by the relevant university and hospital research ethics committees. Families were referred to the study by their treating clinician at the FASD diagnostic service. The therapist met with each family to provide further information about the study and to obtain informed consent to participate in the research. Families were given the choice of whether treatment should take place at the university clinic or in their home. The assessments and PuP therapy was delivered by NR, a Registered Psychologist and who had undergone specialist training in the assessment and diagnosis of FASD and in the PuP program. The PuP training took place over five days on three separate occasions. Ongoing supervision was provided on a fortnightly basis by one of the program developers (SD). This also ensured that there was fidelity to the model.

**Treatment: Adaptation of the PuP Program**

The PuP program is a home-based intervention underpinned by two key constructs: (1) that child wellbeing is dependent on the parent's capacity to provide a

sensitive, responsive, and nurturing caregiving environment; and (2) that in order for this to occur, a parent needs to be able to understand and manage their own emotional state, which includes the resources to manage stressors present in the wider social ecological context of the family (Dawe & Harnett, 2013).

Importantly, the PuP program assessment allows for an individualised case plan to be developed. Immediate priority areas and goals for change are identified by the practitioner in collaboration with the caregivers and a treatment plan is developed. This approach allows flexibility and provides a tailored approach to supporting families (see Table 6.3). For families in the current study, the PuP program was adapted by including psychoeducation regarding the neurobehavioural impacts of FASD and strategies aimed at enhancing self-regulatory skills of the children. School consultation is often undertaken in PuP; however, given the significant difficulties children with FASD have at school, this was considered a core-element of the current intervention.

Sessions took place weekly or fortnightly and lasted between 1 to 2 hours, depending on the families' needs. Sessions began with a review of the events of the week (e.g., any difficulties at home or school) and moved onto a discussion of the way in which strategies around self-regulation had been implemented. Problems were identified and discussion followed to help parents/caregivers plan for more effective use of the strategies. Activities from the PuP Parent Workbook were completed to complement the focus of the session and, where appropriate, the therapist provided specific guidance based on each child's individual neurobehavioural needs, which had been identified at their diagnostic assessment. Both parents and the child participated in each of the sessions. Typically, there would be individual child time at the start of the session, then time spent together as a family, and finally a discussion with parents on their own. Sometimes additional family members would also participate (e.g., siblings or grandparents) depending on the focus of the session.

There was consistent child involvement during the program that included teaching age-appropriate mindfulness exercises, augmented with games and tablet application-based mindfulness training. Time was also spent in sessions to help resolve communication difficulties that had arisen in the family by teaching effective skills in the context of improving self-regulation of all family members. Potential resources in the public domain that reflected the key therapy goals of improving self-regulation were identified and piloted prior to the study. For example, the children's book Mindful Monkey, Happy Panda (Alderfer & Maclean, 2011) was provided to each family. This allowed a metaphor of being in a "monkey mind" or "panda mind" to be used by the children and their parents and was complemented with a small monkey finger puppet."

Table 6.3

*Overview of Treatment Process and Content*

| | Family 1: Activities, relevant PUP modules & resources | Family 2: Activities, relevant PUP modules & resources |
|---|---|---|
| Phase 1 | • Information gathering, case conceptualisation, assessment feedback, and goal setting (PUP modules 1 & 2)<br>• Psychoeducation regarding the impact of FASD on behaviour and establishment of realistic behavioural expectations (resources: results of the neurocognitive assessment; 3D brain app on iPad; Forgetful Frankie children's book).<br>• Helping parents and children manage emotions under pressure: Increasing mindful awareness (PUP module 4)<br>  ○ Initial focus on parents helping their child to recognise and label emotions (resources: Inside out figurines, games based on the movie characters)<br>  ○ Introduction to mindfulness (resources: Sitting Still Like a Frog book; Mindful Monkey, Happy Panda book; belly breathing with favourite stuffed toy)<br>  ○ Managing emotional outburst<br>• View of self as parent e.g., challenging the notion of a perfect parent, developing understanding of parenting beliefs and strengths (PUP module 3) | • Information gathering, case conceptualisation, assessment feedback, and goal setting (PUP modules 1 & 2)<br>• View of self as parent e.g., challenging the notion of a perfect parent, developing understanding of parenting beliefs and strengths (PUP module 3)<br>• Helping parents and children manage emotions under pressure: Increasing mindful awareness (PUP module 4)<br>  ○ Managing anger outburst<br>  ○ Significant initial focus on reducing level of conflict in the house and fostering a calm home environment<br>• Psychoeducation regarding the impact of FASD on behaviour and establishment of realistic behavioural expectations (resources: results of neurocognitive assessment, 3D brain app on iPad). |

| | | |
|---|---|---|
| Phase 2 | • Focus on improving the parent child relationship (PUP module 6) (resources: applicable chapters from Universal Language of Love book; feedback from video of free play interaction with each parent individually and their child; structured activities in session that parents and child engage in together to foster positive interactions)<br>o Facilitating communication between child and parents to promote understanding of difficulties<br>o Structured activities in session that parents and child engage in together to foster positive interactions<br>o Parents paying attention to their child and spending small amounts of quality time with child engaging in positive interactions and building up to longer periods.<br>o Parents as good role models<br>• Helping parents understand individual parenting styles and work together with each other's strengths and weaknesses (resources: feedback from the parent-child interaction videos)<br>• Continued focus on helping parents and children manage emotions under pressure: Increasing mindfulness awareness (PUP module 4)<br>o Managing emotions in tricky situations at home and at school (resources: Breathe, Think Do iPad app, worksheet based on the app & worksheet based on the Mindful Monkey Happy Panda book to help child use "panda" mind vs "monkey" mind) | • Extending social support networks e.g., snapshot of social supports; breaking down barriers to asking for help and support (PUP module 9)<br>• Helping parents understand individual parenting styles and work together with each other's strengths and weaknesses.<br>• Focus on improving the parent child relationship (PUP module 6)<br>o Facilitating communication between child and parents to promote understanding of difficulties<br>o Structured activities in session that parents and child engage in together to foster positive interactions<br>o Parents paying attention to their child and spending small amounts of quality time with child engaging in positive interactions and building up to longer periods.<br>o Parents as good role models<br>• Focus on improving child's sleep quality (resources: sleep hygiene for teenagers, mindfulness audio on iPod, cognitive strategies to assist with managing worry, melatonin from family doctor)<br>• Continued focus on helping parents and children manage emotions under pressure: Increasing mindful awareness (PUP module 4)<br>o Reviewing strategies for managing anger outbursts at home<br>o Managing emotions in social situations with peers and classroom difficulties with teachers |
| Phase 3 | • Generalising to school setting<br>o Activities based on difficulties encountered at school; parents de-briefing with child and problem solving difficulties that were occurring; social story about friendship; school meeting to share strategies that were being implemented at home to encourage communication and consistency across the home and school settings.<br>• Continued focus on helping parents and children manage emotions under pressure: | • Continued focus on helping parents and children manage emotions under pressure: Increasing mindful awareness (PUP module 4)<br>o Encouraging informal and formal mindfulness practice (resources: info. about mindfulness in everyday life for parents, Smiling Mind and stop, breathe & think app)<br>• Generalising to school setting<br>o Discussion and debriefing with child regarding challenging situations at school; collaborative problem solving; facilitating communication with |

| | |
|---|---|
| Increasing mindful awareness (PUP module 3)<br>o Reviewing strategies for managing anger outbursts<br>o Encouraging informal and formal mindfulness practice – parents and children together and separately (resources: information about mindfulness in everyday life for parents & Smiling Mind app and stop, breathe & think app)<br>• Closure e.g., assisting parents to make action plans for what they are going to continue to focus on (PUP module 12) | parents regarding difficulties that were occurring at school<br>o School meeting to share strategies that were being implemented at home to encourage communication and consistency across the home and school settings.<br>• Closure e.g., assisting parents to make action plans for what they are going to continue to focus on (PUP module 12) |

**Data Analysis**

**Qualitative methods.** Parent interviews were audio-recorded and transcribed verbatim, with all identifying information removed. Parent interviews were compared sequentially to identify continuities and changes in their accounts over time. Additionally, the interview transcripts were cross-compared to identify any similarities or differences between the families' experiences of treatment and follow-up. Thematic analysis using QSR International's qualitative software package (Nvivo 10) was undertaken. The analysis was guided by the Braun and Clarke (2006) six phase approach to coding: (1) data familiarisation; (2) initial code generation, which involves detailed examination of the transcripts by two researchers. Initial codes are then discussed and agreed upon; (3) theme searching; (4) reviewing themes; (5) defining and naming themes (stages 3 to 5 also involves discussion and agreement between two researchers); and (6) producing the report.

**Quantitative methods.** Analysis of the repeated measure Y-OQ-PR was conducted using a combination of visual inspection and a *Tau-U* online calculation tool (singlecaseresearch.org; Parker, Vannest, & Davis, 2011). *Tau-U* is a method for measuring data non-overlap between two conditions (i.e. baseline and intervention) and examination of trends both within and between conditions. *Tau-U* analysis provides a

more accurate evaluation of non-overlap of one condition compared to mean or median differences. This type of analysis has strengths in controlling for baseline trend and variability, ceiling and floor effects, and has sensitivity to condition change irrespective of baseline length (Parker et al., 2011). *Tau-U* scores can be interpreted using the following criteria: 65% or lower: weak or small effect; 66% to 92%: medium to high effect; and 93% to 100%: large or strong effect (Parker, Vannest, & Brown, 2009). Analysis of the pre-post and follow-up BRIEF parent reports was conducted using clinically significant and reliable change index (RCI) calculations. See Supplementary Table 2 (Appendix G) for the N. S. Jacobson and Truax (1991) criteria that were used for these calculations.

## Results

All families completed three baseline assessments. Families 1 and 2 completed treatment (they remained in contact for 27 weeks) with a total of 17 and 21 treatment sessions respectively and then 3 post-assessments. Subsequently, both families completed a 3-month follow-up assessment. Family 3 completed four sessions (3 baselines and 1 treatment) over seven weeks and then withdrew due to significant health concerns of a caregiver. All sessions, except for school meetings, were held in the families' homes.

### Feasibility questionnaire

The current study was able to recruit appropriate participants through the FASD diagnostic service and all three families who were offered treatment agreed to participate. The data collection procedures for the parent-report measures were found to be acceptable. However, there were some difficulties with the child measures. Specifically, the YOQ-self report measure took longer than expected for the child to complete and was consequently used as a pre-post and follow-up assessment, rather than a repeated measure. There were also difficulties with the measurement of RSA

(data presented below). Since the sessions took place after school to fit in with the families' schedules, it is possible that this measure was affected by how stressful the child's day at school had been. Overall, the intervention procedures were evaluated as acceptable to participants, with two out of three families completing treatment and one family withdrawing due to poor health unrelated to the intervention procedures. There were no difficulties encountered with management of the study by the research team and, as will be discussed in further detail, the preliminary evaluation of the participant responses was very positive and promising. Refer to Supplementary Table 1 (Appendix G) for the full details of the completed the feasibility questionnaire.

**Parent interviews**

The qualitative data suggests that the PuP intervention provided parents with an increased understanding of their child and provided them with emotional support and practical guidance. Over time, parents described feeling more confident in their own abilities to respond to their child in a helpful way and manage their child's emotions and behaviour. Overall, following completion of the intervention, parents reported a sense of improvement in functioning for the whole family, which fostered feelings of hope for the future. Thematic analysis yielded five major themes: (1) An increased understanding of self and child; (2) Feeling supported; (3) Improved functioning; (4) Aspects of the intervention that were helpful and unhelpful; and (5) Areas to continue to focus on. Table 6.4 provides a summary of these major themes, as well as subthemes and example quotations. Additional themes were also identified that related to the many difficulties families had experienced with the education and health systems. These topics were beyond the scope of the current study; however, these experiences had resulted in significant distress for both families, and therefore have been included in Supplementary Table 3 (Appendix G).

Table 6.4

*Themes Identified from Parent Interviews*

| Themes & subthemes | Example quotations |
|---|---|
| *Major theme 1: An increased understanding of self and child* | |
| Increased understanding of FASD and child's behaviour and emotions | "I think for both of us, it has normalised what's the behaviour and we have understood this is why it happens; that is the biggest thing" (F2,P1). "I think I am cutting [child's name] more and more slack" (F2, P2). "We are not overreacting to [child's name] as much as we used to, which is a good thing cause we understand what she is going through" (F1, P1). |
| Increased awareness of personal responses to child | "I do think it is better if I have got my shit together; then it is a lot better to deal with [child's name]" (F2, P2). "I can generally calm down and think about it and then go back to [child's name] about it…So it has changed my focus" (F1, P2). |
| *Major theme 2: Feeling supported* | |
| Value of therapeutic relationship | "It made us feel like somebody understood and that somebody was going to help us get through this." (F1, P1). "It was good that [child's name] felt that she could have a talk to [therapist's name] and tell her things that, you know, maybe she couldn't talk to us about" (F1, P2). |
| Increased support within the parent relationship | "I think things are better with us [between the parents]" (F2, P2). "We are supporting each other now" (F1, P1). "It [the intervention] has been a real help because I think before we were fighting each other as much as we were fighting her disability" (F1, P2). |
| *Major theme 3: Improved functioning* | |
| Improved family communication | "The communication seems to be better" (F2, P1). "You taught us how to put it in her language and how to show her that this is the appropriate behaviour; not just telling her, 'Don't do that' (F1, P2). |
| Improved child behaviour | "A lot of her skills have now improved. Like, she is now cooking. She wasn't capable of some of these things prior…I think it has probably given her confidence that she can do some things. Before, she didn't have the confidence to try things" (F1, P2). |
| Positive relationships | "Overall, I think it [the parent–child relationship] is improving" (F1, P1). "I think it has been better than when we started, yeah definitely" (F2, P2). "I have noticed now when she gets in trouble at school she wants to get home to tell mum about it straight away" (F1, P1). "That has changed because she used to not tell me and try to hide it because I would go off" (F1, P2). |
| A sense of hope | "There is light at the end of the tunnel" (F2, P1). "It has actually been only in the past couple of months that I have actually felt like, you know what, she probably will get a job. That used to worry me. Her future used |

| | |
|---|---|
| | to terrify me … Now I feel like, you know what, I think she is going to find her little niche … I feel a lot more confident that we can put her on the right track and she will be able to contribute to society in a good way" (F1, P2). |
| *Major theme 4: Aspects of the intervention that were helpful or unhelpful* | |
| Therapist knowledge of FASD | "That [therapist name] knows what the condition is means that [therapist name] starts to understand the difficulties it presents for the child straight away" (F2, P1). "As a parent you need to know that these things are real" (F2, P1) "Yes that your kid is not just 'acting out'" (F2, P2). |
| Intervention strategies were concrete and they worked | "I have noticed that I have definitely changed my modelling with her … I stop and think; now, 'how can I explain this?' I won't go off. Ok [child's name], why has this happened? Let's talk about it." (F1, P2) "[Child's name] likes the Frankie and Panda books, and she really likes to read those and that has helped. It has given her coping strategies" (F1, P2). "Ok, this is a concrete thing that we know has worked that we go back to doing" (F1, P1). |
| Benefits of the intervention taking place in the family home | "I don't think it would work as well in a clinic situation. The kids are always going to be on their best behaviour out of home" (F2, P2). "You pick up more cues about what is really happening in the family home … people tend to feel more comfortable, relaxed in their own environment" (F2, P1). |
| Flexibility of the intervention | "I think the format of the program has been really helpful as through the process [therapist's name] has had a bit of flexibility … the flexibility has been a key thing because there are peaks and troughs and you've got to adjust the process to suit where people are" (F2, P1). |
| The therapist meeting with school staff | "As parents, you go to the school and you will tell them this is happening, but having [therapist's name] involved… authenticated it; that it was a real problem" (F2, P1). "That was fantastic, and I think that is something that needs to happen in more places" (F1, P1). |
| Recommended a more structured approach to post-intervention follow-up | "Maybe a phone call or monthly check in or email or something, just so you feel that lifeline is still there." (F1, P1). "I think sometimes you doubt yourself … How do I handle this? What did [therapist's name] say? And sometimes you find it a bit hard to think back and you get so caught up in what's happening that you can't calm down sometimes to think through" (F1, P2). |
| *Major theme 5: Areas to continue to focus on* | |
| Child's social skills and teenage relationships | "I think the next big one as they become a teenager and get into relationships is helping with that. That is going to be a big one for [child's |

| | |
|---|---|
| | name]" (F2, P2). "We are still working on those [social skills], but they are getting better" (F1, P2). |
| Communicating instructions to their children | "I need to obviously break that down, or say it better or communicate differently. That is something I am going to have to work on" (F2, P2). "And I have to really try my hardest not to assume that she has understood something" (F2, P2). |
| Parental emotion regulation | "It does worry me that those little stresses in life can just get on top of me" (F2, P2). "Sometimes when I am angry I don't always remember" (F1, P2). "We can't always get it right, but we are trying" (F1, P1). |
| Acknowledged that when things are going well it is easy to forget to use the intervention strategies | "When things are going well you think, 'Oh well, you can stop'. You sort of relax off on doing some of the things … Because when you put strategies in place and they work so well you tend to think it is a cure, it's fixed" (F1, P2). "But then we hit a road bump and we are like, "Oh, we forgot to do this or we forgot to do that" (F1, P1). "Yeah, when it is going really well, you do tend to just sort of let things slide" (F1, P2). |

*Note.* F = Family; P = Parent.

**Parent report measures**

Y-OQ parent-report data is displayed in Figure 6.1. Visual analysis suggests that the intervention was associated with improvements in parent-reported child psychosocial distress. To determine the magnitude of the effect, Tau-U effect sizes were calculated for each parent who completed treatment and for the combined weighted average. Although the visual inspection of Family 1 Parent 1 suggested a baseline trend was present, the statistical analysis found no significant trends in the baseline phases for any participants. As displayed in Table 6.5, a significant difference was found between the baseline and treatment phases for two of the parents ($p$ <.05); one parent demonstrated a large treatment effect, two parents a medium to high effect, and one parent a small treatment effect. The overall combined weighted average *Tau-U* effect size was -.75, $p$ = .00 (95% CI = -1.14 to -.36). This result indicates that 75% of the data showed improvement between the baseline and intervention phases. Table 6.6 displays the BRIEF parent report results. Family 1 reported improvements on the BRIEF, whereas Family 2 did not report any changes.

Table 6.5
*Individual Baseline Trends and Phase Comparisons*

| | Baseline Trend | | Baseline vs intervention phase comparison | |
|---|---|---|---|---|
| Participant | *Tau-U* | *p*-value | *Tau-U* | *p*-value |
| Family 1 Parent 1 | 1 | 0.12 | -0.57 | 0.15 |
| Family 1 Parent 2 | 1 | 0.12 | -0.97 | 0.01 |
| Family 2 Parent 1 | -1 | 0.12 | -0.80 | 0.04 |
| Family 2 Parent 2 | 0 | 1 | -0.67 | 0.09 |

Table 6.6
*Summary of BRIEF Results*

| | Measure | Pre-score | Post-score | 3-month FU | RCI |
|---|---|---|---|---|---|
| Family 1 | BRIEF – BRI | 62 | 57 | 57 | Unchanged |
| Parent 1 | BRIEF – MI | 68 | 66 | 58 | Recovered |
| | BRIEF – GEC | 67 | 64 | 58 | Recovered |
| Family 1 | BRIEF – BRI | 64 | 52 | 51 | Recovered |
| Parent 2 | BRIEF – MI | 78 | 66 | 69 | Improved |
| | BRIEF – GEC | 74 | 62 | 62 | Improved |
| Family 2 | BRIEF – BRI | 73 | 74 | 67 | Unchanged |
| Parent 1 | BRIEF – MI | 65 | 61 | 94 | Unchanged |
| | BRIEF – GEC | 69 | 67 | 63 | Unchanged |
| Family 2 | BRIEF – BRI | 74 | 81 | 79 | Unchanged |
| Parent 2 | BRIEF – MI | 69 | 70 | 68 | Unchanged |
| | BRIEF – GEC | 76 | 75 | 73 | Unchanged |
| Family 3 | BRIEF – BRI | 72 | | | |
| Parent 1 | BRIEF – MI | 76 | | | |
| | BRIEF – GEC | 76 | | | |
| Family 3 | BRIEF – BRI | 74 | | | |
| Parent 2 | BRIEF – MI | 76 | | | |
| | BRIEF – GEC | 80 | | | |

*Note:* t-scores are provided; BRI = Behavioural Regulation Index; MI = Metacognition Index; GEC = Global Executive Composite; RCI = Reliable Change Index.


*Note:* b = baseline; t = treatment; w = week; p = post; FU = Follow-up at 3 months

*Figure 6.1.* Youth-Outcome Questionnaire Parent Report Results

**Child measures**

Table 6.7 displays the NEPSY results for each child. Both children who completed treatment demonstrated a decrease in the number of errors they were making for each task; however, the time they were taking to complete the tasks tended to increase from pre- to follow-up. Table 6.8 provides a summary of the RSA during baseline and mindfulness tasks at pre-assessment, post-assessment and the three-month follow-up. Although at some assessment time points both children displayed changes in RSA from baseline to mindfulness, these changes were not consistently found during or following the intervention. Further, no overall increases were noted in RSA at baseline or mindfulness assessments following the intervention. Additionally, Child 2 completed the YOQ self-report measure at the first session and scored 70, which was in the clinical range, and then at the post-assessment they scored 45, which was in the non-clinical range. Subsequently, at the three-month follow-up, Child 2 scored 12. According to Jacobson and Truax's (1991) criteria, this outcome is classified as Recovered.

Table 6.7.
*Summary of Individual Child NEPSY Scores*

| | | Pre–score | Post-score | Follow-up Score |
|---|---|---|---|---|
| Child 1 | Naming Total Errors | 2[a] | 2[a] | 0[aa] |
| | Naming Total Time | 61[b] | 70[b] | 78[w] |
| | Inhibition Total Errors | 12[w] | 9[bb] | 3[a] |
| | Inhibition Total Time | 101[b] | 134[w] | 139[w] |
| | Switching Total Errors | 16[bb] | 16[bb] | 7[a] |
| | Switching Total Time | 151[b] | 170[bb] | 183[w] |
| Child 2 | Naming Total Errors | 1[b] | 0[a] | 0[a] |
| | Naming Total Time | 50[b] | 44[a] | 46[b] |
| | Inhibition Total Errors | 2[a] | 0[aa] | 0[aa] |

| | | | | |
|---|---|---|---|---|
| | Inhibition Total Time | 67 [a] | 67 [b] | 77 [bb] |
| | Switching Total Errors | 3 [a] | 1 [aa] | 0 [aa] |
| | Switching Total Time | 76 [aa] | 74 [aa] | 84 [a] |
| Child 3 | Naming Total Errors | 7 [w] | | |
| | Naming Total Time | 49 [a] | | |
| | Inhibition Total Errors | 4 [a] | | |
| | Inhibition Total Time | 69 [a] | | |
| | Switching Total Errors | 9 [a] | | |
| | Switching Total Time | 123 [a] | | |

*Note.* aa= above expected level; a = at expected level; b = borderline; bb = below expected level; w = well below expected level.

Table 6.8.

*RSA at Pre-intervention Compared to Post-intervention and 3-month Follow-up*

| | Child 1 | Child 2 | Child 3 |
|---|---|---|---|
| Initial baseline | 6.57 | 6.03 | 6.42 |
| Initial mindfulness | 7.82 | 6.03 | 7.65 |
| RSA Δ baseline to mindfulness | 1.25 | 0 | 1.23 |
| Post baseline | 6.37 | 6.14 | - |
| Post mindfulness | 6.70 | 6.99 | - |
| RSA Δ baseline to mindfulness | 0.33 | 0.85 | - |
| 3-month follow-up baseline | 6.93 | 5.59 | - |
| 3-month follow-up mindfulness | 7.32 | 5.68 | - |
| RSA Δ baseline to mindfulness | 0.39 | 0.09 | - |

*Note.* RSA = Respiratory sinus arrhythmia

## Discussion

The present study assessed the feasibility of an adaptation of the PuP program for children with FASD and their families. A number of key findings were identified from the feasibility questionnaire and the qualitative findings. We briefly review the findings that are specific to feasibility studies, and discuss how these findings could be incorporated into future trials.

The first component of a feasibility study is an evaluation of the recruitment and intervention procedures. Importantly, these were found to be feasible and acceptable to participants. All three of the families accepted treatment and two families completed treatment and were retained at the three-month follow-up. The second component addresses the data collection procedures and the utility of the outcome measures used. The parent-report measures of child functioning (i.e., the BRIEF & Y-OQ-PR) were easily completed by all parents. However, some important findings in relation to the feasibility of the child measures were identified. The Y-OQ-SR is designed as a repeated measure to track the progress of treatment (Burlingame et al., 2001). However, the participant burden for the older child who completed the Y-OQ-SR would have been too great if she was required to complete this measure weekly. Nonetheless, it proved to be a sensitive measure of change and provided important feedback from the child's perspective on the three occasions on which it was completed. Further, RSA was used as an index of potential improvement in self-regulatory processes. However, the data were less reliable than anticipated and we hypothesised that this could partially be attributed to the timing of the physiological assessments. Thus, the use of RSA in future studies may need to have greater standardisation around the time of day of measurement.

In relation to the acceptability and suitability of the intervention, parents identified several aspects of the intervention that they found particularly helpful. For

example, both families spoke about the importance of the relationship with the therapist. This is an important aspect of the PuP program, because the therapeutic alliance that the PuP therapist develops with a family is considered to be critical to treatment effectiveness. Further, this is an empirically supported notion as many "relationship factors" have been found to be robust predictors of outcome, including the alliance, therapist genuineness, positive regard, and empathy (Norcross, 2011).

Parents also identified that the flexibility of the intervention as helpful. This is also an important aspect of the PuP program, because the modules are designed to be administered in varying orders depending on the families' needs. Further, therapists need to be responsive to the emerging therapy context. For instance, they may need to deviate from session plans to provide support in an unexpected family crisis. This is also an empirically supported notion, as there is increasing objection to the rigid "cookbook"-style approaches of many manualised therapies (Beutler & Howard, 1998), which are inclined to focus on the outcome rather than the processes of therapy (Barlow, 1996) and tend to lack ecological validity (Persons & Silberschatz, 1998).

Preliminary examination of quantitative and qualitative outcomes suggested that the PuP program has promise as an intervention for children with FASD. Both families reported qualitative improvements in their parent–child relationship; specifically, parents could spend increasing amounts of time in positive interactions with their children. The positive outcomes in this domain are particularly noteworthy, because previous evidence indicates that the quality of the parent-child relationship has an important influence on the development of self-regulation (Calkins, 2007; Fox & Calkins, 2003).

Both families also reported quantitative improvements in their children's psychosocial distress. The Y-OQ-PR results were discussed with the parents after each assessment was completed. Previous research has shown that providing this feedback

can significantly increase clients' progress and treatment effectiveness (Lambert, Jasper, & White, 2005). The results from the Y-OQ-PR were also supported in the interviews from both families where they verbally reported improvements in their children's behaviour and interpersonal functioning.

All parents communicated in their follow-up interviews that their increased understanding of the neurological basis for some of their children's challenging behaviours may have contributed to the positive changes in this domain. This is consistent with previous intervention research that also found that providing caregivers with information about the child's neurodevelopmental deficits is a critical component of interventions for children with FASD (e.g., Kable et al., 2016). This finding was also consistent with Petrenko, Pandolfino, and Roddenbery (2016), who found that when caregivers attributed their child's misbehaviour to underlying neurodevelopmental disabilities they felt more confident in managing their behaviour and were more likely to use antecedent rather than consequence-based behaviour strategies. It was also encouraging that the older child who completed the Y-OQ-SR felt that she had personally experienced significant improvements in her psychosocial functioning following the intervention.

Both children who completed treatment showed fewer errors when completing the inhibition tasks; however, as a result of being more careful, the completion time generally increased. Consequently, in real life situations (e.g., completing school or homework), although their ability to inhibit their behaviour may have improved, they may require extra time to complete tasks or activities. However, it should also be considered that Child 2 was performing at a reasonably high level on this task at the pre-assessments, with many of her scores already at an Expected Level or Above an Expected Level for her age. It is interesting to consider Child 2's relatively high level of performance on this task, compared to the parent reports of her EF abilities

in everyday life (i.e., the BRIEF). It is possible that objective measures of EFs fail to capture daily EF abilities. That is, Child 2 may have adequate EF abilities under ideal conditions (i.e., in a controlled distraction-free environment); however, she may not be able to employ these skills in the more complex situations that she faces in her everyday life.

Alternatively, the difference between the scores on these two measures may also reflect a third parental variable, such as parental frustration or stress, which could be influencing the scores on the parent report measure in this domain (Gross, Deling, Wozniak, & Boys, 2015). This may also be relevant regarding previous interventions targeting self-regulation (e.g., Nash et al., 2015; Wells et al., 2012) who found statistically significant change on the BRIEF; however, the mean scores remained in the elevated range post-intervention. This highlights the importance of including family-focused interventions relating to parent self-regulation to improve parent-child relationships and to assist children in generalising their self-regulatory skills.

**Limitations**

There are several limitations of the current study that can be addressed in future research. A systematic assessment of the risk of bias should be conducted for future studies, that includes independence of the assessment and follow-up measures from the delivery of treatment and ensuring that the assessments are conducted by a researcher who is blind to the treatment condition. Second, future research should consider the use of additional self-report measures for young children and the inclusion of quantitative measures to assess parent and family functioning. Finally, the current study utilized a minimum of three baseline measurements as recommended by Beeson and Robey (2006); however, stability was not established for all parents. Future research using single-case methodology could consider extending the baseline period.

## Conclusions

There is growing interest regarding interventions that can improve self-regulatory outcomes for children with FASD, because assisting children to develop these foundational skills in self-regulation is proposed to underpin future adaptive functioning. The current study was one of the first studies to implement a multifaceted intervention that aimed to improve self-regulatory skills in children with FASD through focusing on improving the parent-child relationship and incorporating mindfulness-based techniques for both parents and children. The results provide preliminary support for the feasibility of an adapted version of the PuP program to support the needs of children with FASD and their families.

# Chapter 7
# General Discussion

The broad objective of the present thesis was to advance the understanding of factors that could improve outcomes for children with FASD and their families. In the final chapter, the key findings from each study are summarised and the methodological limitations are outlined. Additionally, the chapter provides an overview of the implications and recommendations for future research. See Table 7.1 for an overview.

## Summary of the Results

The aim of the first study in the thesis was to contribute information regarding the diagnostic and clinical outcomes of a group of children who attended an FASD diagnostic service. A total of 31 participants agreed to have their data included in the study. The results showed that the majority of children were diagnosed with Static Encephalopathy Alcohol Exposed or Neurobehavioral Disorder Alcohol Exposed. Consequently, in line with previous research, the majority of children did not present with the physical signs of prenatal alcohol exposure. Furthermore, and consistent with previous research, the majority of children were also diagnosed with a comorbid condition, with approximately half also having a diagnosis of ADHD (e.g., Astley, 2010).

Another key finding, again consistent with prior research (e.g., Streissguth et al., 2004), was that a large proportion of children had also experienced a range of other adverse environmental exposures (e.g., trauma, neglect or multiple care placements). Notably, it has been documented that receiving an early FASD diagnosis can be an important protective factor for children against later adverse life outcomes, such as incarceration, drug/alcohol, and mental health problems (Streissguth et al., 2004). Importantly, the findings of the first study demonstrated that once appropriate training in diagnosis had been obtained, it was possible to establish a multi-disciplinary

FASD assessment and diagnostic services within the existing Australian public health services.

Subsequently, after the establishment of the first FASD assessment and diagnostic service operating permanently within an Australian health service, it was then important to ascertain what effective intervention options were currently available to provide to children and their families. An additional aim of Study 2 was to identify any potential gaps in the literature, so as to inform the development of new intervention approaches. Consequently, Study 2 employed systematic review methodology to comprehensively search and appraise available interventions for individuals with FASD. A total of 32 studies were identified and reviewed. The methodological quality of the included studies was assessed using the Effective Public Health Project (EPHPP) assessment tool (Thomas et al., 2004). The majority of studies were rated as strong in their design and data collection methods. None of the included studies were rated as strong for selection bias or blinding.

Regarding the characteristics and findings of the included studies, two focused on early intervention in the postnatal period and six studies aimed to improve attention and/or self-regulation in children. Three of these provided promising evidence on improving self-regulatory difficulties for children with FASD. Nine studies focused on improving specific areas of dysfunction (e.g., maths skills, safety skills). Six studies addressed social skills; three of these used an adaptation of a well-validated social skills program (i.e., the Child Friendship Training Program). Three studies provided promising initial evidence that parents and caregivers could benefit from support with child behaviour, and a further four studies provided education and advocacy for parents/caregivers, teachers or child welfare workers. The last two studies reviewed aimed at supporting parents who were themselves affected by prenatal alcohol exposure.

Overall, the review found that there was growing evidence for interventions to improve outcomes in early to middle childhood. However, a lack of research was found outside of this developmental period. Furthermore, the findings from Study 2 emphasized the wide variety of interventions that had been trialled and consequently, highlighted the fact that the difficulties facing individuals with FASD do not lie in a single domain of functioning. Thus, it was proposed that the way forward was to consider the complex interaction between individual characteristics and the wider ecological context in which the individual lives. Therefore, it was suggested that future interventions should address multiple domains of functioning for individuals with FASD.

One of the key findings from Study 2 was that there was promising evidence for improvements in self-regulation for children with FASD. This led to the consideration of contemporary models that could be employed for improving self-regulatory functioning. This was specifically through considering the underlying physiological processes that play an important role in the development of self-regulatory skills (Calkins, 2007). This is a notion which is further articulated in Thayer and Lane's neurovisceral integration model (Thayer et al., 2009), which suggests that neural networks involved in autonomic, emotional and cognitive self-regulation (i.e., the prefrontal cortex) are also involved in controlling cardiac autonomic activity (Park & Thayer, 2014). Therefore, the measure of respiratory sinus arrhythmia (RSA) may serve as a peripheral index of prefrontal cortex functioning (Thayer et al., 2012).

Notably, previous research has found that baseline RSA is particularly sensitive to early environmental experiences, such that higher or lower RSA may be adaptive given the environment in which a child is raised (e.g., Conradt et al., 2014). However, there was limited research regarding children with FASD. Consequently, the first aim of Study 3 was to explore the differences in baseline RSA between children

with an FASD diagnosis and typically developing children. Importantly, there are a number of strategies that can be implemented to change an individual's resting level of RSA (Thayer et al., 2009), including mindfulness-based techniques. Therefore, the second aim of Study 3 was to investigate if children with FASD were able to engage in a brief mindfulness exercise.

The results showed that children with an FASD diagnosis had lower baseline RSA compared to the typically developing children. Further, children with FASD were able to comply with the mindfulness task instructions and demonstrated an increase in RSA during the mindfulness exercise, thus, providing some initial support for the inclusion of mindfulness-based techniques in interventions for these children. However, in the light of previous research showing that higher RSA can be associated with more behavioural difficulties for children living in stressful family environments, the inclusion of mindfulness-based strategies would need to be in the context of an intervention aimed at improving the quality of family functioning more generally.

The final study employed a mixed methods approach to evaluate the feasibility of using an adaptation of the Parents under Pressure (PuP) Program. The PuP program addresses self-regulatory processes, through improving the parent-child relationship and the use of mindfulness-based strategies for both children and parents. Feasibility was examined by evaluating recruitment, data collection/outcome measures and intervention procedures. The study utilised a phenomenological approach to obtain qualitative information from caregivers, and a single-case experimental design to evaluate the preliminary participant responses to the intervention. Two out of three families completed treatment. The recruitment and intervention procedures were found to be suitable for and acceptable to the families involved. Some concerns were identified with the outcome measures that would need to be addressed in future research. Examination of quantitative and qualitative outcomes were positive, including

improvements in child psychosocial functioning and the parent-child relationship. The results provided preliminary support for the implementation of an adapted version of the PuP program, thus offering a further option to support the needs of children with FASD and their families.

Table 7.1

*Summary of Aims, Key Findings, and Implications of Each Study*

| Chapter/Study & Aims | Key Findings | Theoretical Implications | Clinical Implications | Policy Implications |
|---|---|---|---|---|
| **Chapter 3: Study 1**<br><br>Aims: (i) report on the diagnostic profile of a group of children diagnosed with FASD, (ii) document comorbid diagnoses and (iii) provide information on the neurocognitive functioning of children diagnosed with FASD. | Clinic based outcomes on 31 children. 11 children each diagnosed with SE/AE or ND/AE; One child diagnosed with FAS; Five children diagnosed with pFAS. Majority of children were not in the care of their biological parents (80%). 84% had a comorbid diagnosis (most prevalent was ADHD). 45% had experienced trauma or neglect | Diagnostic features were consistent with other published reports that had also implemented the 4-Digit Code. | Majority of children did not present with the physical features of prenatal alcohol exposure. Number of the children had experienced other risk factors – treatment planning needs to consider the range of difficulties that children and their families face. | Assessment and diagnostic services need to be expanded in Australia. Need for a wider range of services (e.g., screening processes, earlier diagnosis, diagnostic services for adolescents/adults and access to ongoing support post-diagnosis). |
| **Chapter 4: Study 2**<br><br>Aims: Identify studies from across the life span that focused on improving well-being and functioning for individuals with FASD through the provision of behavioural | 32 studies were included in the review. Growing evidence for interventions that improve outcomes for early to middle childhood. Particularly, interventions focused on self-regulation. However, a lack of research | Provided support for proposed unified conceptual framework (Petrenko, 2015) that brings together models proposed by Kodituwakku (2010) and Olson et al. (2009) and takes into account the lived experience of | Wide range of interventions trialled recognises difficulties facing individuals with FASD do not lie in single domains of functioning. Suggested that future research should take into account individual and ecological factors and | Need to develop and provide interventions outside of the early-middle childhood i.e., interventions for infants/toddlers and also adolescents and adults. Government funding needs to be provided to enable the development |

| | | | | |
|---|---|---|---|---|
| treatment, advocacy or support. | outside this developmental period. | individuals and families with FASD to guide intervention development. | therefore address multiple domains of functioning. Acknowledged benefits of targeting self-regulation as a focus of interventions. | and implementation of interventions for all individuals with FASD. |
| **Chapter 5: Study 3**<br><br>Aims: (i) Exploration of differences in baseline RSA between school-aged children with FASD, many of whom had experienced other pre- and/or post-natal exposures, compared to typically developing children. (ii) Evaluate the impact of a therapeutic technique (mindfulness meditation) on RSA in children with FASD. | Children with a diagnosis of FASD had lower baseline RSA compared to typically developing children<br><br>Children with FASD were able to comply with the mindfulness instructions and demonstrated an increase in RSA during the mindfulness task. | Children diagnosed with FASD have the physiological capacity to respond to a mindfulness technique. | Importance of considering both individual and family factors when planning interventions. Any mindfulness-based strategies would need to take into account the context that the child lives and if appropriate be provided in conjunction with strategies aimed at improving the quality of family functioning more generally. | More attention needs to be placed on studying potential mechanisms of change for children with FASD to inform the development of evidence-based interventions. |

| | | | | |
|---|---|---|---|---|
| **Chapter 6: Study 4**<br><br>Aims: To evaluate the feasibility of an adaptation of the PuP program that addresses self-regulatory processes through improving the parent-child relationship and the use of mindfulness-based strategies for children and parents. | Two out of three families completed treatment. The recruitment and intervention procedures were found to be suitable for, and acceptable to, the families involved. Examination of quantitative and qualitative outcomes were positive. | Proposed that self-regulatory skills can be improved for children with FASD through focusing on improving the parent-child relationship and through the incorporation of mindfulness-based techniques for both parents and children. | Points to the potential of multi-component family-based approaches to improve outcomes for children with FASD. | Funding needs to be provided to develop evidence-based interventions for children with FASD. More services need to be available for families caring for children with FASD. Education needs to be provided to health professionals and school staff to support the needs of children with FASD. |

**Methodological Considerations**

A number of key methodological limitations need to be acknowledged regarding the current research. As noted previously, although Studies 1 and 3 provided diagnostic and clinical information on some of the first children assessed and diagnosed at an Australian FASD diagnostic clinic, the total numbers of children reported are still small. Further, given that these were some of the first children referred to one of the first available services in Australia, they may not be representative of the wider population of children with FASD. Consequently, future research assessing a larger and more diverse sample of children is required.

Additionally, in Study 3, it is possible that the significant differences in IQ between the FASD group and the typically developing control group influenced the results. There is wide variability in the level of neurocognitive functioning observed for children with FASD. Although we could have excluded the children in the FASD sample with lower IQs, it was clinically relevant to retain these children to see if a group of clinic-referred children with an FASD diagnosis could engage in, and respond to a mindfulness exercise, as some children with FASD do present with significantly reduced intellectual functioning. Future research with a larger sample of non-FASD children matched for IQ would be necessary to establish whether differences in baseline RSA exist after controlling for IQ.

Last, as previously described, the time of day that the physiological assessments of RSA were completed in Study 4 limited the investigation of RSA as a therapeutic outcome measure. Future research should consider taking these assessments at varying time points during the day, rather than just after school. As the technology continues to develop at a rapid pace in the measurement of RSA, with a wider variety of measurement options becoming available, this is likely to become significantly more feasible in the future.

**Implications**

The findings from the thesis point to a number of important implications (see Table 7.1 for an overview). Although awareness of FASD has been increasing in Australia, we are still significantly behind many other developed countries regarding the availability of diagnostic and intervention services. Currently in Australia, diagnosis is typically only available for children 6 – 10 years of age. Furthermore, ongoing support services are not routinely available for families after receiving an FASD diagnosis. Consequently, assessment and diagnostic services need to be significantly expanded in Australia to include younger and older individuals and all families need to have access to ongoing support following diagnosis.

Additionally, consideration needs to be given to the types of diagnostic services being provided for individuals with FASD. Currently, as described in Study 1, due to the comprehensive nature of the assessment process, the Child Development Service (CDS) FASD diagnostic clinic at Southport only has the capacity to see two children per month. Following appropriate training for health professionals; however, all the Child Development Services in Australia could also provide this service. However, not all children who have been exposed to alcohol prenatally may require such an intensive assessment process, as not all children display significant neurocognitive deficits. Furthermore, not all children live in metropolitan areas that allow access to multi-disciplinary diagnostic services. Consequently, screening and streamlined diagnostic processes need to be developed and implemented so that intensive assessment processes can be appropriately provided when required or available and also so that more children in Australia can have access to diagnostic services.

Furthermore, consideration also needs to be given to the types of intervention services that are provided for individuals with FASD. The findings from

the current thesis demonstrate the importance of considering both individual and family factors when planning interventions for children with FASD. Importantly, assessment of children's home environments that includes the quality of the caregiving relationship needs to be considered, given that different intervention approaches will need to be applied based on the context in which children are raised. Further, given the wide variability in presentations of children with FASD it will be important that interventions are individualised based on each child and family's needs (Pei, Baugh, Andrew, & Rasmussen, 2017). Consequently, interventions will need to vary in their intensity depending on the level of support that each family requires. Notably, the Commonwealth Government's national FASD Action Plan (Australian Government, 2013) does not include funding for the expansion of diagnostic or intervention services for individuals with FASD.

Last, the feedback from the families who participated in Study 4 described a lack of knowledge and understanding from health professionals and school staff regarding FASD. This finding was consistent with other qualitative studies of caregivers' views (e.g., Chamberlain et al., 2016; Petrenko, Tahir, Mahoney, & Chin, 2014). The families felt very strongly that education needed to be provided to all professionals who work with children so that they can understand and support the needs of children with FASD. Additionally, both families interviewed in Study 4 communicated that FASD needed to be recognised as a disability in Australia. This finding was also consistent with the views of other Australian caregivers of children with FASD (Chamberlain et al., 2016). The National Disability Insurance Agency (NDIA) has identified FASD as a category of disability for consideration within the National Disability Insurance Scheme (NDIS). Dudley, Reibel, Bower, and Fitzpatrick (2015) provided a review regarding the impairments and interventions for FASD that could be considered within the NDIS, so that effective interventions can be provided for

individuals within an appropriate funding framework. The authors suggested that "the immediate policy implication for NDIA is for FASD to be embedded in the disability sphere as a permanent and lifelong disability that is amenable to intervention and supports to improve life outcomes for affected individuals" (p. 9).

**Recommendations for Future Research**

The findings from the current thesis point to several key directions for future research in this field. First, there is potential for the implementation of multiple-component family-focused interventions, such as the PuP program. Future research is required to ascertain if such approaches will be effective in improving outcomes for children with FASD. Second, there is evidence to support the incorporation of mindfulness-based interventions, in the context of interventions that also improve wider family functioning. Studies 3 and 4 were one of the first studies to include mindfulness-based approaches with children with FASD. Future research is needed to explore the potential of these types of strategies for children and adolescents or adults with FASD. Furthermore, intervention efforts need be significantly expanded, beyond early to middle childhood to include a targeted focus on early intervention and support for adolescents and adults with FASD.

Third, increased research is required that investigates physiological regulation in individuals with FASD. Researchers could consider measuring intervention effects using other tools in addition to the usual standardised assessments. If the focus of the intervention is to improve self-regulatory capacity, then physiological measures such as heart rate, heart rate variability and salivary cortisol could also be used to assess outcomes for individuals with FASD. Importantly, this could be of particular benefit in studies with younger populations, as there are currently not as many standardised assessment tools available, to assess EFs in young children with FASD.

Further research is needed to see if interventions could lead to physiological changes for individuals with FASD.

**Conclusions**

Overall, the current thesis advances the FASD literature in several important ways. In particular, the thesis presented the first study of clinic-based outcomes of a sample of Australian children diagnosed with FASD (Study 1). A comprehensive review of the available intervention literature was provided (Study 2). This review highlighted the potential for interventions to improve self-regulation for children with FASD. Study 3 investigated a novel way to improve self-regulation for children with FASD, namely mindfulness meditation. The results indicated that children with FASD did have the capacity to engage in a brief mindfulness exercise and demonstrated physiological responsiveness, indexed by increased RSA during the mindfulness task. Finally, Study 4 provided preliminary support for the use of a multi-component family-based intervention that included a focus on improving the parent-child relationship and mindfulness strategies for parents and children. Collectively, these findings have important implications for diagnostic, intervention and policy practices, and future research with the FASD population.

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In order to comply with copyright the articles in Appendix A and B have been removed.

## Appendix C: Supplementary Tables for Chapter 3

Supplementary Table 1

*Overview of the 4-Digit Diagnostic Code Criteria*

| Rank | Growth deficiency | FAS facial phenotype | Probability of CNS damage | Prenatal exposure to alcohol |
|---|---|---|---|---|
| 4 | **Significant** Height and weight <3rd %tile | **Severe** All 3 features: PFL 2 or more SDs below mean Thin lip: rank 4 or 5 Smooth Philtrum: rank 4 or 5 | **Definite** Structural and/ or neurologic evidence | **High Risk** Confirmed exposure to high levels i.e. high peak blood alcohol concentrations delivered at least weekly in early pregnancy |
| 3 | **Moderate** Height or weight < 3rd %tile | **Moderate** 2.5 features | **Probable** Significant dysfunction across 3 or more domains | **Some Risk** Confirmed exposure. Level of alcohol use is less than Rank 4 or level is unknown |
| 2 | **Mild** Height and/or weight >3rd and ≤ 10th or Height or Weight > 10th | **Mild** 1-2 features | **Possible** Evidence of dysfunction, but less than rank 3 | **Unknown** Exposure not confirmed present or absent |
| 1 | **None** Height and weight > 10th percentile | **None** No features | **Unlikely** No structural neurologic or functional abnormalities | **No Risk** Confirmed absence of exposure from conception to birth |

*Note:* PFL = palpebral fissure length; SD = standard deviation; %tile = percentile
Source: Astley, 2004

Supplementary Table 2

*Definitions of CNS Ranks 1 through 4*

| | |
|---|---|
| **CNS Rank 4:** Structural/Neurological Abnormalities Definite Evidence of CNS damage | This rank is selected when the evidence for CNS damage is defined through a traditional medical approach.<br><br>At least one significant structural or neurological finding is required.<br><br>Structural evidence may include, but is not limited to: Microcephaly, defined as occipital frontal circumference 2 or more standard deviations below the mean or Significant brain abnormalities observable through imaging.<br><br>Neurological evidence may include, but is not limited to: Seizures or other hard neurological signs. |
| **CNS Rank 3:** Significant Dysfunction Probable evidence of CNS damage | This rank is based on evidence from standardised psychometric assessments that are administered directly to the individual or obtained from a reliable informant.<br><br>Significant impairment is defined as performance 2 or more standard deviations below the mean on a standardised test (i.e. below the 3rd percentile).<br><br>Important to also consider whether there are significant differences (i.e. at least 1SD) between test subdomains within the individual's profile that are unusual or occur rarely in the normative population. |
| **CNS Rank 2:** Mild to Moderate Delay/Dysfunction Possible evidence of CNS damage | This rank is also based on evidence from standardised psychometric assessments.<br><br>Scores > 1SD and < 2SDs below the mean.<br><br>This rank could also be assigned to individuals who have not yet been able to complete all the testing e.g. they are too young to be tested, typically less than 6 years. |
| **CNS Rank 1:** No Current evidence of Delay/dysfunction No current evidence of CNS damage | No functional or developmental problems are identified. |

Source: Astley, 2004

Supplementary Table 3
*Overview of Brain Domains and Assessment Methods*

| **Brain domain** | **Assessment tools used** |
|---|---|
| Neurological/Motor | Standard neurological examination conducted by a Paediatrician |
| Cognitive | Wechsler Intelligence Scale for Children – 4th Edition (WISC-IV) |
| Communication | Clinical Evaluation of Language Fundamentals – 4th Edition (CELF-4) |
| Academic | Wechsler Individual Achievement Test – 2nd Edition (WIAT-II) |
| Memory | NEPSY-2 Developmental Neuropsychological Assessment – 2nd Edition (NEPSY-II) |
| Executive Function | Behaviour Rating Inventory of Executive Function (BRIEF) |
| | NEPSY-2 Developmental Neuropsychological Assessment – 2nd Edition (NEPSY-II) |
| | Test of Problem Solving – Elementary (TOPS 3) |
| Attention | NEPSY-2 Developmental Neuropsychological Assessment – 2nd Edition (NEPSY-II) |
| | Child Behaviour Checklist for ages 6 – 18 (CBCL) |
| | Teacher Report Form for ages 6 – 8 years (TRF) |
| Adaptive, Social behaviour | Adaptive Behaviour Assessment System – 2nd Edition (ABAS-II) |
| | Social Language Development Test, Elementary (SLDT-E) |
| | CELF-4 Pragmatics Profile |

Supplementary Table 4

*Terminology used to describe the 22 Diagnostic Categories of the 4-Digit Diagnostic Code*

| | |
|---|---|
| Sentinel Physical findings | This term is used when an individual presents with growth deficiency at the Rank 3 or 4 level and/or FAS facial phenotype at the Rank 3 or 4 level. |
| Static encephalopathy | This term is used when an individual presents with significant structural, neurological. And/or functional abnormalities that strongly support the presence of underlying CNS damage at the Rank 3 or 4 level. The term does not define or suggest any specific pattern. |
| Neurobehavioural disorder | This term is used when an individual presents with cognitive/behavioural dysfunction at the Rank 2 level and no evidence of structural, neurological or functional abnormalities at the Rank 3 or 4 levels. |
| Alcohol Exposed, Not exposed or Exposure Unknown | These terms are used to reflect prenatal alcohol exposure and its potential risk to the unborn child. Alcohol exposure is reported independently of outcomes and does not imply that a causal association exists between the exposure and the outcomes. |
| Fetal alcohol syndrome (alcohol exposed) | The term FAS is used to refer to an individual who presents with one of the 12 4-digit diagnostic code combinations reflecting growth deficiency; the full facial phenotype; significant structural, neurological, and/or functional CNS abnormalities; and confirmed prenatal alcohol exposure. |
| Fetal alcohol syndrome (alcohol exposure unknown) | A diagnosis of FAS can be made when prenatal alcohol exposure is unknown. Six possible codes fall under this category. |
| Partial fetal alcohol syndrome (alcohol exposed) | This term is used for individuals who present with static encephalopathy, most (but not all) of the growth and/or facial features of FAS, and have a confirmed history of prenatal alcohol exposure. 20 possible codes fall under this category |
| Fetal alcohol syndrome phenocopy (no alcohol exposure) | This term is used when an individual who meets the growth, face and CNS criteria, but has a confirmed absence of alcohol exposure. This has not yet been observed. |

*Note:* The above terms are used in various combinations to name the 22 diagnostic categories that the 256 possible 4-digit Diagnostic Codes fall under.

Source: Astley, 2004

## Appendix E: Supplementary Table for Chapter 4

| Organisation | Current intervention services listed on website & any unpublished reports found |
|---|---|
| Community Living BC | Supports for individuals and families affected by FASD |
| Ministry of Children and Family development – British Columbia | Key Worker and Parent Support Program – **summative report found** |
| Yukon Government | Supported living for adults with FASD |
| Healthy Child Manitoba | New directions – FASD family support, education & counselling program<br>Bridges FASD school program<br>Building circles of support – 8 week parenting information service<br>FASD family network |
| Asante centre | Family & individual support<br>Justice-involved youth with FASD – survey of practices and focus group |
| Canada FASD research network | Strongest families – currently being developed |
| FASD support network of Saskatchewan | Family support groups |
| FASDOntario | Support groups, Financial aid/planning, assisted employment and housing |
| Northwest FASD partnership | (website under construction) |
| FASD connections | Support group for parents<br>Motor skills intervention – Simon Fraser University |
| Canadian centre on substance use | None listed |
| NeuroDevNet | Neurofeedback – video games – currently being investigated |
| FAS world.com | None listed – links to support groups |
| FASlink | The TRIUMF project – proposal |
| Gov. Alberta – Calgary Network | Funds 8 organisations to provide services to indviduals and families with FASD<br>1 offered PCAP |
| Gov. Alberta – Edmonton Network | PCAP<br>CSS – step by step program<br>CSS – coaching families program<br>Bissell centre<br>Bosco homes – PCAP and other services<br>CASA – mental health services for children with FASD<br>Elizabeth Fry society – support and mentorship to girls with FASD<br>Elves – respite for families with children with FASD<br>Bridges program – long-term support for adults with FASD |

| | |
|---|---|
| | Metis nation FASD program – support to adults and youth<br>WRAP project – support to school students with FASD |
| Gov. Alberta –Lakeland network | Assessment, diagnosis and parent and individual support – **service evaluation found** |
| Gov. Alberta – Mackenzie network | Family coach program – intensive support to families<br>PCAP<br>Youth coach<br>Pebbles FASD education |
| Gov. Alberta – Metis Settlement Network | "supports through the lifespan"<br>PCAP |
| Gov. Alberta – Northeast Network | PCAP<br>Mental health therapy , group support, mentorship outreach & family support |
| Gov. Alberta – Northwest Network | "FASD supports for individuals and families"<br>PCAP |
| Gov. Alberta – Northwest Central Network | Offers support services |
| Gov. Alberta – Prairie Central Network | PCAP<br>CSS |
| Gov. Alberta – Southeast Network | Mentoring for individuals and families (adult program)<br>First steps-Bridges – PCAP model<br>FASD youth mentor program<br>FASD transition program |
| Gov. Alberta – South Network | McMan life span program – parents and caregivers of children, coaching for adults, work and finances<br>Youth and adult justice programs |
| Telethon Institute | 'Liliwan Project' Prevalence study reported |
| Russell Family | Links to support groups |
| NoFASD | Support groups |
| The George Institute | Marulu - Overcoming Fetal Alcohol Spectrum Disorders (FASD) – underway |
| Fetal Alcohol network New Zealand | None listed |
| Ministry of Health | None listed |
| NoFAS-UK | Support groups |
| FAS Aware | Links to support groups |
| FASD Network UK | Virtual support group |
| The European Birth Mother network | Links to support groups |
| FASCETS | Educational workshops for parents and professionals |
| National Institute on Alcohol Abuse and Alcoholism (NIAAA) | The Collaborative Initiative on Fetal Alcohol Spectrum Disorders (CIFASD) is a multidisciplinary consortium of domestic and international projects established by NIAAA in 2003 – no reports/unpublished info found |

| | |
|---|---|
| No FAS | The circle of hope – support group for mothers |
| Centers for Disease Control and Prevention (CDC) | Project Step Up – University of California – adolescents – underway<br>Partners for success – Saint Louis University – adolescents – underway |
| Washington FAS Diagnostic and Prevention Service | Families moving Forward Project &<br>Social communication intervention listed as underway<br>A NIAAA-sponsored study (Co-PIs: Westcott & Jirikowic, 2009-2014) listed as currently underway |

## Appendix F: Supplementary Material for Chapter 5

Results of a sub-sample analysis of the boys

A mixed ANOVA was conducted to explore the differences between the two groups (FASD and TDC) on RSA across the three conditions (pre-mindfulness, mindfulness and post-mindfulness). There was no significant interaction between group and condition, $F$ (2, 34) = .54, $p$ = .59, partial eta squared = .03. There was a main effect of condition, $F$ (2, 34) = 11.49, $p$ = .00, partial eta squared = .40. Both groups showed an increase in RSA during the mindfulness condition (see Supplementary Table 1). The main effect comparing the two groups was also significant, $F$ (1, 17) = 11.67, $p$ = .00, partial eta squared = .99. The FASD group showed significantly lower RSA across all conditions.

Supplementary Table 1

*Male Sub-Sample Means and Standard Deviations for Pre-, During and Post-Mindfulness*

| | FASD ($n$ = 9) Mean (SD) | TDC ($n$ = 10) Mean (SD) |
|---|---|---|
| Pre-mindfulness RSA | 6.93 (.97) | 8.21 (.90) |
| Mindfulness RSA | 7.45 (.90) | 8.66 (.82) |
| Post-Mindfulness RSA | 6.71 (.84) | 8.20 (1) |

## Appendix G: Supplementary Tables for Chapter 6

Supplementary Table 1

*Feasibility Questionnaire*

| Objective | Questions | Response |
|---|---|---|
| 1. Evaluation of recruitment capability and resulting sample characteristics | **Main question:** Can we recruit appropriate participants?<br><br>a) How many potential eligible members of the targeted population are accessible?<br>b) What were the recruitment rates<br>c) How feasible and suitable are eligibility criteria?<br>d) What are the obstacles to recruitment?<br>e) How relevant is the intervention to the intended population? | a) The diagnostic clinic where the families were recruited had the capacity to see two children per month for diagnosis. They had previously seen approximately 30 children. For the purposes of the current study we had accessibility to enough participants. However, if future larger studies were to take place this would be an important consideration as the referral base would be relatively small. Although, as time progresses, the numbers of children diagnosed are increasing and it is planned to expand the diagnostic services in 2017.<br>b) We initially started with one family and then increased to having three in treatment. There were no families who refused treatment.<br>c) For the current study we just had referrals from the clinic for three families who had attended the clinic and had a FASD diagnosis and lived locally. We had no other eligibility criteria and no difficulties were encountered with this.<br>d) No obstacles to recruitment for the current study<br>e) The choice to implement the intervention was based on a systematic literature review of previous intervention work so there is strong evidence that the intervention was relevant. The pre-assessments indicating the level of behavioural difficulties that the families were reporting and the qualitative reports from the families also supported this. |

| | | |
|---|---|---|
| 2. Evaluation and refinement of Data collection procedure and outcome measures | **Main question:** How appropriate are the data collection procedures and outcome measures for the intended population and purpose of the study?<br><br>a) How feasible and suitable are the data collection procedures? | a) No problems found with the parent report measures. Each of the parent reports took approximately 10minutes to complete. Parents reported that it was helpful completing the Y-OQ as a repeated measure and discussing the progress or lack of progress between each time the measure was completed. The parents had no difficulties completing the assessments and there was no missing data. There was an issue encountered with the self-report Y-OQ – the older child who completed this measure took substantially longer to complete it than the usual time (i.e., 25minutes compared to 10-15minutes). Therefore it was decided to just use this as a pre-post & follow-up measure rather than a repeated measure. There were also issues with the measurement of RSA which have been discussed in detail in the manuscript. There were no difficulties with the children completing the NEPSY however we have concerns regarding practice effects having them complete it three times in such a short time frame. |
| 3. Evaluation of acceptability and suitability of intervention and study procedures | **Main question:** Are the study procedures and intervention suitable for and acceptable to participants?<br><br>a) What are the retention and follow-up rates?<br>b) What are the adherence rates to study procedures, intervention attendance and engagement?<br>c) What is the level of safety of the procedures in the intervention? | a) Two out of three families completed treatment and follow-up.<br>b) Both families who completed treatment had a high level of attendance and engagement. This is supported in the qualitative data. Parents reported that the flexibility of the intervention was an important factor. Attendance may have partly been high because the sessions took place in the families' homes so they did not need to travel.<br>c) There were no adverse events reported. |
| 4. Evaluation of resources and ability to | **Main question:** Does the research team have the resources and ability to | a) The therapist had experience working with children and adolescents with FASD and other developmental |

| | | |
|---|---|---|
| manage and implement the study intervention | manage the study and intervention?<br>a) Does the research team have the administrative capacity, expertise, skills, space and time to conduct the study and intervention?<br>b) Can we conduct the study procedures and intervention in an ethical manner?<br>c) Can the study and intervention be conducted within the designated budget?<br>d) Is the technology and equipment sufficient to conduct the study and intervention?<br>e) Are we able to efficiently and effectively manage data entry and analysis? | disabilities. The other research team members had experience in implementing intervention studies (single-case and RCTs). All members had the time and capacity to conduct the intervention.<br>b) The researchers all complied with the HREC ethics protocol.<br>c) The study received no additional funding besides the 1st author's Research Training Program funding. Future research would benefit from funding to be able to provide the intervention to more families.<br>d) As improvements in technology for measuring heart rate improve and the prices for more advanced equipment become more affordable the inclusion of this as outcome measure will become more feasible.<br>e) Due to the small sample size the time required for data management and analysis was minimal. This would be an important consideration for future larger studies. |
| 5.Preliminary evaluation of participant responses to intervention | **Main question:** Does the intervention show promise of being successful with the intended population?<br>a) Does examination of the quantitative data suggest that the intervention is likely to be successful?<br>b) Do participants provide qualitative feedback that may be indicative of the likelihood that the intervention will be successful? | a) Yes, the quantitative data shows improvements for both families.<br>b) Yes, both families provided qualitative feedback regarding the benefits they experienced from taking part in the intervention. |

Supplementary Table 2

*Criteria for Determination of Clinically Significant Change in Treatment Outcomes*

| Outcome | Clinically significant change (exceed cut-off?) | RCI |
|---|---|---|
| Recovered | Yes | > 1.96 |
| Improved | No | > 1.96 |
| Unchanged | No | - 1.96 < 0 > 1.96 |
| Deteriorated | No | < - 1.96 |

*Note:* RCI = Reliable Change Index

Source: Jacobson & Truax (1991)

Supplementary Table 3

*Additional Themes Identified*

| Themes & subthemes | Example quotations |
|---|---|
| *Major theme: Concerns relating to education and health systems* | |
| Lack of funding and support available in school for their children. | "They [the school] say their hands are tied because there is no actual funding for her. They try to do what they can but with no funding available it is really hard" (P2). "Resources are miniscule…" (P3) |
| Frustration with previous health professionals | "Do not write off mothers as being neurotic and that they wouldn't know what they are talking about because we are not the professionals or because you haven't heard about it [FASD] so there is no such thing as it" (P2). "If you said to me do you think the medical profession has let [child's name] down I would say totally" (P3). |
| Need for education of health professionals and school staff | "It is just education, needs to be a lot more education out there" (P1). "I would like a lot more professional people to be educated about FASD. Particularly in the school system and even in the day-care system" (P2). |
| *Major theme: Need for increased awareness of FASD and support for families* | |
| FASD needs to be recognised as a disability | "FASD needs to be a recognised disability that I think is paramount" (P3). "I would like to see the government recognise FASD as a disability. Through Centrelink, through government departments everywhere that [child's name] has got a diagnosed problem and then the different help that could be available" (P2) |

**Appendix H: Ethics Approval Letters**

Gold Coast Health
Building a healthier community

Queensland Government

Office of the Human Research Ethics Committee

21 July 2015

Enquiries to: HREC Coordinator
Phone: 07 5687 3879
HREC Ref HREC/15/QGC/121
E-mail:: GCHEthics@health.qld.gov.au

Miss Natasha Reid
Southport Health Precinct
16-30 High St
Southport QLD 4215

Dear Miss Reid

**HREC Reference number: HREC/15/QGC/121**
**Project title:** Description of a new diagnostic service for Fetal Alcohol Spectrum Disorders

Thank you for submitting the above project for ethical and scientific review. This project was first considered by the Gold Coast Health Service District Human Research Ethics Committee (HREC) held on 15 July 2015.

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007)* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

I am pleased to advise that the Human Research Ethics Committee has granted approval of this research project. The documents reviewed and approved include:

| *Document* | *Version* | *Date* |
|---|---|---|
| Response to Request for Further Information | | 30 June 2015 |
| Study Protocol | Version 1 | 02 April 2015 |
| Confirmation Letter | | 06 July 2015 |
| Site Specific Consent Form | | 06 July 2015 |
| Site Specific Participant Information Sheet | | 06 July 2015 |
| CV's | | |
| Application | | |

Please note the following conditions of approval:

1. The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:
    a. Unforeseen events that might affect continued ethical acceptability of the project.
    Serious Adverse Events must be notified to the Committee as soon as possible. In addition the Investigator must provide a summary of the adverse events, in the specified format, including a comment as to suspected causality and whether changes are required to the Patient Information and Consent Form. In the case of Serious Adverse Events occurring at the local site, a full report is required from the Principal Investigator, including duration of treatment and outcome of event.

2. Amendments to the research project which may affect the ongoing ethical acceptability of a project must be submitted to the HREC for review. Major amendments should be reflected in a revised online NEAF (accompanied by all relevant updated documentation and a cover letter from the principal investigator,

providing a brief description of the changes, the rationale for the changes, and their implications for the ongoing conduct of the study). Hard copies of the revised NEAF, the cover letter and all relevant updated documents with tracked changes must also be submitted to the HREC coordinator as per standard HREC SOP. Further advice on submitting amendments is available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

3. Amendments to the research project which only affect the ongoing site acceptability of the project are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the Research Governance Office/r (by-passing the HREC).

4. Proposed amendments to the research project which may affect both the ethical acceptability and site suitability of the project must be submitted firstly the HREC for review and, once HREC approval has been granted, then submitted to the RGO.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the project (e.g. typographical errors) should be submitted in hard copy to the HREC coordinator. These should include a cover letter from the principal investigator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the project is discontinued at a site before the expected date of completion.

7. The Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

8. The District administration and the Human Research Ethics Committee may inquire into the conduct of any research or purported research, whether approved or not and regardless of the source of funding, being conducted on hospital premises or claiming any association with the Hospital; or which the Committee has approved if conducted outside [name] Hospital Health Service District.

HREC approval is valid for 3 Years from the date of this letter. **Expiry 8th July 2018**.

Should you have any queries about the HREC's consideration of your project please contact the HREC Coordinator on ph 07 5687 3879]. The HREC terms of Reference, Standard Operating Procedures, membership and standard forms are available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

**You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a site until separate authorisation from the District CEO or Delegate of that site has been obtained.**

**A copy of this approval must be submitted to the District Research Governance Officer/Delegated Personnel with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the GCHHS.**

Once authorisation to conduct the research has been granted, please complete the Commencement Form (Attachment II) and return to the office of the Human Research Ethics Committee.

The HREC wishes you every success in your research.

Yours sincerely

Steve Morris
**A/HREC Co-ordinator**
**Gold Coast Hospital and Health Service**
Human Research Ethics Committee (EC00160)

# Queensland Health

Queensland Government

Office of the Human Research Ethics Committee

20 January 2014

Enquiries to: Tanya Douglass
Phone: (07) 5687 3879
Our Ref: HREC/13/QGC/154
E-mail GCHEthics@health.qld.gov.au

Miss Natasha Reid
Griffith University Mt Gravatt Campus
176 Messines Ridge Road
Mt Gravatt QLD 4122

Dear Miss Reid,

**HREC Reference number: HREC/13/QGC/166**
**Project title:** An investigation of self-regulation abilities in young children: A comparison of typically developing children and children with prenatal alcohol exposure

Thank you for submitting the above project for ethical and scientific review. This project was first considered by the Gold Coast Health Service District Human Research Ethics Committee (HREC) held on 26th February 2014.

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007)* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*. Attached is the HREC Composition with specialty and affiliation with the Hospital (Attachment I).

I am pleased to advise that the Human Research Ethics Committee has granted approval of this research project. The documents reviewed and approved include:

| *Document* | *Version* | *Date* |
|---|---|---|
| Covering Letter | | 11 November 2013 |
| Patient Information Sheet/Consent Form | | 11 November 2013 |
| Patient Information Sheet/Consent Form | | 11 November 2013 |
| Patient Information Sheet/Consent Form | | 11 November 2013 |
| Investigator CV | | 12 November 2013 |
| Investigator CV | | 12 November 2013 |
| Investigator CV | | 12 November 2013 |
| Investigator CV | | 12 November 2013 |
| Investigator's Brochure | | 10 November 2013 |
| Peer Review | | 10 November 2013 |
| Advertisement | | 11 November 2013 |
| Application | | 11 November 2013 |
| Covering Letter | | 11 November 2013 |
| Investigator CV | | 11 November 2011 |
| Master Consent Form | | 11 November 2013 |
| Master Participant Information Sheet | | 11 November 2013 |
| Other | | 11 November 2013 |

| | | |
|---|---|---|
| Response to Request for Further Information | | 12 February 2014 |
| Application | Version 1.2 | 11 February 2014 |
| Master Consent Form | | 12 February 2014 |
| Master Participant Information Sheet | | 12 February 2014 |
| Other | | 12 February 2014 |
| Other | | 12 February 2014 |
| Other | | 12 February 2014 |

Please note the following conditions of approval:

1. The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:
    a. Unforeseen events that might affect continued ethical acceptability of the project. Serious Adverse Events must be notified to the Committee as soon as possible. In addition the Investigator must provide a summary of the adverse events, in the specified format, including a comment as to suspected causality and whether changes are required to the Patient Information and Consent Form. In the case of Serious Adverse Events occurring at the local site, a full report is required from the Principal Investigator, including duration of treatment and outcome of event.

2. Amendments to the research project which may affect the ongoing ethical acceptability of a project must be submitted to the HREC for review. Major amendments should be reflected in a revised online NEAF (accompanied by all relevant updated documentation and a cover letter from the principal investigator, providing a brief description of the changes, the rationale for the changes, and their implications for the ongoing conduct of the study). Hard copies of the revised NEAF, the cover letter and all relevant updated documents with tracked changes must also be submitted to the HREC coordinator as per standard HREC SOP. Further advice on submitting amendments is available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

3. Amendments to the research project which only affect the ongoing site acceptability of the project are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the Research Governance Office/r (by-passing the HREC).

4. Proposed amendments to the research project which may affect both the ethical acceptability and site suitability of the project must be submitted firstly the HREC for review and, once HREC approval has been granted, then submitted to the RGO.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the project (e.g. typographical errors) should be submitted in hard copy to the HREC coordinator. These should include a cover letter from the principal investigator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the project is discontinued at a site before the expected date of completion.

7. The Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

8. The District administration and the Human Research Ethics Committee may inquire into the conduct of any research or purported research, whether approved or not and regardless of the source of funding, being conducted on hospital premises or claiming any association with the Hospital; or which the Committee has approved if conducted outside God Coast University Hospital.

HREC approval is valid for **three (3) years** from the date of this letter.

Should you have any queries about the HREC's consideration of your project please contact Mr Simon Langston via GCHEthics@health.qld.gov.au or (07) 5687 3879. The HREC terms of Reference, Standard Operating Procedures, membership and standard forms are available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

**You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a site until separate authorisation from the District CEO or Delegate of that site has been obtained.**

**A copy of this approval must be submitted to the District Research Governance Officer/Delegated Personnel with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the Gold Coast University Hospital and Health Service.**

Once authorisation to conduct the research has been granted, please complete the Commencement Form (Attachment II) and return to the office of the Human Research Ethics Committee.

The HREC wishes you every success in your research.

Yours faithfully

for
Mr Simon Langston
**CHAIR**
**HUMAN RESEARCH ETHICS COMMITTEE**
**GOLD COAST HOSPITAL AND HEALTH SERVICE**

Mater

*Exceptional People. Exceptional Care.*

18 February 2015

Prof Sharon Dawe
School of Applied Psychology
Griffith University
Mt Gravatt, QLD
4111

Dear Professor Dawe

**HREC Ref Nº: HREC/14/MHS/204**
**Project title: Adaption of the PuP program for children with FASD: A pilot study**

I refer to your application dated 19 November 2014.

This application was considered by the Mater Health Services Human Research Ethics Committee (MHS HREC) (EC00332) at its meeting of 16 December 2014 and I further reviewed your responses on 9 February 2015 and further response again on 16 February 2015 and am pleased to advise you that the MHS HREC has granted ethical approval of this application.

The nominated participating site in this project is:

- **Community Child Health , Level 3 Southport Health Precinct, Southport**

The approved documents include:

| *Document* | *Version* | *Date* |
|---|---|---|
| Covering Letter | | 19 November 2014 |
| Online Forms NEAF Application Submission Code AU/1/FDCB15 | V2.2 (2014) | 19 November 2014 |
| Investigator CV: Sharon Dawe | | December 2012 |
| Investigator CV: Paul Harnett – Received November 2014 | | Undated |
| Investigator CV: Frances O'Callaghan – Received November 2014 | | Undated |
| Investigator CV: Natasha Reid – Received November 2014 | | Undated |
| Griffith University Research ethics approval - ***Noted*** | | 05 November 2014 |
| Questionnaire: INDEXPARENTING STRESS SHORT FORM Copyrighted 1990 – Abidin - Received November 2014 | | Undated |
| Questionnaire: DASS Scoring Template – Received November 2014 | | Undated |
| Cover Letter with Response to Request for Further Information | | 10 February 2015 |
| 2nd Cover Letter with Further response to queries | | 16 February 2015 |
| Protocol | V3 | 16 February 2015 |

*This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007), updated in 2014. The processes used by this HREC to review multi-centre research proposals have been certified by the National Health and Medical Research Council.*



| | | |
|---|---|---|
| Referral Form | V2 | 16 February 2015 |
| Consent Form | V3 | 16 February 2015 |
| Information Sheet | V3 | 16 February 2015 |

**This letter constitutes ethical approval only. This research cannot proceed until separate Research Governance authorisation has been obtained from the Chief Executive Officer or Delegate of the institution under whose auspices the research will be conducted.**

Approval of this project by the MHS HREC is valid from **18 February 2015** to **18 February 2017**, subject to the following conditions being met:

- The Principal Investigator will immediately report anything that might warrant review of ethical approval of the project.
- The Principal Investigator will notify the MHS HREC of any event that requires a modification to the protocol or other project documents and submit any required amendments.
- The Principal Investigator will submit any necessary reports related to the safety of research participants.
- In accordance with *Section 3.3.22(b)* of the National Statement the Principal Investigator will report to the MHS HREC annually, a final report is to be submitted by **18 February 2016**.
- The Principal Investigator will notify the MHS HREC if the project is discontinued before the expected completion date, with reasons provided.
- The Principal Investigator will notify the MHS HREC of any plan to extend the duration of the project past the approval period listed above and will submit any associated required documentation.

Please confirm the commencement date with the Research Ethics Office.

Should you have any queries about the MHS HREC's consideration of your project, please contact the HREC Coordinator on (07) 3163 1585. The MHS HREC Terms of Reference, membership and standard forms are available at *http://www.mater.org.au/Home/Research/Human-Research-Ethics-Committee/Human-Research-Ethics/HREC-Resources)*

The MHS HREC wishes you every success in your research.

Yours sincerely

Dr Conor Brophy
**Chairperson**
Mater Health Services Human Research Ethics Committee