Emotion Recognition in Children with Fetal Alcohol Spectrum Disorders

by

Susan Siklos
B.Sc., University of British Columbia, 1999
M.Sc., University of Victoria, 2002

A Dissertation Submitted in Partial Fulfilment of the
Requirements of the Degree of

DOCTOR OF PHILOSOPHY

In the Department of Psychology

© Susan Siklos, 2008
University of Victoria

All rights reserved. This dissertation may not be reproduced in whole or in part, by
photocopying or other means, without the permission of the author.
Emotion Recognition in Children with Fetal Alcohol Spectrum Disorders

by

Susan Siklos
B.Sc., University of British Columbia, 1999
M.Sc., University of Victoria, 2002

Supervisory Committee

Dr. K. A. Kerns, Supervisor
(Department of Psychology)

Dr. B. Leadbeater, Departmental Member
(Department of Psychology)

Dr. U. Mueller, Departmental Member
(Department of Psychology)

Dr. B. Shepard, Outside Member
(Department of Educational Psychology and Leadership Studies)
Abstract

Despite the anecdotal evidence of social difficulties in children with Fetal Alcohol Spectrum Disorders (FASD), and the risk for secondary disabilities as a result of these social difficulties, very little research has examined social-emotional functioning in children with FASD. The majority of the research conducted thus far has relied on parent and teacher reports to document social impairments. These parent and teacher reports provide a broad measure of social functioning but are unable to elucidate the specific aspects of social functioning that this group of children might find difficult. As a result, it has been very difficult to develop effective social interventions for children with FASD because it is unclear what aspects of social functioning should be targeted. The current study aimed to examine emotion recognition abilities in children with FASD, as recognition of emotions is an important precursor for appropriate social interaction. The study included 22 participants with diagnosed FASD (ages 8-14), with age- and gender-matched typically developing controls. Participants were assessed using computerized measures of emotion recognition from three nonlinguistic modalities: facial expressions (static and dynamic, child and adult faces), emotional tone of voice (child and adult voices), and body positioning and movement (postures and point-light walkers). In addition, participants completed a task assessing emotion recognition in real-life scenarios. Finally, caregivers completed measures of behavioural functioning, adaptive functioning, FASD symptomatology, and a demographics questionnaire. Overall, findings suggest that children with FASD do have more difficulties than age-matched
typically developing peers in aspects of emotion recognition, with particular difficulties in recognizing emotions from adult facial expressions and adult emotional prosody. In addition, children with FASD had more difficulty perceiving differences in facial expressions. When the effect of age was examined, it was found that some aspects of emotion recognition were more impaired in children with FASD between age eight and ten years compared to same-age typically developing peers and compared to children with FASD age 11-14. This finding suggests that younger children with FASD may demonstrate a delay in the acquisition of some aspects of emotion recognition or may be more vulnerable to the information processing demands of some tasks compared to older children with FASD. The types of emotion recognition difficulties found in the current study supported a pattern where children with FASD make more errors on emotion recognition tasks when the complexity of the task is increased and consequently demands greater information processing. As such, it is anticipated that children with FASD would be likely to have the most difficulty with emotion recognition abilities embedded within complex, rapidly changing, real-world social situations, and in recognizing more subtle emotional displays. Caregivers, teachers, and professionals living and working with children and youth with FASD should be aware of possible emotion recognition difficulties in complex social situations and should help foster stronger emotion recognition skills when difficulties are detected.
# Table of Contents

Supervisory Committee .................................................................................. ii  
Abstract ........................................................................................................ iii  
Table of Contents .............................................................................................. v  
List of Tables ..................................................................................................... vii  
List of Figures .................................................................................................. viii  
Acknowledgments .............................................................................................. ix  
Dedications ........................................................................................................ xi  

Introduction ........................................................................................................ 1  
  Background ..................................................................................................... 5  
  Social Functioning in Children with FASD .................................................. 8  
  A Theoretical Model of Social Information Processing ......................... 19  
  Emotion Processes in Social Information Processing: A Model ............ 26  
  Encoding and Decoding Emotions ............................................................. 29  
  Summary and Purpose for the Proposed Study ....................................... 38  
  Hypotheses .................................................................................................. 39  

Methods ........................................................................................................... 42  
  Participants .................................................................................................. 42  
    FASD Group ............................................................................................ 42  
    Control Group .......................................................................................... 45  
    Total Sample ............................................................................................ 45  
  Measures ...................................................................................................... 48  
    Caregiver-Report Measures .................................................................. 48  
    Measure of Intelligence ........................................................................ 52  
    Measures of Emotion Recognition ....................................................... 52  
  Procedures .................................................................................................... 59  
  Power Analyses ........................................................................................... 60  

Results ............................................................................................................... 62  
  Covariates .................................................................................................. 63  
  Hypothesis #1: Emotion Recognition and Intensity of Emotions .......... 64  
  Hypothesis #2: Faces, Prosody and Postures .......................................... 66  
  Hypothesis #3: Hostile Attributions ........................................................ 69
Hypothesis #4: Perception Tasks ......................................................... 72
Hypothesis #5: Caregiver Reports of Social Functioning and Emotion
Recognition Tasks ........................................................................ 74
Hypothesis #6: Fetal Alcohol Behavior Scale and Emotion
Recognition .................................................................................. 75
Complex Emotion Recognition from Real-Life Scenarios ............... 75
Child vs. Adult Stimuli .................................................................... 78
Visual vs. Auditory Measures of Emotion Recognition ................. 79
Effect of Age .................................................................................. 80

Discussion ................................................................................... 83
Hypothesis #1: Emotion Recognition and Intensity of Emotions .... 84
Hypothesis #2: Faces, Prosody, and Postures .............................. 91
Hypothesis #3: Hostile Attributions ............................................. 93
Hypothesis #4: Perception Tasks .................................................. 95
Hypothesis #5: Caregiver Reports of Social Functioning and Emotion
Recognition Tasks ........................................................................ 99
Hypothesis #6: Fetal Alcohol Behavior Scale and Emotion
Recognition .................................................................................. 101
Complex Emotion Recognition from Real-Life Scenarios ........... 103
Effect of Age on Emotion Recognition in Children with FASD .... 105
Potential Clinical Implications ...................................................... 108
Limitations and Directions for Future Research ......................... 115
Conclusions .................................................................................. 118

References .................................................................................. 121

Appendix A: Consent and Assent Forms .................................... 143
Appendix B: Demographics Questionnaire ................................. 148
Appendix C: Instructions for Complex Emotion Task ................ 151
List of Tables

Table 1. Participant demographics and parent-report measure descriptives……..46
Table 2. Additional demographics and descriptives for the FASD group……… 47
Table 3. Correlations among the facial expression tasks for both groups combined………………………………………………………………..67
Table 4. Correlations among the voices tasks for both groups combined………. 68
Table 5. Correlations among the body tasks for both groups combined…………68
Table 6. Multiple regression of emotion recognition composites as predictors of the Complex Emotion Task……………………………………… 76
List of Figures

Figure 1. Reformulated model of social information processing (Crick & Dodge, 1994).........................................................21

Figure 2. An integrated model of emotion processes and cognition in social information processing.........................................28

Figure 3. Mean intensity errors per group.............................................66

Figure 4. Repeated measures ANOVA of Faces, Voices and Body composites....69

Figure 5. Cumulative percentages of incorrect emotional attributions by group....71

Figure 6. Cumulative percentage of emotion stimuli errors by group..............71
Acknowledgements

I would like to give my deepest thanks to my supervisor, Dr. Kimberly Kerns, for
the years of mentorship, support, and guidance she provided as I navigated through
graduate school. She helped me to do my best work on this project and others
previously, and she continued to support me even when my life threw some curves
into the journey. I am grateful for her faith in my abilities and her encouragement to
help me reach my goals. I have also valued the relationship we have developed over
the years: long chats about research, systems issues, and how to help kids reach their
fullest potential. I hope that we will continue to collaborate and work together in the
future.

I would like to express my gratitude to my committee members, Dr. Bonnie
Leadbeater, Dr. Ulrich Mueller, and Dr. Blythe Shepard for their guidance and
interest in this dissertation. I especially appreciated all of their helpful comments and
thoughtful ideas at the beginning stages of this study, which helped develop it into the
final work presented here. Finally, thank you to Dr. Jo Nanson for agreeing to sit on
my committee as the External Examiner.

I am grateful to Naznin Virji-Babul, Robyn Hovorka, Steve Nowicki, William
Arsenio, Arieta Chouchourelogi, Maggie Shiffrar, and Ann Streissguth for donating
measures that they had spent so much time creating to be used in this study. Thank
you to Rob McInerney and Jon Berall for your help and guidance with the
programming of my tasks. I would also like to acknowledge the Social Sciences
Research Council for supporting this project.
I would like to warmly thank the many individuals and organizations that helped find participants with FASD for this study and/or provided me with office space, especially: Scott McLaughlin; Beverly Palibroda; Diane Russell; and the Cowichan Valley FAS Society. I extend my deepest gratitude to the many caregivers, children, and youth who participated in this study. I would especially like to thank the biological, foster, and adoptive parents of the children with FASD who participated in this study. Your strength and love for your children, despite the difficulties you face raising children with special needs, is always inspiring.

To my friends in Vancouver, Victoria, and other cities throughout North America, thank you for listening to me and understanding my lack of communication as I completed this project. Special thanks go to my UVic girls: Jenn, Cathy, Daphné, Lisa, Jen, Rema and Sandra. I love you girls – thanks for all of the laughter, friendship, and encouragement.

To my extended Epstein/Bogdonov family, thank you for your love and support. Special thanks to Elana for all of your help finding participants for this study. To my brothers and sister(-in-law), you have put up with years of me being busy and distracted and nerdy. Thank you for listening to me and always being there for me.

My deepest and warmest gratitude to my parents who have supported me, loved me, and encouraged me throughout my life. You’ve always made me feel like I could do anything I set my mind to. Thank you for raising me to be who I am today. I love you.
Dedication

To Jeff, who has only known me as a graduate student but loved me anyways.

Your love and encouragement, your partnership,

and your sense of humour have helped me travel this part of my journey

without any major breakdowns or anxiety attacks. Thank you.

To my little Alex, you always light up my day with your smiles, laughter, and kisses.

You both make it all worth it. I love you.
Emotion Recognition in Children with Fetal Alcohol Spectrum Disorders

Fetal alcohol syndrome (FAS), a disorder caused by alcohol consumption during pregnancy, is recognized as the leading cause of mental retardation in the Western world (Abel & Sokol, 1986; Abel & Sokol, 1987). It is also the most easily prevented childhood disorder; the cause of this disorder is very clear – alcohol consumption during pregnancy can cause FAS, and there is no known ‘safe’ amount of alcohol that can always be consumed without harming the fetus (Institute of Medicine, 1996).

It has been clearly documented in the literature that prenatal alcohol exposure can result in lowered intelligence, complex learning disabilities, language disorders, memory impairments, attention deficits, difficulties with mathematics, behavioural problems, as well as deficits in social functioning (Carmichael Olson, Feldman, Streissguth, Sampson, & Bookstein, 1998; Carmichael Olson, 1998; Ervalahti et al., 2007; Kelly, Day, & Streissguth, 2000; Mattson & Riley, 1998, 2000; Mattson, Riley, Delis, Stern, & Jones, 1996; Mattson, Riley, Gramling, Delis, & Jones, 1998; Nanson & Hiscock, 1990; O’Leary, 2004; Rasmussen, Horne, & Witol, 2006; Steinhausen & Spohr, 1998; Streissguth et al., 1991a; Streissguth, Barr, Bookstein, Sampson, & Olson, 1999; Streissguth & O’Malley, 2000; Streissguth, Randels, & Smith, 1991b; Thomas, Kelly, Mattson, & Riley, 1998; Wacha & Obrzut, 2007). Longitudinal data reveals that individuals with prenatal alcohol effects grow up to experience many secondary disabilities: disabilities that develop as a result of their primary cognitive difficulties, but could be mitigated with protective factors such as a nurturing, consistent, and structured environment (Carmichael Olson, 1998; Streissguth, 1997; Streissguth, Barr, Kogan, & Bookstein, 1996). These secondary disabilities include problems with the law, sexually
inappropriate behaviours, school failure and dropping out, difficulties holding jobs, and high rates of psychiatric illnesses such as depression and suicide (Carmichael Olson, 1998; Famy, Streissguth, & Unis, 1998; Fast, Conry, & Loock, 1999; Fryer, McGee, Matt, Riley, & Mattson, 2007; Kelly et al., 2000; Streissguth, 1997; Streissguth et al., 1991a; Streissguth et al., 1999; Streissguth & O'Malley, 2000). Steinhausen and Spohr (1998) found that the rate of psychopathology in their sample of children with FAS was approximately 63%, while Streissguth and colleagues (1996) found that 91% of the individuals with FAS in their study had at least one psychiatric or behavioural disorder. Fryer and colleagues (2007) reported that although 97% of their sample had one or more Axis I disorder, only 40% of their alcohol-exposed sample had previously been evaluated for or received a psychiatric diagnosis.

In spite of the frequently cited difficulties with socio-emotional functions in this population, relatively little research has examined the socio-emotional functioning in children with prenatal alcohol exposure. In addition, the research conducted primarily uses parent or teacher reports to assess the child’s functioning (Kelly et al., 2000; Schonfeld, Paley, Frankel, & O’Connor, 2006; Streissguth et al., 1991a; Thomas et al., 1998; Whaley, O’Connor, & Gunderson, 2001) versus direct assessment. These parent and teacher reports provide a very general and broad measure of social functioning but are unable to elucidate the specific aspects of social functioning that this group of children might find difficult. As a result, it has been very difficult to develop effective social interventions for children with FAS because it is unclear what aspects of social functioning should be targeted. Finally, it is likely that difficulties with socio-emotional functioning would precede the onset of more serious psychopathology; therefore, it is
crucial to identify the early manifestations of these impairments in order to develop interventions and reduce the likelihood of secondary disabilities (Greenbaum, 2004).

The aim of the current study was to examine emotion recognition abilities in children who have prenatal alcohol exposure, as recognition of emotions is an important precursor for appropriate social interaction. Emotion recognition was examined in an effort to determine whether children with FASD have difficulties perceiving and interpreting social cues. The study examined emotion recognition as an early step in a theoretical model of social information processing to determine whether specific aspects of emotion discrimination and identification are impaired in children with FASD. We can begin to understand which aspects of social information processing are difficult for these children by examining a small but important aspect of social functioning in children with known prenatal alcohol exposure. This can ultimately lead to the creation of effective social interventions.

The following section will provide basic information about Fetal Alcohol Spectrum Disorder (FASD), including historical information, nomenclature, and diagnostic issues; review the literature on social functioning in individuals with FASD; describe the Lemerise and Arsenio (2000) model of emotional processes in social information processing (adapted from Crick & Dodge, 1994) that was used as a theoretical framework for the present study; and describe how the original model of social information processing (Crick & Dodge, 1994) has been used with both clinical populations and typically developing children. Finally, a review of the literature on nonverbal information processing and emotions will be provided with a description of the various aspects of emotion processing that were assessed in the present study.
By examining emotion recognition in children prenatally exposed to alcohol, the present study should fill a gap in the previous research in the following ways:

1. Rather than examining social functioning in a group of children with Fetal Alcohol Syndrome (FAS), the study examined social functioning in a more heterogeneous group of children with known prenatal alcohol exposure, but who may not have the physical features for a diagnosis of FAS. The study assessed children fitting under the umbrella of Fetal Alcohol Spectrum Disorders (FASD).

2. Instead of looking at social functioning as a whole, this study examined a specific aspect of social functioning, namely emotion recognition, that is crucial to appropriate interpersonal interactions. By completing an in-depth examination of emotion recognition in various modalities, it can be determined whether this basic element of social functioning is impaired or preserved in children with FASD.

3. The study did not rely on parent or teacher reports solely to examine social functioning in children with FASD. The study used specific tasks that have been validated to assess emotion recognition abilities and therefore obtained information directly from children with FASD, rather than only from important adults. In addition, by also collecting caregiver report information, the relationship between the child’s performance on various tasks and the caregiver’s perceptions of his/her child’s performance was assessed.

4. Finally, the study adopted a theoretical framework of social information processing in order to help elucidate the various aspects of social behaviour important for success within interpersonal interactions. Very few studies have
worked within this theoretical framework to examine social functioning in children prenatally exposed to alcohol (Timler, 2000).

**Background**

Fetal alcohol syndrome (FAS) is caused by alcohol consumption during pregnancy. FAS was first described in 1973, when Jones and Smith (1973) observed the same birth defects in a group of three infants born to alcoholic mothers and provided the label ‘Fetal Alcohol Syndrome’ to describe this set of impairments. In their original publication, Jones and Smith (1973) describe these infants as having short palpebral fissures, heart anomalies, cleft palates, microcephaly, developmental delay, fine-motor dysfunction, and low-birth weights and heights. Currently FAS is characterized by pre- and post-natal growth deficiency, facial anomalies, and central nervous system (CNS) dysfunction. In addition to FAS, diagnostic nomenclature has been devised to account for individuals who have known prenatal alcohol exposure but, when examined by a dysmorphologist, do not display the full facial features or growth characteristic of FAS: individuals without the facial features are typically diagnosed with fetal alcohol effects (FAE), partial FAS, or alcohol-related neurodevelopmental disorder (ARND; Hoyme et al., 2005; Institute of Medicine, 1996). For the remainder of this paper, the umbrella term fetal alcohol spectrum disorders (FASD) will be used to describe individuals with known prenatal alcohol exposure who have been diagnosed with FAS, FAE, partial FAS, or ARND (Chudley et al., 2005).

Current estimates of the incidence of FAS suggest a rate of approximately 1 - 7 cases per 1000 live births in the general population and approximately 4% among
“heavy” drinkers (Abel, 1995; Abel & Sokol, 1986; Abel & Sokol, 1987; Barinaga, 2000; Institute of Medicine, 1996; Korkman, Autti-Rämö, Koivulehto, & Granström, 1998; Niccols, 2007). Prevalence rates of FASD in the United States have been estimated to be approximately 9 cases per 1000 live births, however it has been stated that this is likely a conservative rate (Sampson et al., 1997). Most estimates of prevalence rates come from the United States or from Europe. There are no national statistics on the rates of FASD in Canada, although selected studies have found rates of FAS or FASD ranging from .5 - 190 per 1000 live births in some small communities (Chudley et al., 2005).

The fact that mothers are not always forthright about their drinking during pregnancy or are unable to recall how much alcohol they consumed during some or all of their pregnancy also leads to difficulties in diagnosing FASD (Institute of Medicine, 1996). Over the last ten years, several diagnostic guidelines or criteria have been developed in an attempt to make diagnosing FASD more objective and reliable (Astley & Clarren, 2000; Chudley et al., 2005; Hoyme et al., 2005; Institute of Medicine, 1996). All of the diagnostic guidelines note the importance of obtaining a clear exposure history, however the Institute of Medicine guidelines (Hoyme et al., 2005; Institute of Medicine, 1996), the University of Washington FAS-DPN system (Astley & Clarren, 2000), and the Canadian guidelines (Chudley et al., 2005) allow a diagnosis of full Fetal Alcohol Syndrome even when alcohol exposure is unknown. For example, a diagnosis of FAS can be given when facial features of FAS are present in addition to suspected exposure, such as when a child has been adopted or is in foster care and there is no way to access the mother to confirm the exposure, or when the mother was reported to be an alcoholic at the time of her pregnancy but personally denies having consumed alcohol during her
pregnancy. The diagnostic assessment for FASD also requires that physical features be assessed for particular known anomalies, such as facial features, growth retardation, or other physical anomalies. However, a diagnosis can be made without any physical anomalies. Finally, and most important to the current line of research, behavioural or cognitive deficits are required for a diagnosis of FAS, pFAS, or ARND.

The Canadian guidelines for the diagnosis of FASD (Chudley et al., 2005, p. 59) recommend assessing the following neurobehavioural domains: 1) hard and soft neurological signs; 2) brain structure (e.g. magnetic resonance imagine [MRI]); 3) cognition (IQ); 4) communication: receptive and expressive; 5) academic achievement; 6) memory; 7) executive functioning and abstract reasoning; 8) attention deficit/hyperactivity; and 8) adaptive behaviour, social skills, and social communication. A great deal of research has examined the cognitive and neuropsychological deficits frequently observed in individuals with FASD and have found deficits in all of the neurocognitive areas listed above (e.g., Carmichael Olson et al., 1998; Kaemingk & Paquette, 1999; Kodituwakku, 2007; Korkman et al., 1998; Mattson et al., 1998; Rasmussen et al., 2006; Streissguth et al., 1999). Neuropsychological studies have identified impairment in intellectual functioning, fine and gross motor performance and adaptive functioning as major areas of impairments in individuals with fetal alcohol syndrome (Wacha & Obrzut, 2007). Rasmussen and colleagues (2006) found that children with FASD had greatest difficulty on tasks assessing auditory attention skills, information processing speed, and certain aspects of visual memory. However, despite the abundance of research examining cognitive functioning in individuals with FASD, a clear pattern of strengths and deficits has not been found. This is likely due to the
variability of alcohol exposure – it has been impossible to control for timing and dose of alcohol exposure in subjects participating in these studies. Anderson and colleagues (2001) noted that “the consequences of prenatal alcohol exposure are suggestive of prefrontal dysfunction in the setting of more widespread brain damage” (Anderson et al., 2001).

Social Functioning in Children with FASD

In addition to the clear deficits in cognitive functioning documented in the literature, individuals with FASD have significant difficulties with social functioning (Carmichael Olson, 1998; Coggins, Olswang, Carmichael Olson, & Timler, 2003; Coggins, Timler, & Olswang, 2007; Giunta, 1988; Greenbaum, 2004; Kelly et al., 2000; Schonfeld et al., 2006; Steinhausen & Spohr, 1998; Streissguth et al., 1991a; Thomas et al., 1998; Timler, 2000; Timler, Olswang, & Coggins, 2005; Whaley et al., 2001). These studies have assessed social behaviour using parent- or teacher-report measures of adaptive functioning (Coles, Brown, Smith, & Platzman, 1991; Streissguth et al., 1991a; Thomas et al., 1998; Whaley et al., 2001), socioemotional and behavioural functioning (Brown, Coles, Smith, & Platzman, 1991; Greenbaum, 2004; Mattson & Riley, 2000; Steinhausen & Spohr, 1998), and social skills (Greenbaum, 2004; Schonfeld et al., 2006; Timler, 2000). All of these methods of assessing social functioning in individuals with FASD have consistently shown that children with FASD have significant difficulties with most aspects of social behaviour.

Streissguth and colleagues (1991a) were one of the first groups of investigators to examine social functioning in individuals with FASD. In their study, they administered
the Vineland Adaptive Behavior Scale interview version (VABS; Sparrow, Balla, & Cicchetti, 1984) to caregivers of 43 adolescents (age 12-17) and 18 adults (age 18-40 years) with FAS or FAE. The VABS measures three broad domains of adaptive functioning: daily living skills, communication skills, and social skills. Individuals with FAS performed most poorly on the socialization scale of the VABS with a mean age equivalent of approximately 6 years of age. Not one subject with FASD was rated as having age-appropriate socialization or communication skills. Caregivers commonly endorsed maladaptive behaviours such as poor judgment, distractibility and difficulty perceiving social cues. They felt that these behaviours were a challenge to manage in individuals with FASD. Finally, individuals with FASD who were not intellectually challenged according to intelligence testing were described as failing to consider the consequences of their actions, lacking appropriate initiative, unresponsive to subtle social cues, and lacking reciprocal friendships.

Around the same time as Streissguth and colleagues administered the VABS to a group of caregivers of individuals with FASD, Coles and her colleagues administered the VABS to a group of biological mothers who had drank during their pregnancies (Coles et al., 1991). Their study consisted of 22 children who were exposed during the beginning of the pregnancy but the mother stopped drinking during the second trimester, 25 children who were exposed throughout the pregnancy, and 21 non-exposed children. The children in the study were between the ages of five and eight, with a mean age of 5 years 10 months. Coles and colleagues (1991) found no group differences on any of the VABS scales indicating that the extent of maternal alcohol use and prenatal alcohol exposure
were not related to mothers’ reports of children’s adaptive functioning. They found all scores to be within the average range.

Following these two contradictory findings, Thomas and colleagues (1998) examined the social skills domain of the VABS in three groups of children (n=15/group) between the ages of 5 and 12 years (mean age of 9-10 years). The children in the first group were diagnosed with FAS, the second group consisted of children matched by verbal intelligence, and the third group consisted of typically developing children with average to above-average intelligence (Thomas et al., 1998). Thomas and colleagues found that all three groups differed significantly on the social skills domain of the VABS and children with FAS were most impaired on the interpersonal relationship skills ratings. Interestingly, they also found that there was an increased discrepancy between the age of the child and the age-equivalent score on the social skills domain in the older children with FAS. The age-equivalent scores on the social skills domain of the VABS plateaued at roughly four to six years in the FAS group, but did not show any plateau in the other two groups. This finding suggests that the social skills deficits observed in children with FAS cannot be explained by low IQ scores and are indicative of arrested social development rather than just a delay in social skills.

Thomas et al’s (1998) findings are consistent with those of Streissguth and colleagues (1991a), who also found social functioning to be arrested at around six years of age in their group of adolescents and adults with FASD. Coles and colleagues’ (1991) lack of group differences on the VABS could be explained by Thomas et al’s (1998) findings: Coles’ group were between the ages of five to eight years with a mean of 5 years 8 months and therefore were, on average, younger than the point of developmental
arrest found by Streissguth et al. (1991a) and Thomas et al. (1998). It is possible that below the age of six or seven years the social impairments in children with FASD cannot be discriminated by the VABS due to a lack of sensitivity, or at young ages children with FASD are able to function appropriately within social contexts because the social demands are not yet very complex. Finally, it is possible that the biological mothers in Coles and colleagues’ (1991) study underreported their child’s difficulties.

Whaley and colleagues (2002) examined whether the adaptive function deficits found in children with FASD are specific to this group by comparing a group of children with FASD to a group of children referred for psychiatric treatment with no known prenatal alcohol exposure. They found no group differences on any of the domains of the VABS, but found that both groups were significantly compromised in their adaptive functioning. However, Whaley et al. (2001) compared their participants with the full diagnosis of FAS to those with ARND and found that they did not differ in their levels of adaptive functioning, suggesting that deficits in adaptive behaviour are not specific to more severe exposure. Whaley and colleagues (2001) noted that the standard scores on the VABS were lower in the older children in their group, consistent with Streissguth et al.’s (1991a) and Thomas et al.’s (1998) findings in which deficits in socialization skills may be more debilitating in older children with FASD.

Social functioning has also been assessed in children with FASD using the Child Behavior Checklist (CBCL; Achenbach, 1991), a parent- and teacher-report measure of socioemotional and behavioural functioning in children and adolescents. Brown and colleagues (1991) were the first to administer the CBCL to a group of biological mothers and teachers of children with FASD. Teachers reported that the children who had been
exposed to alcohol throughout the pregnancy had significantly weaker social competence and were more likely to behave inappropriately compared to children who had only been exposed to alcohol for the first two trimesters or children who had not been exposed at all (Brown et al., 1991). Teachers reported that children with FASD had attention and behavioural problems, but mothers did not describe their children in this way. Coles et al (1991) used this same sample of mothers and also found that they did not endorse difficulties with adaptive functioning in their sample, suggesting that this group of mothers may have not seen their child as having difficulties.

In a longitudinal study with a group of children with prenatal alcohol exposure, Steinhausen and colleagues (1993) found that parents were most likely to endorse attention deficits and social relationship problems in their school-age children. Teacher reports were consistent with parent reports; attention deficits and social relationship problems were also most prominent in their responses to the CBCL (Steinhausen et al., 1993). In a follow-up study of this same group, Steinhausen and Spohr (1998) found that parents and teachers continued to endorse the most difficulties in the areas of attention deficit problems and social relationship problems.

In an attempt to determine whether intelligence or socioeconomic status (SES) is related to behavioural disturbances in children with FASD, Mattson and Riley (2000) administered the CBCL to a group of caregivers of children with histories of heavy prenatal alcohol exposure, and compared the results to a group of children matched by age, sex, SES, ethnicity and verbal intelligence. Consistent with previous findings, Mattson and Riley (2000) found that parents of children with FASD most frequently endorsed difficulties in social impairments and attention deficits, but they also found that
parents endorsed increased levels of aggression. Finally, the serious impairments in
behavioural functioning found in children with FASD could not be explained entirely by
the presence or absence of facial features, intelligence, or demographic factors such as
age, sex, or SES (Mattson & Riley, 2000).

As part of a more in-depth evaluation of the socio-emotional functioning of
children prenatally exposed to alcohol, Greenbaum (2004) administered the CBCL to the
parents and teachers of three groups of children; a group of children with prenatal alcohol
exposure (PAE group), a group of children with Attention Deficit/Hyperactivity Disorder
(ADHD group), and a typically developing group without a known history of alcohol
exposure (NC group). Both the parents and teachers reported that the children in the PAE
group had higher levels of Externalizing Problems compared to children in both the
ADHD and normal control groups (Greenbaum, 2004). Greenbaum found that the
children in the PAE group presented with similar emotional and behavioural profiles
compared to the children in the ADHD group, but their profiles were more severe,
meaning that the PAE group were more likely to have elevations in the clinical range,
while the ADHD group were more likely to have elevations in the borderline/at-risk
range. She found that parents of both the PAE and ADHD groups reported comparable
elevations on the Social Problems scale of the CBCL. Greenbaum (2004) also
administered the Social Skills Rating Scale (SSRS) to the parents of the children in her
study and found that both the ADHD and PAE groups differed significantly from the
normal controls on the Social Skills and Behaviour Problems Indices. Overall,
Greenbaum concluded that although there were qualitative and quantitative differences in
the emotional and behavioural profiles of the PAE and ADHD groups (measured by the
CBCL), the children with PAE and ADHD had comparably severe social skills deficits (Greenbaum, 2004).

In order to better understand the relationship between executive functioning (EF) and social skills in children with FASD, Schonfeld and colleagues (2006) administered rating scales of social skills (SSRS) and executive functioning (Behavior Rating Inventory of Executive Function [BRIEF]) to parents and teachers of children with FASD. Executive functioning, defined as an individual’s ability to engage in cognitive processing within novel situations in order to reach a desired goal (Lezak, 2004), refers to abilities such as novel problem solving, planning, working memory, inhibition and cognitive flexibility (Schonfeld et al., 2006). It has been well-documented that children with FASD have deficits in executive functioning (e.g. (Kodituwakku, 2007; Mattson & Riley, 1998; Rasmussen et al., 2006; Vaurio, Riley, & Mattson, 2008), but the relationship between social functioning and EF had not been examined prior to this study. Schonfeld and colleagues (2006) found that executive functioning significantly predicted social skills in children with FASD and recommended that EF be considered in designing social skills interventions for children with FASD. However, it is important to note that both EF and social skills were assessed using parent and teacher reports, and again the specific aspects of social skills that would need to be targeted in a social skills intervention were not elucidated.

In addition to examining parent- and teacher-reports of socio-emotional, behavioural, or adaptive functioning in children with FASD, Greenbaum (2004) also administered experimental measures of affective processing and social cognition to a group of children with prenatal alcohol exposure ages 6 to 13 years. With respect to
emotion processing, the participants were administered four subtests from the Minnesota Tests of Affective Processing (MNTAP; Lai, Hughes, & Shapiro, 1991): Affect Naming, in which participants have to match the emotion on a photograph of a child’s face to a cartoon face; Affect Match, in which the child has to choose whether the emotions shown on two subsequent photographs are the same or different; Affect Choice, in which the child is shown five faces with different emotions and the computer provides a verbal instruction of which emotion to choose; and Prosody Content Congruence, in which the child has to discriminate whether the emotional tone of a sentence matches its content. The PAE group performed significantly worse than the ADHD and NC groups on the Affect Choice task, but there were no significant group differences on the other MNTAP tasks. The PAE group also performed poorly on the Prosody Content Congruence task; however, this difference did not reach significance. Greenbaum (2004) concluded that the PAE group performed most poorly on the emotion processing measures that included a language component and performed comparably to the other groups when the tasks were nonverbal.

Greenbaum’s (2004) study is unique in that it not only examined social functioning in children with FASD through parent- and teacher-report measures, but it also directly examined aspects of social functioning through experimental tasks administered to the child. The major shortcoming of Greenbaum’s work was that it failed to examine social functioning from a theoretical framework and consequently examines a broad range of aspects of social functioning in an attempt to differentiate children with FASD from children with ADHD. In the end, we are still left with many questions about where specifically children with FASD have problems in their interpersonal interactions.
and where to target specific interventions to remediate social skills deficits in this population.

To date, one group of researchers has developed a social skills training intervention for children with FASD (Laugeson et al., 2007; O'Connor et al., 2006). This evidence-based manualized behavioural intervention known as Child Friendship Training (CFT; Frankel & Myatt, 2003) was modified according to the cognitive and behavioural deficits seen in children with FASD (Laugeson et al., 2007). The parent-assisted intervention focused on teaching knowledge of appropriate social behaviour to children with FASD within a group setting, while parents attended parent groups that taught them about issues pertinent to FASD and on the key social skills being taught to their children each week. Results of this intervention study showed that children with FASD improved their knowledge of appropriate social behavior and parents reported improved social skills and fewer problem behaviours compared to the delayed treatment control group. These gains in social skills were maintained at the 3-month follow-up. However, teachers did not report improvements in social skills as a result of the CFT intervention (O'Connor et al., 2006).

This first study on an empirically validated social skills intervention for children with FASD is promising, however there are some limitations to the study. For example, the study sought to improve social knowledge in children with FASD when it has not been well-documented that children have deficits in social knowledge. Anecdotal parent reports often suggest that children with FASD can tell you what they should do in a particular social situation, but fail to act accordingly when in that social situation. To determine whether increased social knowledge was connected to improvements in social
behavior, O’Connor and colleagues (2006) used parent and teacher reports as measures of real-life social behavior. Unfortunately, the parents were involved in the intervention and therefore may have been biased in their responses due to the ‘halo’ effect. Parents not only learned to help their children with their social skills during the intervention, but parents also received psychoeducation about FASD and therefore may have seen their children’s social challenges in a less negative light as a result of their own education about FASD. The teachers in this study did not observe changes in the social skills of these children, suggesting that any social skills improvements that may have occurred did not generalize to the school environment, where deficits in social functioning are likely most noticeable due to the frequency of peer social interactions within this environment.

In order to examine social functioning from a theoretical framework, Timler (2000) examined social communication skills using peer conflict tasks in school-age children with FASD. Due to the literature demonstrating significant deficits in social functioning in children with FASD, Timler’s study was designed to examine social information processing skills in children with FASD. She defined social information processing skills as skills and behaviours demonstrated by children as they interact in social situations with their peers. She differentiated social information processing from social knowledge, which she defined as knowing what to do in a social situation based on the other person’s beliefs, intentions and expectations as well as one’s own intentions and expectations.

To examine social information processing (SIP), Timler (2000) used the theoretical model of social information processing developed by Crick and Dodge (1994). In this model, social information processing is broken down into six sequential steps: 1)
encoding of social cues; 2) interpreting social cues; 3) goal selection; 4) strategy generation; 5) response decision; and 6) behavioural enactment. This model will be discussed in more detail in the next section. Timler’s (2000) study examined the third and fourth steps in this SIP model, namely goal selection and strategy generation. To assess goal selection and strategy generation, participants were read brief hypothetical vignettes that presented information about a peer conflict situation. Participants were then asked to answer a series of open-ended and forced-choice questions about the vignettes that were designed to elicit information about goals and strategies (Timler, 2000).

Nine children with FASD and nine typically developing children participated in the study. Both groups produced a similar number of strategies, although the children with FASD generated less favourable strategies that tended to be more hostile/coercive and many of their strategies involved asking adults to assist them (Timler, 2000). Overall, the children with FASD produced less prosocial strategies and chose less effective strategies to meet their goals. On a more positive note, the FASD group demonstrated appropriate social knowledge in two ways: they were able to accurately predict the consequences of their actions, and they were able to accurately predict appropriate teacher suggestions about what they should say or do in the peer conflict situation. However, although the FASD group often “knew” what the teacher would want them to do, they rarely elected to use that strategy on their own.

Timler’s is one of the first studies of social functioning in children with FASD based on a theoretical framework. However, her groups were quite small (n=9 per group), and she only examined the third and fourth steps in Crick and Dodge’s (1994)
model. Without examining how children with FASD perform on the first two steps in the SIP model, it is unclear whether the deficits she found in children with FASD are due to deficits at those later steps in the model, or whether they could be the result of problems in the first two steps of the model. For example, if a child does not perceive the information in the vignette accurately, or makes inappropriate attributions or interpretations of the information perceived, they are likely to set inappropriate goals or choose ineffective strategies. The current study utilized a more recent version of Crick and Dodge’s (1994) model that was modified to include more information about emotion processes (Lemerise & Arsenio, 2000). The first step in this model was used as a theoretical framework to determine whether children with FASD have difficulties perceiving and encoding social information.

A Theoretical Model of Social Information Processing

Within the last twenty years, social information processing models have emerged in order to further our understanding of children’s social adjustment and social competence (e.g., Crick & Dodge, 1994; Dodge, Pettit, Mcclaskey, & Brown, 1986; Lemerise & Arsenio, 2000; Shapiro, Hughes, August, & Bloomquist, 1993). One notable model of social information processing by Crick and Dodge (1994), posited that social processing occurs in six sequential steps: 1) encoding of both external and internal cues; 2) interpreting and forming mental representations of those cues; 3) clarifying or selecting a goal; 4) accessing responses or constructing strategies to address the situation; 5) deciding on a behavioural response; and 6) enacting the response (Figure 1; Crick & Dodge, 1994). This model was reformulated from an earlier model developed by Dodge
and colleagues (Dodge et al., 1986). The reformulated model is presented in a nonlinear manner in an attempt to represent the rapid, “on-line” brain performance that occurs during social situations. Crick and Dodge (1994) note that social information processing (SIP) actually occurs in simultaneous parallel paths and therefore individuals tend to be engaged in multiple SIP steps at the same time. For example, an individual may be interpreting social information while they are encoding social cues and at the same time they may be considering the meaning of their peer’s behaviour while they access behavioural responses or strategies. Therefore, children are consistently encoding, interpreting and accessing behavioural responses. Crick and Dodge incorporated this aspect of social information processing in their reformulated model by including feedback loops and portraying the model as a cyclical structure (Crick & Dodge, 1994; see Figure 1). However, they note that despite the feedback loops and cyclical form of the reformulated model, it is still important to conceptualize social processing of a single stimulus in a sequential manner, as one needs to go through each of the steps in order to appropriately respond to a social situation.
In steps 1 and 2 of Crick and Dodge’s (1994) model of social information processing, children selectively attend to environmental and internal cues, encode those cues and then interpret their meaning. Interpretation includes filtering the cues based on their own mental representations of these situational cues stored in long-term memory, analyzing the events in the situation, making inferences about the perspectives of others, and evaluating the situation based on past similar experiences. In step 3 of the model,
children select a goal or a desired outcome. In step 4, the child accesses from memory possible behavioural responses to the situation, or if it is a novel situation, they may come up with new strategies based on internal and external social cues. In step 5, the child evaluates the behavioural responses accessed from memory or the newly formulated strategies and will select the most favourable response for behavioural enactment. Finally, in step 6, the chosen response is enacted (Crick & Dodge, 1994).

Social information processing is likely to improve as the child ages due to increases in various aspects of social knowledge (Crick & Dodge, 1994). With age, a child’s social knowledge increases, especially his/her knowledge of social outcomes, social goals, the intent of others, causes of social events and the appropriateness of social abilities. A child’s attentional abilities also improve with age. Finally, children develop more skilful ways of representing, interpreting, and organizing social information and social knowledge as they get older (Crick & Dodge, 1994).

Social information processing has been extensively studied in typically developing children using Dodge’s original and reformulated models (Crick & Dodge, 1994; Crick & Ladd, 1990, 1993; Dodge, Bates, & Pettit, 1990; Dodge et al., 2003; Dodge, McClaskey, & Feldman, 1985; Dodge, Murphy, & Buchsbaum, 1984; Dodge et al., 1986; Dodge & Price, 1994; Dodge & Tomlin, 1987; Feldman & Dodge, 1987; Gouze, 1987; Gronau & Waas, 1997; Keane, Brown, & Crenshaw, 1990; Lemerise & Arsenio, 2000; Mayeux & Cillessen, 2003; Salzer Burks, Laird, Dodge, Pettit, & Bates, 1999; Schippell, Vasey, Cravens-Brown, & Bretveld, 2003; Waldman, 1996). The vast majority of the research on this SIP model has involved looking at social information processing styles in aggressive, hostile, or rejected children. While some studies have
examined a specific step in the model (Crick & Ladd, 1990, 1993; Dodge et al., 1984; Dodge & Tomlin, 1987; Gronau & Waas, 1997; Keane et al., 1990; Mayeux & Cillessen, 2003; Schippell et al., 2003; Waldman, 1996), others have examined the model as a whole (Crick & Dodge, 1996; Dodge et al., 1990; Dodge et al., 1986; Dodge & Price, 1994; Feldman & Dodge, 1987; Salzer Burks et al., 1999). Overall, studies have found that aggressive, unpopular, or rejected children are more likely to attribute hostile intent to ambiguous peer provocations than non-aggressive peers (Crick & Dodge, 1996; Dodge et al., 1986; Dodge & Tomlin, 1987), are more likely to develop a biased way of attending to social cues in their environment and of solving social problems (Dodge et al., 2003), use fewer social cues to make a decision compared to their peers (Gouze, 1987), come up with fewer pro-social effective solutions when posed with a social problem (Mayeux & Cillessen, 2003), and are less socially competent overall (Dodge et al., 1985; Dodge et al., 1984; Dodge & Price, 1994; Feldman & Dodge, 1987).

More recently, some investigators have begun to apply Crick and Dodge’s social information processing model (1994) to children from clinical populations, such as children with learning disabilities (Bauminger, Edelsztein, & Morash, 2005; Tur-Kaspa, 2004; Tur-Kaspa & Bryan, 1994), anxiety disorders (Bell-Dolan, 1995), intellectual disabilities (Gomez & Hazeldine, 1996; Siperstein & Leffert, 1997; van Nieuwenhuijzen, de Castro, Wijnroks, Vermeer, & Matthys, 2004), FASD (Timler, 2000), and maltreated children in foster care (Price & Landsverk, 1998). Bauminger and colleagues (2005) found that children with learning disabilities (LD) encoded social cues less well than children without learning disabilities, while Tur-Kaspa (2004) found that kindergarten children with developmental LD made more ‘poor response’ decisions and behavioural
enactments compared to non-LD peers. However, Sprouse and colleagues (1998) found that students with learning disabilities combined with Attention Deficit Hyperactivity Disorder (LD/ADHD) do not misperceive nonverbal social cues significantly more than their peers.

Children with intellectual handicaps have been found to be less accurate in interpreting ambiguous cues and tend to be more hostile in their responses to these ambiguous cues (Gomez & Hazeldine, 1996). Siperstein and Leffert (1997) found that rejected children with intellectual handicaps tended to choose friendly-assertive goals and generated a high rate of positive outgoing strategies, which is inconsistent with the findings for rejected typically developing children (e.g. Dodge et al., 2003). Finally, van Nieuwenhuijzen and colleagues (2004) found that children with mild intellectual disabilities encoded more negative cues, generated more responses and showed more variability in their responses than children without intellectual disabilities. In contrast to Siperstein and Leffert (1997), van Nieuwenhuijzen and colleagues (2004) found that children with mild intellectual handicaps generated fewer assertive responses, evaluated the assertive responses less positively, and selected fewer assertive responses than children without MR.

Timler (2000), as previously described, has examined social information processing in children with FASD using Crick and Dodge’s (1994) model. She found that the children with prenatal alcohol exposure generated less effective strategies, were more likely to select less effective strategies to meet their social goals, and chose more hostile/coercive and adult-seeking strategies. Importantly, Timler only examined steps 3 and 4 of Crick and Dodge’s (1994) model, and consequently, it is unclear how children
with FASD perform on the encoding and interpretation steps of the social information processing model. Because successful social information processing relies on proceeding through each of the steps sequentially, it is likely that difficulties in any of the first few steps could influence the results of the latter steps in the model. For example, if a child only perceives the more negative social cues in their environment, then it would follow that they would generate more hostile strategies and responses to the social situation. Also, if a child is unable to perceive certain types of emotional or social information (e.g. from facial expressions, sarcasm, posturing) then once again they are more likely to produce inappropriate strategies and responses to certain social situations. For example, if a child misinterprets a situation (e.g. thinks a peer is happy when they are in fact angry), they will produce erroneous strategies or responses for the situation. Shapiro and colleagues note, “a deficit identified by measuring relatively high-level behaviours may actually be the result of a deficit occurring at a lower level of the model” (Shapiro et al., 1993, p. 209). From Timler’s finding that children with FASD have problems with response generation and selection we cannot conclude that this is the only area of weakness, because if those difficulties are a result of faulty encoding and interpretation, we could inappropriately target the wrong aspects of social information processing in interventions. Therefore, it is crucial to examine the entire process, including the first steps in the model, to determine whether children with FASD have difficulties with earlier steps of social information processing that could affect performance at later steps in the social information-processing model.
Emotion Processes in Social Information Processing: A Model

Lemerise and Arsenio (2000) modified Crick and Dodge’s (1994) model of social information processing to create an integrated model of emotion processes and cognition in social information processing (see Figure 2). They note that although the research on social information processing and emotionality focus on social competence, these two domains have not been integrated into one coherent framework. Lemerise and Arsenio (2000) argued that “1) it is vitally important for developmental psychologists to take a broader view of children’s social and cognitive development, and 2) an essential aspect of this broader view involves considering, both theoretically and empirically, how emotional and cognitive processes can be integrated in models of social competence.” (p. 107).

Lemerise and Arsenio (2000) hypothesize that emotion processes (i.e. mood, emotion regulation, temperament/emotionality, etc.) affect social information processing and decision making in challenging, ambiguous, or uncertain social situations. They point out that Crick and Dodge (1994) recognize the importance of emotion processes in social information processing, but do not pay adequate attention to the contribution of emotion within their model. In order to more fully integrate cognitive and emotional processes within one model of social information processing, Arsenio and Lemerise (2000) modified Crick and Dodge’s (1994) model to incorporate emotion processes within each step of the model (see Figure 2). Lemerise and Arsenio (2000) note the importance of affective cues from peers and emotion recognition in the encoding of cues in the first step of the model; the importance of the affective nature of the peer relationship in the interpretation of cues (step 2), the clarification of goals (step 3), and making a response decision (step 5); the emotional prioritizing of somatic markers before
making a response decision (between steps 4 and 5); the importance of empathic
responsiveness while making a response decision (step 5); and the importance of emotion
production and display rules during enactment of the behaviour (step 6). Lemerise and
Arsenio (2000) also incorporate affect-event links into the database of past events, and
emotion processes such as emotionality/temperament, emotion regulation and
moods/background emotions that influence all of the steps in social information-
processing (Figure 2).
Encoding and Decoding Emotions

Within the last ten to fifteen years, nonverbal processing abilities have been examined to determine the influence of emotion recognition on social functioning (Baum

\[1\] Items marked with filled circles are from Crick and Dodge’s (1994) model; items marked with filled diamonds represent emotion processes added to the model.
Emotion recognition and nonverbal processing will be used interchangeably to refer to one’s ability to perceive and interpret emotional information through various nonverbal channels, such as facial expressions, prosody, body postures, and gestures. Nowicki and colleagues have used the term “dyssemia” to describe nonverbal processing difficulties (e.g., Duke, Nowicki, & Manusov, 2005; Love et al., 1994; Nowicki et al., 2001; Nowicki & Carton, 1997). Dyssemia, which is literally defined as an inability to read signs, has been found to increase the likelihood that children’s social interactions will fail (Nowicki & Carton, 1997). Furthermore, because nonverbal processing difficulties tend to occur outside of the child’s awareness, children are unlikely to know that they have dyssemias, and are often unaware of how much their difficulties reading emotional cues interfere with the maintenance and facilitation of social interactions (Nowicki & Carton, 1997). As such, these children may consistently fail at interpersonal interactions, but not understand why. Children with dyssemias have lower feelings of social competence (Custrini & Feldman, 1989; Nowicki & Carton, 1997; Nowicki & Mitchell, 1998; Russell et al., 1993), tend to be less popular (Nowicki & Duke, 1992, 1994), and have lower academic achievement scores (Nowicki & Duke, 1992), compared to peers with more appropriate nonverbal processing abilities.
The perception and interpretation of emotional information is an important area of research because if a child consistently misperceives or misinterprets emotions, he/she will have significant difficulty in social situations. For example, if a child consistently misinterprets anger for happiness (both of which tend to be expressed with enthusiasm and intensity), they will end up in situations where they are vulnerable to being threatened or attacked and not foresee the danger cues. In addition, if a child does not perceive a peer as sad, his/her peers may perceive him/her as insensitive. Consequently, a child who misperceives or misinterprets emotional information is likely to be ostracized by peers or is vulnerable to be taken advantage of due to his/her clear lack of social perception skills.

Emotion recognition has been extensively studied over the last fifty years, especially in the area of facial expressions (Ekman, 1992a, 1992b, 1993; Ekman & Friesen, 1971; e.g., Ekman & Friesen, 1974; Ekman, Friesen, & Ellsworth, 1972; Fridlund, Ekman, & Oster, 1987; Izard, 1971). It has been noted that the ability to differentiate facial expressions, as well as other nonverbal cues, plays a very important role in the development and maintenance of human relationships (McClure, 2000). In a review of the literature on emotions displayed in facial expressions, it has been concluded that there are six basic emotions recognized: happiness, sadness, fear, surprise, anger, and disgust (Fridlund et al., 1987).

Encoding of emotional facial expressions has been studied in children and it has been found that children’s accuracy increases with age, and some emotions are more easily recognized (e.g. happiness and sadness) than others (e.g. surprise, fear and anger; Camras & Allison, 1985). A review of facial expressions of emotion noted that
children’s ability to recognize and produce facial expressions seems to improve until the child reaches age 10, at which time most children, adolescents, and adults are equally capable of encoding and decoding the major categories of emotion (Camras & Allison, 1985; Fridlund et al., 1987). More recently, Tonks and colleagues (2007) found that children showed significant improvement in recognizing facial expressions at approximately 11 years of age. This suggests that deficits in recognizing emotions might be less apparent until pre-adolescence or adolescence when children fail to develop more adult skills. Finally, neurological studies of facial expression processing in children have shown that the right hemisphere is specialized for processing emotional information in children as it is in adults, and that the temporal cortex and amygdala play an important role in facial expression processing, as well as general emotion recognition (Anderson & Phelps, 2000; Borod, Bloom, Brickman, Nakhutina, & Curko, 2002; Davidson & Slagter, 2000; McClure, 2000; Schmolck & Squire, 2001; Silberman & Weingartner, 1986; Voeller, Hanson, & Wendt, 1988).

The encoding and decoding of emotions from facial expressions has also been studied in children with ADHD (Cadesky et al., 2000; Guyer et al., 2007; Hall et al., 1999; Kats-Gold, Besser, & Priel, 2007; Sprouse et al., 1998), conduct problems (Cadesky et al., 2000; Guyer et al., 2007), learning disabilities (Sprouse et al., 1998), intellectual disabilities (Wishart, Cebula, Willis, & Pitcairn, 2007), nonverbal learning disabilities (Petti et al., 2003), mood disorders (Guyer et al., 2007), and children who have been physically abused (Pollak & Kistler, 2002).

Cadesky and colleagues (2000) found that children with ADHD and conduct problems were significantly less accurate at interpreting emotions compared to normal
controls and Kats-Gold and colleagues (2007) found that boys at-risk for ADHD were also significantly impaired in their emotion recognition abilities. Sprouse and colleagues (1998) found that children with learning disabilities have more difficulty in the accurate decoding of emotions from pictures of faces compared to typically developing children and children with ADHD/LD. Petti and colleagues (2003) reported that children with nonverbal learning disabilities were less accurate at interpreting facial expressions compared to children with verbal learning disabilities and a typically developing control group. Wishart and colleagues (2007) found that children with Down syndrome had significant difficulties with an emotion-matching task, as compared to children with Fragile X syndrome, non-specific intellectual disabilities, and a typically developing comparison group. Guyer and colleagues (2007) found that children with bipolar disorder and severe mood dysregulation made more errors labelling emotions from adult or child facial expressions compared to children with anxiety, depression, ADHD, conduct disorder, or controls. Finally, Pollak and Kistler (2002) found that children who had been physically abused overidentified anger but did not differ from controls in their recognition of other emotions. Important to note, children at risk for behavioural or neurodevelopmental disorders, for example children at risk for ADHD, may have fewer compensatory resources to fall back on if they fail to recognize an emotion which could then lead to even more significant social deficits (Kats-Gold et al., 2007).

More recently, there has been some interest in whether facial expressions are processed differently when static versus dynamic stimuli displays are used. Traditionally, static stimuli (i.e. photographs of faces) have been used to study the perception and interpretation of facial expressions (e.g., Camras & Allison, 1985; Ekman
& Friesen, 1974; Robel et al., 2004; Voeller et al., 1988). However, the ecological validity of static portrayals of emotion has been questioned because static images only correspond to a brief peak or middle stage of meaningful movements and in real life faces move in and out of facial expressions (Atkinson, Dittrich, Gemmell, & Young, 2004). Bassili (1978) analyzed adults’ ability to distinguish facial expressions from moving displays of facial expressions, using full-light stimuli and point-light stimuli. Point-light stimuli, originated by Johansson (1973), involve the moving figure (in this case, the face) being portrayed by only a few points of light in which the motion of the main features is visible, but the form and specific details (e.g. gender, identity) are not visible. Video clips are created in which the only visible elements are these points of light attached to key points on the face in which movement occurs during emotional expressions (e.g., mouth, eyebrows, etc.). When a static image of these points of light is created, it appears to be a meaningless constellation of lights. However, once movement is introduced, the configuration of lights and movement clearly becomes recognized as a representation of a moving body or face (Johansson, 1973). Bassili found that the participants were able to distinguish the six basic emotions from point-light displays, although participants were more accurate when judging actors’ movements in fully lit video clips (Bassili, 1978, 1979). Finally, Humphreys and colleagues (1993) examined static versus dynamic face processing in two patients with face processing impairments and found that one patient was able to make judgments about facial expressions from a set of moving point-lights (showing the form of the face) but was unable to discriminate facial expressions from static photographs of faces. The other patient was not able to judge emotional expression from static or dynamic faces. Their finding suggests that the
perception of facial expressions can be dissociated depending on whether the information is depicted by static or moving stimuli (Humphreys et al., 1993).

Another modality of emotion recognition that has recently gained considerable attention has been the study of prosody. A prosodic feature of speech is defined as any nonverbal aspect of speech, such as pitch, intonation, loudness, stress, timing, rhythm, or rate (Frick, 1985; Monnot, Lovallo, Nixon, & Ross, 2002). Affective prosody refers to the nonlinguistic aspects of speech that provide information about the speaker’s emotional state (Monnot et al., 2002). Emotions such as happiness, anger, sadness, fear, disgust, and surprise can be expressed prosodically, and it is the right hemisphere that is responsible for the recognition of emotional information through paralanguage (Merewether & Alpert, 1990). Frick (1985) reported that prosody providing emotional information is universal within and between cultures.

Studies of prosody recognition in children have found that children as young as four years of age can accurately label the emotional prosody in filtered sentences where the content of the sentence is unintelligible and only the prosody is comprehensible (Morton & Trehub, 2001). However, when the content of the sentence and the prosodic features conflict, children younger than age eight are more likely to rely on content to ascertain emotional information than on prosody, whereas adults are more likely to rely on the prosodic features than on the content of the sentences (Morton & Trehub, 2001). Between the ages of five and twelve years, children become increasingly accurate at labelling emotions from prosodic features of vocal expressions (Dimitrovsky, 1964; as cited in Morton & Trehub, 2001). Studies in typically developing children have found that children who are better at decoding emotional prosody tend to be more popular, more
likely to be internally controlled, have higher social competence, and are more likely to have higher achievement scores (Nowicki & Duke, 1992; Rothman & Nowicki, 2004). Finally, Tonks and colleagues (2007) found no significant phases of improvement in identification of emotion through prosody between the ages of 9 and 15, whereas they found a significant phase of improvement at 11 years of age at recognizing facial expressions. These findings suggest either that the ability to identify emotion through prosody is fully developed by age 9, or that this ability becomes fully developed later in adolescence.

Affective prosody recognition has also been examined in clinical populations of children such as children with ADHD (Cadesky et al., 2000; Hall et al., 1999), conduct problems (Cadesky et al., 2000), learning disabilities (Hall et al., 1999; Sprouse et al., 1998), and language impairments (van der Meulen, Janssen, & Os, 1997). Cadesky and colleagues (2000) found that children with ADHD and conduct problems had difficulty compared to peers in perceiving emotional cues from recordings of voices. Hall and colleagues (1999) found that children with ADHD and learning disabilities (ADHD/LD) also had considerable difficulty compared to peers in perceiving emotional prosody cues. However, Sprouse and colleagues (1998) did not find any group differences between children with ADHD/LD, ADHD and typically developing controls on a measure of affective prosody. In a study on affective prosody recognition and production in children with language impairments, van der Meulen and colleagues (1997) found that children with language impairments had difficulties imitating prosodic sentences but had no difficulty identifying emotions based on prosody.
Affective prosody recognition has also been studied in adult alcoholics and adults who have been prenatally exposed to alcohol (Monnot et al., 2002). It was found that both alcoholics and fetal alcohol-exposed adults were significantly less accurate than control subjects in comprehending affective prosody, and scored similarly to subjects with focal brain lesions. A subsequent study with adult alcoholics also found that alcoholics had difficulty matching affective prosody to facial expression (Uekermann, Daum, Schlebusch, & Trenckmann, 2005).

A channel of emotional recognition that has largely been ignored has been the study of postures and how postures and body movements portray emotions. James (1932), over 70 years ago, was the first to examine the interpretation of emotions and attitudes from photographs of a masked male posing in various postures. After James (1932), the study of emotion recognition from postures was largely ignored until the 1980’s and 1990’s (de Meijer, 1989, 1991; Hall et al., 1999; Pitterman & Nowicki, 2004; Sprouse et al., 1998). Pitterman and Nowicki (2004) assessed an individual’s ability to identify emotion in photos of human standing and sitting postures and found that in typical adults more errors in emotional posture recognition were related to feelings of loneliness, social anxiety, external locus of control and lower self-esteem. Hall and colleagues (1999), using photos of humans in various postures, assessed decoding of emotions from postures in children with ADHD, ADHD/LD and normal controls and found no group differences. Finally, Sprouse and colleagues (1998), using the same stimuli as Hall and colleagues (1999), found that children with LD, ADHD/LD and normal controls did not differ in their decoding of emotions from postures.
de Meijer used a different methodology compared to other studies in this area by assessing body movements, and therefore studying dynamic rather than static postures (de Meijer, 1989, 1991). He hypothesized that particular body movements might provide information about emotions and tested this hypothesis by using video clips of actors portraying various body movements. de Meijer (1989, 1991) found that particular body movements can be perceived as expressive of specific emotional states, and that the perception of emotions is not only determined by the movement of the body, but also by the sex of the person moving.

More recently, the study of emotional recognition through body movements has been conducted using point-light stimuli (Atkinson et al., 2004; Blake, Turner, Smoski, Pozdol, & Stone, 2003; Brownlow, Dixon, Egbert, & Radcliffe, 1997; Chouchourelou, Matsuka, Harber, & Shiffrar, 2006; Clarke, Bradshaw, Field, Hampson, & Rose, 2005; Dittrich, Trosclair, Lea, & Morgan, 1996; Walk & Homan, 1984). In these studies, approximately 8-12 points of light are attached to various points on the body while the actor is wearing a black suit. The actor is filmed in a dark room so all that appears is his/her movement outlined by the points of light. As a static image, the stimuli do not portray any meaningful information – they look like a random constellation of lights. However, once the video clip is played and motion is observed, the human form is easily identifiable to both adults (Johansson, 1973) and children as young as three years of age (Pavlova, Krageloh-Mann, Skolov, & Birbaumer, 2001). In one of the earlier works on emotion detection using point-light displays, Walk and Homan (1984) found that participants could accurately identify emotions from dances performed by professional dancers. Since that time, several other researchers have shown that the emotional state of
a human figure can be detected from motion information alone (Atkinson et al., 2004; Chouchourelou et al., 2006; Clarke et al., 2005; Dittrich et al., 1996).

**Summary and Purpose for the Proposed Study**

Research literature clearly demonstrates that individuals with FASD have significant difficulties in social functioning as assessed by parent- and teacher-reports. However, these reports provide very broad information about the child’s social deficits and do not provide enough detailed information about the particular aspects of social functioning children with FASD have difficulties with, and thus do not provide adequate information for targeting potential interventions. Recently, two studies have been conducted using direct experimental measures with children with FASD (Greenbaum, 2004; Timler, 2000). These studies have found that children with FASD are impaired in aspects of social information processing and socioemotional functioning. However, Timler’s (2000) study looked at an advanced step in Crick and Dodge’s (1994) model of social information processing; therefore, it cannot be concluded that the deficits are primarily in strategy generation and selection, or whether earlier steps, such as encoding and interpretation, led to the impairments in these latter steps of the model. Greenbaum’s (2004) study provided a great deal of information from parent- and teacher-reports of social functioning, and also directly examined some areas of emotion processing in children with FASD. However, her study was not theoretically grounded, and like previous studies, provided a great deal of information about broad social deficits without examining specific ability areas to target in interventions.
The current study examined the first step in Lemerise and Arsenio’s model of social information processing; specifically, encoding and decoding of emotions. It is important to examine emotional processing in children with FASD because the ability to perceive and interpret emotions appropriately is a fundamental aspect of all social interactions. If one cannot perceive emotional information from a peer, one is likely to be rejected, harassed, or even victimized. Children with FASD are often ostracized and are vulnerable to being taken advantage of and it is possible that these observed difficulties are a result of problems encoding and decoding emotional information. These basic skills need to be examined in order to determine whether there are deficits at this step of social information processing and to develop appropriate interventions to remediate social difficulties.

The encoding and decoding of emotions was examined through multiple modalities, including facial expressions, prosody, postures, and movement. In addition to the experimental measures, caregivers were asked to complete a number of measures tapping into social behaviour, including a measure of behavioural problems and competencies, a measure of adaptive functioning, and a measure of behaviours characteristically observed in individuals with FASD. The relationship between caregiver reports of social functioning and the child’s nonverbal information processing were examined.

**Hypotheses**

1. Children with FASD have significant difficulties in social functioning and social information processing and therefore would make more errors than
typically developing children on items assessing emotional content, especially items with more subtle emotional information. More specifically, it was hypothesized that children with FASD would perform best on high intensity stimuli, but would make more errors on low-intensity stimuli on the DANVA-2.

2. From a very young age children are shown pictures of faces and asked to label the emotion. However, they are rarely specifically asked to label emotions from postures, prosody, or movement. Therefore, it was hypothesized that children with FASD would perform significantly worse on the prosody, postures, and point-light walkers tasks compared to the faces tasks. These tasks require the recognition of cues that children are not as used to labelling as they are facial expressions. It was hypothesized that children with FASD would demonstrate significantly more errors on these tasks as compared to typically developing children.

3. It was hypothesized that the FASD and typically developing control groups would demonstrate different patterns of errors on the emotional recognition tasks. Because many clinical populations with social difficulties tend to make more hostile attributions, it was predicted that children with FASD would be more likely to label subtle or more challenging stimuli as angry.
4. It was hypothesized that children with FASD would show deficits on step 1 of the model by performing more poorly on perceptual measures compared to typically developing children. It was hypothesized that children with FASD would have difficulty differentiating stimuli based on emotion, such as in facial expressions or emotional prosody stimuli.

5. It was hypothesized that children who made more errors on the affective processing tasks would have lower social competence and social skills as rated by caregivers.

6. The Fetal Alcohol Behavior Scale (FABS) was used as a measure of FASD symptomatology. Higher scores on the FABS indicated more negative behaviours associated with the diagnosis. It is hypothesized that children with higher scores on the FABS would have greater deficits in emotion recognition and would make more errors on the emotion tasks.
Methods

Participants

Permission to involve human subjects in the present study was granted by the University of Victoria Human Research Ethics Committee (Protocol Number 06-366, Project Title: Emotion Recognition in Children with Fetal Alcohol Spectrum Disorders). Consent forms were approved by the ethics committee, and are included in the Appendix (Appendices A and B).

Two samples of children were recruited for the study: children with a diagnosed FASD and a typically developing control group. All children were between the ages of eight and fourteen and this six-year age span was chosen as it was felt that children in this age range would be able to understand the task demands and by approximately age 6 children have well-established emotion recognition skills for the four basic emotions (Ekman & Friesen, 1975). It was reasoned that a large age range of participants might mask group differences due to large variability within groups. In addition, to ensure that all children had the cognitive abilities to understand the tasks, children with Full-Scale intelligence quotients (FSIQ) of less than 70 were excluded.

FASD Group

Psychologists and FASD diagnostic clinics in the greater Vancouver, Victoria and Nanaimo areas were contacted and given information about the study (including how to contact the primary investigator) to provide to families with children with FASD. In addition, contacts were made through a province wide list serve, through regional FASD key workers throughout British Columbia, and through support networks in Alberta,
Saskatchewan, Manitoba, and Ontario. Information was provided to these agencies to distribute to interested families. In total, 26 children with FASD were recruited for the study. Seven children were recruited from Victoria and nine children were recruited from central Vancouver Island, including Nanaimo, Duncan, and Ladysmith. Four children were recruited from Williams Lake and six children were recruited from Saskatoon.

To be eligible for the study, children in the FASD group needed a confirmed diagnosis made by either a qualified team of diagnosticians, including at minimum, a physician and psychologist or a diagnosis by a physician only in those cases that were diagnosed several years ago prior to multidisciplinary diagnostic teams. The diagnosis was verified by asking the caregiver to refer to the assessment report and provide the primary investigator with the diagnostic label that was given, and who made the diagnosis. Diagnostic labels such as Fetal Alcohol Syndrome (FAS), Fetal Alcohol Effects (FAE), Partial Fetal Alcohol Syndrome (pFAS), or Alcohol Related Neurodevelopmental Disorder (ARND) were all accepted as confirmed diagnoses. Children with diagnoses such as Fetal Alcohol Spectrum Disorder (FASD; n=2) were not used in the study because FASD is not a recognized diagnostic label but rather a descriptive term for the group of diagnostic labels.

When four-digit diagnostic codes were available, the primary investigator gauged whether children were eligible to participate in the study based on the code. The Four-Digit Diagnostic Code system was developed at the University of Washington FAS Diagnostic and Prevention Network (DPN; Astley & Clarren, 2000). The four digits in the code represent the degree of expression of the four key diagnostic features of FASD: 1) growth deficiency; 2) the FASD facial phenotype; 3) central nervous system (CNS)
dysfunction/damage; and 4) gestational alcohol exposure. Each feature is assigned an independent rank on a four-point Likert scale with 1 reflecting complete absence of the FASD feature and a 4 reflecting strong presence of the FASD feature. For the present study, children were not excluded based on their growth or facial features code (any code 1 to 4 was accepted for growth and face), as it has been clearly shown that children with FASD can exhibit neuropsychological deficits without the characteristic facial features or growth impairments (e.g. Mattson et al., 1998). Evidence of impairment in at least three central nervous system domains was necessary (codes 3 and 4 for CNS), and confirmed maternal alcohol exposure (codes 3 and 4 were accepted for alcohol exposure). One child was excluded from the study because his CNS code was a two, indicating only mild to moderate central nervous system impairment.

In summary, exclusionary criteria for the FASD group included participants without a confirmed diagnosis of FASD (n=3), children less than eight years and greater than 14 years of age, and children with a Full-Scale intelligence quotient (FSIQ) less than 70 (n=1). Another criterion that was set for the study was to exclude participants with a history of incarceration or trouble with the law. The rationale for this exclusionary criteria was that children who had been involved with the law at such young ages (prior to the age of 14) were likely very high in externalizing behaviors and were more profoundly deficient in social functioning than other children with FASD. However, no children who were interested in participating in the study had had any involvement with the law and therefore no one was excluded based on this criteria.
Control Group

Control participants were recruited through fliers and information distributed to FASD keyworkers, the FASD Support Network of Saskatchewan, and through word of mouth by friends and family of the primary investigator. Two control participants were recruited in Williams Lake, four control participants were recruited in Saskatoon (3 were unaffected half siblings of a child with FASD), and 21 control participants were recruited through word of mouth or fliers within the Lower Mainland.

In total, 27 typically developing children were recruited for the present study. As emotion recognition and social information processing abilities have been shown to be unrelated to intellectual functioning (Baum & Nowicki, 1998; Gouze, 1987; Nowicki & Duke, 1994), control subjects were matched to the participants with FASD by gender and age, but not on intellectual level. Exclusionary criteria for the control group included prenatal exposure to alcohol or other substances (n=1), the diagnosis of autism spectrum disorders, nonverbal learning disabilities, attention deficit/hyperactivity disorder, head injuries or other neurological conditions (n=2).

Total Sample

The final sample of participants included 22 children with a clear diagnosis of a FASD and 22 typically developing children, matched by age and gender. Table 1 provides descriptive information about the two groups of participants, including performance on parent report measures described below. Table 2 provides descriptive information about the FASD group specifically, with respect to number of placements, years in their current placement, and any history of suffering from abuse.
### Table 1. Participant demographics and parent-report measure descriptives

<table>
<thead>
<tr>
<th></th>
<th>FASD Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years [Mean (SD), Range]</td>
<td>11.2 (2.2), 7.9-14.8</td>
<td>11.2 (2.1), 7.9-14.8</td>
</tr>
<tr>
<td>Gender ratio (Male:Female)</td>
<td>12:10</td>
<td>12:10</td>
</tr>
<tr>
<td>WASI [Mean (SD), Range]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSIC**</td>
<td>84.7 (8.3), 75-108</td>
<td>110.1 (10.8), 90-130</td>
</tr>
<tr>
<td>Vocabulary subtest (T-score)**</td>
<td>39.1 (6.6), 27-57</td>
<td>57.4 (7.4), 43-73</td>
</tr>
<tr>
<td>Matrices subtest (T-score)**</td>
<td>40.7 (9.4), 21-59</td>
<td>54.1 (7.2), 40-64</td>
</tr>
<tr>
<td>CBCL (T-scores) [Mean (SD), Range]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Problems**</td>
<td>64.4 (9.6), 46-82</td>
<td>45.3 (8.9), 24-62</td>
</tr>
<tr>
<td>Externalizing**</td>
<td>63.1 (9.6), 43-84</td>
<td>45.6 (8.5), 33-60</td>
</tr>
<tr>
<td>Internalizing*</td>
<td>56.6 (14.2), 33-73</td>
<td>47.1 (9.6), 33-68</td>
</tr>
<tr>
<td>Social Problems**</td>
<td>63.8 (10.1), 50-86</td>
<td>51.9 (3.0), 50-62</td>
</tr>
<tr>
<td>VABS-2 (scaled scores) [Mean (SD), Range]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptive Behavior Composite**</td>
<td>78.2 (10.3),62-105</td>
<td>107.6 (14.2),63-138</td>
</tr>
<tr>
<td>Communication**</td>
<td>76.5 (6.8), 62-90</td>
<td>108.9 (13.7),75-130</td>
</tr>
<tr>
<td>Daily Living**</td>
<td>82.2 (13.5), 65-125</td>
<td>105.4 (14.4), 71-133</td>
</tr>
<tr>
<td>Socialization**</td>
<td>81.5 (13.7), 61-108</td>
<td>106.3 (15.4), 80-132</td>
</tr>
<tr>
<td>FABS Total Score**</td>
<td>19.3 (5.9), 9-31</td>
<td>2.5 (2.7), 0-9</td>
</tr>
<tr>
<td>Current Family Placement of Child</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with ≥1 Biological Parent</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Living with Adoptive Parent(s)</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Living with Foster Parent(s)</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Ethnicity of Child – as reported by primary caregiver (number of children)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>First Nations</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Indo-Canadian</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mixed Ethnicity</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethnicity of Current Family – as reported by primary caregiver (number of children)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
</tr>
<tr>
<td>First Nations</td>
</tr>
<tr>
<td>Indo-Canadian</td>
</tr>
</tbody>
</table>

*p<.05 and **p<.01

Table 2. Additional demographics and descriptives for the FASD group (as reported by the child’s current primary caregiver)

<table>
<thead>
<tr>
<th>Diagnostic Label (number of children)</th>
<th>FASD</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAS</td>
<td>4</td>
</tr>
<tr>
<td>pFAS/FAE</td>
<td>6</td>
</tr>
<tr>
<td>ARND/Static Encephalopathy</td>
<td>7</td>
</tr>
<tr>
<td>FASD (unknown specific label, but brain and alcohol code of 3 or 4)</td>
<td>5</td>
</tr>
<tr>
<td>Physical Abuse</td>
<td>9 (2 unknown)</td>
</tr>
<tr>
<td>Emotional Abuse</td>
<td>10 (2 unknown)</td>
</tr>
<tr>
<td>Sexual Abuse</td>
<td>6 (6 unknown)</td>
</tr>
</tbody>
</table>
Number of placements (number of children; data missing for 2 participants)

<table>
<thead>
<tr>
<th>Number of Placements</th>
<th>Number of Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 placement</td>
<td>1</td>
</tr>
<tr>
<td>2 placements</td>
<td>3</td>
</tr>
<tr>
<td>3 placements</td>
<td>7</td>
</tr>
<tr>
<td>4 placements</td>
<td>4</td>
</tr>
<tr>
<td>5 or more placements</td>
<td>5</td>
</tr>
</tbody>
</table>

Years in Current Placement (number of children; data missing for 3 participants)

<table>
<thead>
<tr>
<th>Years in Current Placement</th>
<th>Number of Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 years</td>
<td>3</td>
</tr>
<tr>
<td>5 – 8 years</td>
<td>9</td>
</tr>
<tr>
<td>9 or more years</td>
<td>8</td>
</tr>
</tbody>
</table>

**Measures**

**Caregiver-Report Measures**

Caregiver report measures were used to assess socioemotional functioning, social skills, social competence, adaptive functioning, and behavioural functioning.

Standardized measures included the Child Behavior Checklist (Achenbach & Rescorla, 2001), the Vineland Adaptive Behavior Scales Second Edition (Sparrow, Cicchetti, & Balla, 2005), and the Fetal Alcohol Behavior Scale (Streissguth, Bookstein, Barr, Press, & Sampson, 1998). Additionally, a demographics questionnaire was completed by each caregiver.
Demographics Questionnaire

The primary caregiver completed an 18-item demographics questionnaire while their child completed the study (Appendix B). The demographics questionnaire provided information on age, gender, and ethnicity of the child, family characteristics, history of living arrangements, history of substance exposure and abuse, comorbid diagnoses and any medications being taken by the child.

Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001)

The CBCL is a caregiver-report measure designed to assess social competence, emotional problems, and behaviour problems in children between the ages of 4 and 18 years. It includes 118 items rated on a 3-point Likert scale: “0” (not true), “1” (sometimes true), “2” (very true). Ratings are based on caregiver judgments about the past six months and the CBCL takes approximately 15 minutes to complete. The measure is computer scored based on normative data provided by Achenbach and raw scores are converted to T-scores with a mean of 50 and a standard deviation of 10. Scoring the measure yields a Total Problems Score, two broadband factor scores (Internalizing and Externalizing Behaviours), and eight narrow-band scales (Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Delinquent Behaviour, and Aggressive Behaviour). Higher scores on any of the broad and narrow-band scales yield higher T-scores reflecting greater problems. On the narrow-band scales, T-scores between 65 and 70 represent borderline range problems, while scores greater than 70 represent clinical level problems. On the broadband scales, T-scores between 60 and 63 represent borderline problems, while scores of 64 and above
suggest clinically significant problems. The questionnaire also provides scores for six scales consistent with DSM-IV diagnostic categories: Affective Problems, Anxiety Problems, Somatic Problems, ADHD Problems, Oppositional Defiance, and Conduct Problems. Finally, the CBCL provides information on the child’s social and academic competence.

The CBCL has been used extensively for research purposes and has demonstrated strong psychometric properties. Inter-parent reliability coefficients of 0.96 and 0.93 for behaviour problems and social skills, respectively, have been demonstrated. Test-retest reliability has been found to be between 0.95 and 1.00. Internal consistency coefficients have been found to fall within the 0.78 to 0.97 range. Finally, the construct validity of the CBCL has been supported.

Vineland Adaptive Behavior Scales – 2nd Edition – Caregiver Report Form (VABS-2; Sparrow et al., 2005)

The VABS-2 is a measure of personal and social skills needed for everyday living. It includes three broadband scales of adaptive functioning (Communication, Daily Living Skills, and Socialization Skills), plus an overall Adaptive Behaviour Composite. Within the Communication Scale, receptive, expressive and reading and writing skills are assessed. Within the Daily Living Skills Scale, self-care, domestic care, and living in the community are assessed. Finally, within the Social Skills Scale, interpersonal relationships, play and leisure, and coping skills are assessed. Raw scores are converted to standard scores with a mean of 100 and standard deviation of 15. Higher scores suggest better adaptive functioning and age-equivalent scores can also be obtained from
the standard scores. The Caregiver Report Form used in this study includes 307 items in total, and responses are made according to a 3-point Likert Scale: “2” – usually, “1” – sometimes or partially, and “0” – never. There are different start points within each subscale depending on the age of the child, and therefore, parents in the present study were required to complete approximately 200 items.

The original VABS (Sparrow et al., 1984), was used extensively in research and had strong psychometric properties. The updated VABS-2 also has strong psychometric properties. Test-retest reliability coefficients for the Adaptive Behavior Composite are greater than .9, and test-retest reliability coefficients for the three broad domains range between .88 and .92. The internal consistency coefficients range between .93 and .97.

_Fetal Alcohol Behavior Scale (FABS; Streissguth et al., 1998)_

The FABS is an experimental caregiver report measure that has been developed to describe the behavioural characteristics of individuals with FASD, regardless of age, sex, ethnicity, and intelligence. It includes 36 items about communication and speech, personal manner, emotions, motor skills, academic/work performance, social skills and interactions, and bodily or physiologic functions. Caregivers respond to each item with “yes,” “no,” or “don’t know.” The final score is a simple count of “yes” responses. The FABS was designed to be applicable for individuals age 2 to approximately 35. It has been found to be moderately correlated with the VABS and is correlated quite highly (0.60 range), with three scales from the CBCL: Social, Attention, and Total Problems. This was replicated in the present study: the FABS was found to correlate highly with the VABS-2 and the three scales from the CBCL (p<.001). The FABS has demonstrated
high internal consistency and good test-retest reliability over an average interval of five years (Streissguth et al., 1998). Streissguth and colleagues (1998) found that the measure was able to identify many of the subjects with known or presumed prenatal alcohol exposure in detection studies using individuals from a prison population and from a general sample. They also found that the scores on the FABS predicted dependent living among adult patients with FAS/FAE.

**Measure of Intelligence**

*Wechsler Abbreviated Scales of Intelligence (WASI; Wechsler, 1999)*

The WASI is a brief measure of intelligence that provides the three traditional Verbal (VIQ), Performance (PIQ), and Full Scale IQ (FSIQ) scores. It can be used with individuals age 6 to 89 years. The two-subtest form of the WASI (Vocabulary and Matrix Reasoning) can be administered within 15 minutes and was used to obtain an estimate of general intelligence through the FSIQ score. The WASI has demonstrated strong psychometric properties with test-retest reliability coefficients ranging between 0.88 and 0.92, and inter-rater reliability coefficients of 0.98 and 0.99 for the verbal subtests.

**Measures of Emotion Recognition**

*Diagnostic Analysis of Nonverbal Accuracy – 2nd Edition (DANVA-2; Nowicki & Duke, 1994; Nowicki et al., 2001)*

The DANVA-2 is a battery of tests designed to assess emotion recognition abilities in children and adults. It has been used with individuals differing in age, sex,
ethnicity, cultural background, intellectual ability and psychological adjustment (Nowicki, 2006). Each subtest assesses the individual’s ability to identify the four basic emotions: happiness, sadness, anger, and fear. The DANVA-2 is made up of five subtests: Adult Faces, Child Faces, Adult Paralanguage, Child Paralanguage, and Adult Postures. Each subtest consists of 24 stimuli: six for each of the four basic emotions. The stimuli are further broken down by intensity. Overall, there are three high intensity stimuli for each of the four basic emotions and three low intensity stimuli for each emotion type. The Adult Faces subtest consists of photos of adults displaying various emotional expressions, while the Child Faces subtest consists of photos of children displaying the four emotions. The Adult Paralanguage and Child Paralanguage subtests consist of an adult or child’s voice, respectively, saying, “I am going out of the room now, but I’ll be back later” using emotional prosody of high or low intensity. Half of the stimuli are with a female’s voice and half are with a male’s voice. The Adult Postures subtest consists of 24 photos of an adult in seated or standing postures that convey emotional information. The face is blacked out in each of the photos so that emotional information cannot be detected from the face. An additional Postures Discrimination task was created for the present study as a perceptual control task for the Adult Postures task. Postures Discrimination involved showing two photos taken from the Postures task: the two photos were either the same photo shown side-by-side or two different photos. Participants were required to respond, “same” or “different.” The DANVA-2 subtests have all demonstrated adequate internal consistency (.6 to .9 range for different age groups), test-retest reliability (.6 to .8 range for different age groups with lower
correlation coefficients in the younger age groups), and construct validity. Finally, the DANVA-2 has been shown to be unrelated to intellectual ability (Nowicki, 2006).

Four of the DANVA-2 subtests (Adult Faces, Child Faces, Adult Paralanguage, and Child Paralanguage) were programmed by the original authors into a computer program. The program tracks errors and provides information about the types of errors that are made by the participant. For example, the program details on which emotions the participant made errors, whether errors were on high- or low-intensity items, and which incorrect responses were chosen. Consequently, one can track whether the individual has difficulties with only low-intensity items, or with particular emotions, or frequently confuses two emotions. The Postures and Postures Discrimination subtests, while not presented on computer previously, were programmed and presented by computer for this study.

*Florida Affect Battery (FAB; Bowers, Blonder, & Heilman, 1999)*

The FAB is a battery of tests designed to assess “two elemental components of ‘social cognition’ – facial expressions and tone of voice” (Bowers et al., 1999, p. 3). It was designed as a research tool for studying disturbances in the perception and understanding of nonverbal signals of emotion that can occur as part of various neurological or psychiatric disorders. The battery includes ten different subtests: five facial, three prosodic, and two cross modal. Perception and recognition of the four basic emotions (happiness, sadness, anger, and fear) is assessed, plus the authors have included neutral stimuli within each subtest.
The facial affect tasks that were used in the present study were Facial Identity Discrimination and Facial Affect Discrimination. In Facial Identity Discrimination, participants are shown pairs of unfamiliar faces and are required to determine if the faces are the same or a different person. The stimuli are photographs of women with a neutral facial expression and their hair covered by a surgical cap to reduce nonfacial cues that could be used for identification. This task was designed to act as a perceptual control for the other facial affect tasks.

The prosody tasks used in the present study were Nonemotional Prosody Discrimination and Emotional Prosody Discrimination. In Nonemotional Prosody Discrimination, the subject listens to 16 pairs of sentences, spoken either in an interrogative (e.g. fish jump out of water?) or declarative tone of voice (fish jump out of water). In half of the trials the sentences are said with the same propositional prosody, and on the other half they differ by propositional prosody. The participant must identify whether the two sentences are the same or different in terms of prosody. This task provides a control for the perception of prosodic differences, without requiring affective prosody recognition. In Emotional Prosody Discrimination, participants are presented with pairs of semantically neutral sentences that are spoken the same or differently with respect to emotional tone. The participant must determine whether the prosody is the same or different for the pairs of sentences.

Normative information has been collected from approximately 164 normal individuals, ranging between the ages of 17 and 85 years (Bowers et al., 1999). A normative sample using children has been collected (though has not yet been published). The normative data collected with adults suggest that normal individuals from age 17
through to the mid-60’s perform quite well on the FAB. The test-retest reliability of the FAB has been examined and the reliability coefficients ranged from .89 to .97. Factor analysis has found two factors: one corresponding to a visual/facial factor and the other corresponding to a general prosody factor.

*Dynamic Faces Task (Hovorka & Virji-Babul, 2006)*

The Dynamic Faces Task used in the present study is a new paradigm by Hovorka and Virji-Babul (2006), created to be a more ecologically valid measure of facial expression recognition. Researchers have pointed out that static photos of facial expressions only represent a peak state of that expression, or a brief moment during an emotional display (e.g., Atkinson et al., 2004) and typically emotional recognition is occurring in a dynamic setting. Consequently, video clips of facial expressions may be more ecologically valid because they show the individual forming the emotional expression and returning back to neutral, more representative of what happens in day-to-day interactions between individuals. The Dynamic Faces Task used in this study consisted of 32 video clips of college-age adults forming facial expressions of the four basic emotions (happiness, sadness, anger, and fear). Eight video clips for each emotion were used, with half of the clips showing male actors and half showing females. The task was displayed on a computer screen, and the participants were required to identify which of the four emotions was displayed. Because this measure is quite new, there are no published data about its psychometric properties or normative data.
**Point-light Walker Measure (Chouchourelou et al., 2006)**

The point-light walker stimuli used in this study were developed by Chouchourelou and colleagues (2006) as a measure of emotion recognition determined from body movement. The stimuli were made up by having two professional actors wear specially designed suits in which a set of 30 motion sensors were attached. Each actor was asked to walk along a linear path of three metres for approximately 3-4 seconds displaying a particular emotion. This resulted in point-light walker movies in which the actor expressed one of five emotional states (happy, angry, sad, fearful or neutral). The neutral stimuli were excluded for this study. The movies were edited so that the emotional gait was shown from four different observer-centred orientations (walking towards the observer, away from the observer, from left to right, and from right to left). From the original 300 movies created, all four orientations of 15 stimuli were selected for use in subsequent studies based on an interobserver agreement of 83%. For the present study, 12 stimuli of each of the four basic emotions from Chouchourelou and colleague’s (2006) study were used (48 in total). All four orientations were represented in the 12 stimuli for each emotion. Because this is a new experimental measure, psychometric and normative data are not yet available.

As a perceptual control for the emotion point-light walkers, non-emotional point-light walkers were used (Chouchourelou et al., 2006). The non-emotional point-light walker videos depicted actors performing non-emotional actions: walking, skipping, boxing, and playing ping-pong. Participants were asked which of these four activities was depicted in each video clip. Psychometric and normative data are not yet available for this task.
**Arsenio’s Complex Emotion Task**

The Complex Emotion Task used in this study was originally developed by Arsenio, Gold and Adams (2004) as a measure of self-attributed emotion expectancies for nonaggressive events in which participants judge emotions of others based on short vignettes. Arsenio et al. (2004) modified an instrument originally designed by Garrison and Stolberg (1983): they made the vignettes more appropriate for adolescents rather than young children, excluded any aggressive vignettes, and abbreviated the task from 53 to only include 20 vignettes. The vignettes of nonaggressive situations were designed to elicit emotion expectancies of either happiness, sadness, anger, fear, or a mixture of sadness and anger (based on adult raters’ judgments). In this task, the children were presented with a sheet of paper with each emotion (happy, sad, angry, scared, and okay/neutral) listed along the bottom. Additionally, the child was provided with ten poker chips (see Appendix C for instructions). The child was read twelve brief vignettes and asked to place their poker chips on the emotion(s) they thought they would feel in that situation. They could place all ten chips on one emotion or split them up to represent feeling multiple emotions. Two scores were derived from this measure: 1) a total score which was created from the total number of chips placed on the expected emotion(s) for each item (maximum 120); and 2) an anger emphasis score, which was the total number of emotion chips assigned to the anger emotion category for vignettes that were not designed to elicit anger, divided by the total number of errors on the task. Errors were defined as the number of chips placed on emotions that were not elicited in each vignette.
Procedures

When interested families contacted the primary investigator to participate in the study, they underwent a brief phone screening to ensure that eligibility criteria were met. For the FASD group, caregivers were asked for the age of the child, what was the diagnostic label or 4-digit diagnostic code for the child, when the diagnosis was made and by whom, whether the child has ever been in trouble with the law or incarcerated, and whether the child has a diagnosis of mental retardation (IQ<70). For the typically developing control group, caregivers were asked the age of the child, whether the child had ever been in trouble with the law or incarcerated, whether the child was exposed to alcohol in utero, whether the child had ever had a head injury, and whether the child had ever been diagnosed with a nonverbal learning disability, ADHD, autism spectrum disorder, or mental retardation. When the child was deemed eligible to participate in the study, arrangements were made as to where the appointment would take place: at the University of Victoria, at an office space in their community, or in their home. If the child was in foster care, the name and contact information for the child’s social worker was obtained. The social worker was contacted and required to fax a signed consent form to the primary investigator prior to the date of the appointment.

At the beginning of the appointment, the parent/caregiver was provided with a consent form to read and sign. While the parent read the consent form, the details of the consent form were verbally explained to the child and an assent form was provided to the child to read and sign. Once consent was granted by the caregiver and assent granted by the child, the caregiver was given the Demographics Questionnaire, CBCL, VABS-2, and FABS to complete. Instructions for completing each questionnaire were provided on the
forms and verbally. Next, the primary investigator administered the two-subtest form of the WASI as a brief measure of intelligence.

Following the WASI, the child completed all of the computerized emotion perception and recognition tasks described above. The tests were grouped into three sets: 1) facial expression tasks (FAB Facial Identity Discrimination, FAB Facial Affect Discrimination; DANVA-2 Adult Faces, DANVA-2 Child Faces, and the Dynamic Faces Task), 2) Prosody Tasks (FAB Nonemotional Prosody Discrimination, FAB Emotional Prosody Discrimination, DANVA-2 Adult Paralanguage, DANVA-2 Child Paralanguage), and 3) postures/body movement tasks (Postures Discrimination, DANVA-2 Postures and Emotional and Non-Emotional Point-light Walker Tasks). The three sets of tasks were counterbalanced to remove any order effects. In between each group of computerized tasks, six items from Arsenio’s Emotion Expectancies task were administered (12 items in total). It took caregivers and the child 75-90 minutes to complete the questionnaires, the WASI, and all of the tasks. Following the completion of the tasks and the caregiver-reports, the caregiver was given $10 and the child was given $10 for their time spent completing the study.

Power Analyses

The DANVA-2, the FAB, the dynamic faces measure, and the point-light walker measure have not been used to assess nonverbal information processing in children with FASD. As such, there is no literature from which to calculate effect sizes for this group. However, according to Bezeau and Graves (2001) theoretically grounded clinical neuropsychological research should use large effect sizes (d) of 0.8. Small to medium
Effect sizes may be statistically significant and important in experimental psychology, but larger effect sizes are needed in clinical research in order to detect clinically significant findings. In fact, Bezeau and Graves (2001) recommend using an effect size of 1.35 for clinical neuropsychological research that is designed to detect group classification, as this is the minimum effect that will classify groups with 75% sensitivity and specificity. Using the minimum effect size of 0.8 recommended by Bezeau and Graves (2001) for clinical neuropsychological research and a sample of 22 children per group, this dissertation had a power level of .74. Therefore, a sample size of 22 children per group was likely sufficient to detect clinically significant group differences in these two samples of children. The study does not have sufficient power to detect more subtle emotion recognition difficulties between the two groups.

Effect sizes for the major analyses are reported throughout the results section. Cohen’s $d$ is reported for effect size of t-tests: small = 0.2, medium = 0.5, and large = 0.8 (Cohen, 1992). Pearson’s $r$ is reported for effect size of correlations: small = 0.1, medium = 0.3, large = 0.5 (Cohen, 1992). Partial eta squared ($\eta_p^2$) is reported for effect size of ANOVA’s and MANOVA’s: small = .01, medium = .06, large = .14 (Cohen, 1988). Finally, Cohen’s $f^2$ is reported for effect size of multiple regressions: small = 0.02, medium = 0.15, and large = 0.35 (Cohen, 1992).
Results

Prior to running statistical analyses, the data were examined to determine if there were univariate and/or multivariate outliers and to determine if any of the variables were significantly skewed. As most tasks were computerized, there were very few missing data points. However, one control child did not complete the Complex Emotion Task due to time constraints, and one child with FASD did not complete the Adult Paralanguage task on the DANVA-2 due to elevated anxiety levels. As a result, the sample is smaller on the analyses that utilized these data, as these subjects were not included in those specific analyses. These two participants’ data were included for measures in which their data was complete.

All data distributions were examined for accuracy of data entry. Univariate outliers were also identified separately within each group utilizing a criteria for case scores with $z \geq 3.29$ identified as outliers (Tabachnik & Fidell, 2001). Three univariate outlier points were identified (one on CBCL Social Scale; one on CBCL Thought Disorder Scale; one on Nonemotional Pointlight Errors). These points were transformed according to Tabachnik and Fidell’s (2001) recommendation, “For univariate outliers, a second option is to change the score(s) on the variable(s) for the outlying case(s) so that they are deviant, but not as deviant as they were.” (p. 71). The points were transformed by recoding them to be two points greater than the next most deviant score on that variable. For example, if the next most deviant score on the CBCL social scale was 58, an outlier of 62 was transformed to a 60. Analyses were run both with these outliers transformed, and with the original scores. Transformation of outliers did not affect the results of the statistical analyses so original scores were used throughout the analyses.
reported here. For each group separately, Mahalanobis distances were created to assess for multivariate outliers within the data set. No multivariate outliers were identified.

Finally, skew and kurtosis were examined within the individual variables for each group separately. Several variables were identified as being moderately skewed ($z \geq 3.29$). Square root transformation of these variables was conducted and analyses completed using both transformed and original values. The pattern of results for the analyses were not affected by use of these transformations, nor significance values and as such, the analyses on the original data set are reported.

**Covariates**

Although the two groups differed significantly on FSIQ and the Vocabulary and Matrix Reasoning subtests of the WASI, FSIQ was not used as a covariate in subsequent analyses. This decision was made based on the argument that the majority of individuals with FASD have FSIQ’s significantly lower than non-alcohol exposed typically developing individuals (e.g. Carmichael Olson et al., 1998; Streissguth et al., 1999; Streissguth et al., 1991b) and therefore, one cannot statistically covary out a demographic trait that is relevant to, and often characteristic of, most individuals with FASD. In addition, statistically removing the effect of IQ would make it difficult to generalize the findings of the current study to children with FASD with IQ’s below the average range.

The literature clearly demonstrates that typically developing children develop stronger emotion recognition abilities as they get older, with fairly solid emotion recognition abilities by approximately age 10. Due to the developmental aspect of
emotion recognition, age was also used as a covariate in some analyses to determine the effect of age on emotion recognition abilities in children with FASD.

**Hypothesis #1: Emotion Recognition and Intensity of Emotions**

It was hypothesized that children with FASD would make more errors than typically developing children on tasks assessing emotional content. The tasks assessing emotional content that were used in these analyses were: DANVA-2 Postures, Child & Adult Faces, and Child & Adult Paralanguage, Dynamic Faces, and Emotional Point-light Walkers. Although the children with FASD did make somewhat more errors on all tasks, they only made significantly more errors on the DANVA-2 Adult Paralanguage task ($M = 8.67, SD = 2.63$) compared to the age- and gender-matched controls ($M = 6.32, SD = 2.68$), $t(41) = 2.89, p < .01, d = 0.88$. On the DANVA-2 Adult Faces task, the children with FASD made more errors ($M = 6.91, SD = 2.60$) than the typically developing controls ($M = 5.55, SD = 1.87$), although the difference was only bordering on significance, $t(42) = 2.00, p = 0.05, d = 0.60$. The effect sizes ($d$) for the other emotion recognition tasks ranged from 0.31 – 0.51.

Age was a significant covariate for all of the visual emotion recognition tasks (Dynamic Faces, Emotional Pointlight Walkers, Postures, Child Faces, Adult Faces) but was not a significant covariate for the two auditory emotion recognition tasks (Child and Adult Paralanguage). The group difference on the Adult Faces task was marginally stronger as a result of adding age as a covariate, $F(1, 41) = 4.81, p < .05, \eta^2_p = .11$.

To control for variance caused by differences in perceptual abilities, analyses of covariance were conducted using the modality-specific perceptual control tasks as
covariates: the Facial Identity Discrimination task was used as a covariate for the Dynamic Faces, Adult Faces, and Child Faces tasks; the Nonemotional Prosody Discrimination task was used a covariate for the Child and Adult Paralanguage tasks; the Postures Discrimination task was used as a covariate for the Postures task; and the Nonemotional Point-light task was used as a covariate for the Emotional Point-light task.

None of these analyses of covariance increased the magnitude of the main effect ($\eta_p^2 = .004 - .14$), but rather decreased the group differences: Adult Paralanguage $F(1, 40) = 6.47, p<.05, \eta_p^2 = .14$ and Adult Faces $F(1, 41) = 3.39, p = .073, \eta_p^2 = .08$.

An emotion recognition composite was created by summing the z-scores of the total errors made on all of the emotion recognition tasks (Dynamic Faces, Emotional Point-light Walkers, Child and Adult Faces, Child and Adult Paralanguage, and Postures). T-tests revealed that the children with FASD made significantly more errors overall on the emotion recognition tasks compared to the typically developing controls $t(41) = 2.29, p<.05, d = .70$.

A further hypothesis regarding emotion recognition in children with FASD postulated that children with FASD would make more errors on low-intensity stimuli on the five DANVA-2 tasks (Adult & Child Faces, Adult & Child Paralanguage, and Postures) and would perform better on the high intensity stimuli compared to their performance on the low intensity stimuli. Composite intensity scores were created by adding together the number of errors made on either high- or low-intensity items on each DANVA-2 task. On average, children with FASD made more errors on low-intensity stimuli ($M = 4.08, SD = 1.36$) than on high-intensity stimuli ($M = 2.76, SD = .77$). However, typically developing children showed the same pattern, making more errors on
low-intensity stimuli ($M = 3.43, SD = 1.05$) than high-intensity stimuli ($M = 2.16, SD = .62$). A within subject MANOVA was conducted with intensity as the within-subject factor and group as the between-subject factor. The results show that there was no interaction effect: the number of errors was not affected by the intensity of the stimulus, $F(1, 41) = .03, p > .05, \eta^2 = .001$. There was an overall group effect, with the groups significantly differing on the numbers of high and low intensity errors made, $F(1, 41) = 5.85, p < .05, \eta^2_p = .63$ (Figure 3).

**Figure 3. Mean intensity errors per group**

![Graph showing mean intensity errors per group for FASD and Controls.](image)

**Hypothesis #2: Faces, Prosody and Postures**

Children with difficulties reading emotions are often taught to identify emotions from facial expressions. As such, it was hypothesized that children with FASD would perform better on recognition of emotion from facial expressions than from the prosody,
postures and point-light walkers tasks. In order to test this hypothesis, composites for the task types were created. The Faces Composite was created by adding the z-scores of the errors made on each faces task (i.e. Dynamic Faces, Child Faces and Adult Faces task) and dividing by the number of tasks. The Voices Composite was created similarly using the Child Paralanguage and Adult Paralanguage tasks. Finally, the Body Composite was created using the Postures and Emotional Point-light tasks. Only tasks in which the child had to choose the emotion depicted (i.e. emotion recognition tasks) were included in the composites, as it was believed that tasks in which the child had to identify whether two stimuli depicted the same or different emotions (i.e. emotion perception tasks) were fundamentally different. Correlations supported this assumption (Tables 3, 4, 5).

Table 3. Correlations among the facial expression tasks for both groups combined.

<table>
<thead>
<tr>
<th></th>
<th>FID Errors</th>
<th>FAD errors</th>
<th>DF Errors</th>
<th>CF Errors</th>
<th>AF Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>FID errors</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAD errors</td>
<td>-.01</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DF Errors</td>
<td>.38*</td>
<td>.15</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CF Errors</td>
<td>.32*</td>
<td>.05</td>
<td>.41**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>AF Errors</td>
<td>.15</td>
<td>.30</td>
<td>.42**</td>
<td>.45**</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: FID = Facial Identity Discrimination; FAD = Facial Affect Discrimination; DF = Dynamic Faces; CF = Child Faces; AF = Adult Faces *p<.05 and **p<.01
Table 4. Correlations among the voices tasks for both groups combined.

<table>
<thead>
<tr>
<th></th>
<th>NPD errors</th>
<th>EPD errors</th>
<th>CP Errors</th>
<th>AP Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPD errors</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPD errors</td>
<td>.31*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP Errors</td>
<td>.16</td>
<td>-.12</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>AP Errors</td>
<td>.35*</td>
<td>.06</td>
<td>.48**</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: NPD = Nonemotional Prosody Discrimination; EPD = Emotional Prosody Discrimination; CP = Child Paralanguage; AP = Adult Paralanguage
*p<.05 and **p<.01

Table 5. Correlations among the body tasks for both groups combined.

<table>
<thead>
<tr>
<th></th>
<th>PD errors</th>
<th>NPL errors</th>
<th>P Errors</th>
<th>EPL Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD errors</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPL errors</td>
<td>-.02</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P Errors</td>
<td>-.23</td>
<td>.14</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>EPL Errors</td>
<td>.11</td>
<td>.14</td>
<td>.35*</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: PD = Postures Discrimination; NPL = Nonemotional Point-lights; P = Postures; EPL = Emotional Point-lights
*p<.05 and **p<.01

Prior to examining whether children performed better on the faces composite compared to the voices and body composites, group differences on the individual composites were examined. The FASD group made significantly more errors on both the Faces Composite, t(42) = 2.11, p<.05, d = .64, and the Voices Composite, t(41) = 2.16, p<.05, d = .66, but not the Body Composite, t(42) = 1.10, p>.05, d = .33.
To determine whether children with FASD performed better on the Faces Composite than the Voices and Body Composites, a MANOVA for within subjects was conducted. Within subject comparisons showed that there was no significant composite by group interaction, $F = (1.80, 73.86) = .67, p>.05, \eta^2_p = .02$. Simple contrasts revealed that the Voices and Body composites did not differ significantly from the Faces composite for each group, $F(1, 41) = .05, p>.05, \eta^2_p = .001$; and $F(1, 41) = 1.12, p>.05, \eta^2_p = .03$, respectively (Figure 4).

**Figure 4. Results for Faces, Voices and Body composites by Group**

Hypothesis #3: Hostile Attributions

Many clinical populations with social difficulties, such as aggressive children or children who are rejected by their peers, have been found to make more hostile
attributions than their more prosocial peers (Crick & Dodge, 1996; Dodge et al., 1986; Dodge & Tomlin, 1987). Therefore it was hypothesized that children with FASD would be more likely to erroneously interpret emotional stimuli as demonstrating anger. For each task assessing emotion recognition (Dynamic Faces, Child Faces, Adult Faces, Child Paralanguage, Adult Paralanguage, Postures, Emotional Point-light Walkers, and Arsenio’s Complex Emotion Task) an anger score was created by summing the number of times participants erroneously responded “angry” to emotional stimuli. The number of erroneous anger responses was divided by the total number of errors that individual made on the task in order to remove the influence of the FASD group having made, on average, more errors than the control group. Z-scores of each task’s “angry” variable were calculated and then added together to create the Angry Composite. The children with FASD did not make significantly more angry errors on any of the individual tasks \( p > .05, d = .05 - .45 \), nor on the Angry Composite \( p > .05, d = 0.39 \). Also examined was whether children with FASD were more likely to attribute any of the other 3 emotions (happy, sad, scared) when responding erroneously compared to controls. T-tests revealed that the groups did not differ significantly in their emotion attributions when making errors \( p > .05, d = .15 - .46; \) Figure 5). In addition, the groups did not differ significantly in the frequency of specific emotion errors made \( p > .05, d = .11 - .35; \) Figure 6).
Figure 5. Cumulative percentages of incorrect emotional attributions by group

![Cumulative Percentage of Incorrect Attributions](image)

Figure 6. Cumulative percentage of emotion stimuli errors by group

![Cumulative Percentage of Incorrect Responses](image)
To determine whether performance on the Angry Composite was related to parent reports of hostile behavior, correlations were conducted between the Angry Composite and the CBCL Externalizing, Rule-breaking, and Aggressive scales in the FASD group. The Angry Composite was not significantly related to externalizing behaviors ($r = -.34$, $p > .05$), although the relationship between the CBCL Aggressive ($r = -.37$, $p = .09$) and Rule-breaking scales ($r = -.41$, $p = .06$) bordered on significance.

**Hypothesis #4: Perception Tasks**

To determine whether children with FASD made more errors on perceptual tasks (Facial Identity Discrimination, Nonemotional Prosody Discrimination, Postures Discrimination, and Nonemotional Point-lights), t-tests were performed on each task. The groups did not differ significantly on any of the perceptual tasks ($p > .05$, $d = .07 - .46$). A Perceptual Composite was created by summing the Z-scores of the errors made on each of the four perceptual tasks. The groups did not differ significantly on the Perceptual Composite, $t(42) = 1.03$, $p > .05$, $d = .31$. Upon closer examination, it was discovered that very few errors were made on these perceptual tasks overall. As a result, the perceptual tasks were rescored dichotomously, receiving a score of 0 if the participant had not made any errors and a score of 1 if they made any errors on the task. Chi-square analyses were conducted and showed that the groups did not differ significantly in the frequency of making any error on the perceptual tasks ($p > .05$).

The effect of age was examined on the perceptual tasks. Age was not a significant covariate for the Facial Identity Discrimination, Nonemotional Prosody Discrimination, nor Postures Discrimination tasks, but was a significant covariate for the
Nonemotional Point-light Task; $F(1, 41) = 16.83; p<.001, \eta^2_p = .29$. However, age did not contribute enough variance to the Nonemotional Point-light Task performance to lead to a group difference on this task, $F(1, 41) = .10, p>.05; \eta^2_p = .002$. Age was not significantly related to the Perceptual Composite, $F(1, 41) = 2.35, p>.05, \eta^2_p = .05$.

It was also hypothesized that children with FASD would have more difficulties differentiating stimuli based on emotional information compared to typically developing controls. The tasks discussed above looked at pure perception of faces, voices, postures and point-light walkers, without an emotional component. However, two tasks (Facial Affect Discrimination and Emotional Prosody Discrimination) looked at the ability to discriminate stimuli based on emotional content. These tasks assessed perception of emotions rather than recognition. To determine whether children with FASD performed worse on tasks of emotion perception, t-tests were conducted on the two individual tasks and on a composite measure computed by totalling the z-scores of the errors made on these two tasks. The two groups did not differ significantly on the Emotional Prosody Discrimination task, $t(42) = 1.55, p>.05, d = .47$. However, the children with FASD did perform significantly worse on the Facial Affect Discrimination task, $t(42) = 2.10, p<.05, d = .63$, and on the Emotion Perception Composite, $t(42) = 2.25, p<.05, d = .68$. Age was significantly related to performance on the Facial Affect Discrimination task, $F(1, 41) = 4.58, p<.05, \eta^2_p = .10$, and the Emotion Perception Composite $F(1, 41) = 4.20, p<.05, \eta^2_p = .09$. The group effects were marginally strengthened by removing the effect of age from performance on the Facial Affect Discrimination task, $F(1, 41) = 4.82, p<.05, \eta^2_p = .11$; and the Emotion Perception Composite, $F(1, 41) = 5.49, p<.05, \eta^2_p = .12$. 
Hypothesis #5: Caregiver Reports of Social Functioning and Emotion Recognition Tasks

Within a social-information processing framework, emotion recognition is one of the first steps in effective social interactions. As such, it was hypothesized that children with FASD who performed worse on the emotion tasks would have lower caregiver-reported social competence and social skills. First, a social functioning composite was created by subtracting the z-score of the CBCL social scale from the z-score of the VABS-2 social scale. The z-score of the CBCL social scale was subtracted from the z-score of the VABS-2 social scale because a *higher* score on the CBCL social scale indicates more problems with social functioning, whereas a *lower* score on the VABS-2 social scale indicates more problems with social functioning. Therefore the CBCL social scale z-scores were subtracted from the VABS-2 as a way to reverse the direction of the CBCL z-scores. To assess whether the emotion recognition composites (Faces, Voices, Body) were related to performance on the social functioning composite, multiple regressions were conducted. The emotion recognition composites were not related to parent-reported social functioning ($p>.05, f^2 = .01$). Finally, multiple regressions were conducted to determine whether the tasks in which the groups significantly differed (Adult Faces and Adult Paralanguage) were related to parent-reported social functioning. The Adult Faces and Adult Paralanguage tasks were used as predictors and the social functioning composite acted as the dependent variable. The emotion tasks were not significantly related to parent-reported social functioning for the FASD group ($p>.05, f^2 = .01 - .09$).
Hypothesis #6: Fetal Alcohol Behavior Scale and Emotion Recognition

To assess whether children with more FASD symptomatology are more likely to have more difficulty on emotion recognition tasks, the Fetal Alcohol Behavior Scale (FABS; Streissguth et al., 1998) was used as a measure of FASD symptomatology. Multiple regressions were conducted for the FASD group in which the total FABS score was used as a predictor and the emotion recognition composites added together were used as a dependent variable, as well as each of the individual emotion recognition composites (Faces, Voices, Body). In addition, multiple regressions were conducted in which the total FABS score was used as a predictor and the individual emotion recognition tasks were used as dependent variables. Within the FASD group, FASD symptomatology, as measured by the FABS, was not related to performance on the emotion recognition composites \( (p > .05, f^2 = .01 - .04). \) For the individual emotion recognition tasks, the FABS score was only related to performance on the Postures task \( F(1, 20) = 5.30, p < .05, f^2 = .26. \) The FABS was not related to performance on any other emotion recognition task \( (p > .05, f^2 = 0.004 – 0.06). \)

Complex Emotion Recognition from Real-Life Scenarios

The Complex Emotion Task used in this study (Arsenio et al., 2004) was included to assess emotion recognition from real-life scenarios presented to the participants. The total score was created by summing up the number of tokens placed on the expected emotion(s) for each item. To determine whether the groups differed in their performance on this task, t-tests were conducted. The groups did not differ significantly on the Complex Emotion Task, \( t(41) = -1.32, p > .05, d = 0.4. \) To determine whether basic
measures of emotion recognition were related to more complex emotion recognition, a multiple regression was conducted with each composite (Faces, Voices, and Body) as predictors and the total score on the CET as the dependent variable for the FASD group. Table 6 displays the correlations between the variables, the unstandardized regression coefficients ($B$) and intercept, the standardized regression coefficients ($\beta$), the semipartial correlations ($sr^2$) and $R^2$. The analysis revealed that the Faces, Voices, and Body Composites as a group were significantly related to performance on the CET in children with FASD, $F(3, 17) = 3.98, p<.05, f^2 = .70$. Overall, 41% (31% adjusted) of the variability in performance on the CET was predicted by the performance on these three composites.

Table 6. Multiple regression of emotion recognition composites as predictors of the Complex Emotion Task

<table>
<thead>
<tr>
<th>Variables</th>
<th>CETtotal (DV)</th>
<th>Faces Composite</th>
<th>Voice Composite</th>
<th>Body Composite</th>
<th>$t$</th>
<th>$p$</th>
<th>$sr^2$ (unique)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faces Composite</td>
<td>-.37</td>
<td>-.37</td>
<td>.32</td>
<td>-.23</td>
<td>-2.25</td>
<td>.038</td>
<td>.18</td>
</tr>
<tr>
<td>Voice Composite</td>
<td>.32</td>
<td>.43</td>
<td>.32</td>
<td>.23</td>
<td>2.81</td>
<td>.012</td>
<td>.27</td>
</tr>
<tr>
<td>Body Composite</td>
<td>-.23</td>
<td>.71</td>
<td>.37</td>
<td>-.04</td>
<td>-.04</td>
<td>.971</td>
<td></td>
</tr>
<tr>
<td>Means</td>
<td>84.34</td>
<td>.24</td>
<td>.27</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Deviations</td>
<td>13.48</td>
<td>.96</td>
<td>.73</td>
<td>.93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $R^2a = .41$; Adjusted $R^2 = .31$; $R = .64^*$

* $p<.05$

To determine whether individual tasks in which the groups differed (Adult Faces and Adult Paralanguage) were significantly related to performance on the Complex Emotion Task, a multiple regression was conducted in which the Adult Faces and Adult
Paralanguage tasks were used as predictors and the total CET score was entered as the dependent variable. The Adult Faces and Adult Paralanguage tasks were not significantly related to performance on the CET, $F(2, 18) = 1.72, p > .05, f^2 = .19$.

To determine whether performance on the Complex Emotion Task was related to parent-reported social functioning in children with FASD, linear regressions were conducted using the social functioning composite as the dependent variable, and the CET total score as the predictor. The analysis revealed that the CET was not significantly related to social functioning as reported by parents and caregivers, $F(1, 20) = 2.27, p > .05, f^2 = .11$. However, correlations of the CET with the social functioning composite, the CBCL social scale, and the VABS-2 socialization scale reveal a significant relationship between the CET and the CBCL social scale, $r = -.48, p < .05$.

While administering the Complex Emotion Task to participants, it was noted that children tended to either have a concrete style of responding in which they tended to place the vast majority of their tokens on one emotion, or had a more complex style of responding in which they split up the tokens and thought about the multiple emotions they might feel in that social scenario. However, Arsenio’s scoring system, in which a total score is calculated by adding up the number of tokens placed on the target emotion, penalizes participants who considered the complexity of the scenario and placed the tokens on multiple emotions. For example, on the item that states, “Your friends ask you to go on trip to Disneyland with them. Your parents say ok and give you enough money for the trip,” the correct response was “happy.” However, those participants who thought they might miss their family while away and placed some tokens on “sad” would be penalized and receive a lower total score on the CET. As such, an alternate scoring
system was created in which participants’ response style on each item of the CET was classified dichotomously as either “simple” or “complex.” Participants who chose two or more emotions on 50% or more of the items on the CET (i.e. 6 or more out of the 12 items) were classified as “complex responders.” Those who chose only one emotion on more than 50% of the items (7 or more out of 12) were classified as “simple responders.” Within the FASD group, 10 children were classified as “complex responders” and 12 children were classified as “simple responders.” Within the control group, 15 children were classified as “complex responders” and 6 children were classified as “simple responders.” A chi-square analysis revealed a non-significant group difference in the frequency of complex vs. simple responders, however, the chi-square had a trend toward significance, $X^2(1) = 2.98, p = 0.08$.

**Child vs. Adult Stimuli**

The DANVA-2 is made up of tasks that only use adult stimuli (Adult Faces, Adult Paralanguage) or child stimuli (Child Faces, Child Paralanguage). To determine whether children with FASD differed from typically developing children in their ability to recognize emotions in adults vs. children, Adult and Child Composites were created from the above DANVA-2 tasks. Children with FASD made significantly more errors on the Adult Composite ($M = 7.83$, $SD = 2.25$), compared to typically developing children ($M = 5.93$, $SD = 1.69$), $t(41) = 3.14, p<.01, d = .79$. However, children with FASD did not make significantly more errors on Child stimuli ($M = 5.43$, $SD = 1.88$), compared to typically developing children ($M = 4.57$, $SD = 1.78$), $t(42) = 1.56, p>.05, d = .48$. 
To determine whether the children with FASD’s ability to recognize emotions in adults was related to how parents/caregivers see the social functioning of these children, multiple regressions were conducted. Performance on adult stimuli tasks was not related to performance on parent-report measures of social functioning in children with FASD, $F(1, 19) = 0.62, p > .05, f^2 = .03$.

Finally, to examine whether early experiences were related to performance on the adult stimuli tasks, a regression was conducted with number of placements, and abuse history as predictors and the adult stimuli composite as the dependent variable. Early experiences were not related to performance on the adult stimuli tasks $F(1, 19) = .71, p > .05, f^2 = .03$.

Visual vs. Auditory Measures of Emotion Recognition

The emotion recognition tasks used in this study could be separated into visual (Dynamic Faces, Child and Adult Faces, Postures, Emotional Point-light Walkers) and auditory tasks (Child and Adult Paralanguage). To determine whether children with FASD had more difficulty with visually- or auditory-based tasks compared to typically developing control children, t-tests were conducted on composites created by adding up the z-scores for each visual or auditory emotion recognition task and dividing by the number of tasks used to make up that composite. Children with FASD made significantly more errors on emotion recognition tasks that were based in the auditory modality ($M = .27, SD = .73$) compared to typically developing children ($M = -.28, SD = .91$), $t(41) = 2.16, p < .05, d = .66$. Although only bordering on significance, children with
FASD made more errors on visually-based tasks ($M = .20$, $SD = .86$) compared to typically developing children ($M = -.20$, $SD = .46$), $t(42) = 1.91$, $p = .06$, $d = .58$.

**Effect of Age**

The literature has clearly shown that emotion recognition abilities develop and strengthen with age, with children showing fairly solid emotion recognition abilities by approximately age ten (Camras & Allison, 1985). In addition, the literature on social functioning in children and youth with FASD suggests that this population tends to have more pronounced social difficulties in adolescence, which can lead to secondary disabilities such as inappropriate sexual behavior, drug and alcohol addictions, and involvement in illegal activities (e.g. Sampson et al., 1997; Streissguth et al., 1991a). Consequently, it was important to examine the effect of age on emotion recognition abilities in children with FASD.

Age was found to be a significant covariate for many of the above analyses; however, it only accounted for enough variance to marginally strengthen some group differences. To further explore the effect of age on emotion recognition, two-way ANOVA’s were conducted to examine any age or interactive (age by group) effects for the emotion recognition variables. Children were subdivided into two age groups: one group consisting of children age 8-10 years ($n = 10$ in the FASD group and in the Control group), and one group consisting of children and adolescents age 11-14 years ($n = 12$ in the FASD group and in the Control group). This allowed further exploration of the effect of age both within and across groups.
Significant age effects were found on Postures $F(1, 40) = 9.96, p<.01, \eta_p^2 = .20$; Emotional Point-lights $F(1, 40) = 5.31, p<.05, \eta_p^2 = .12$; Child Faces $F(1, 40) = 9.61, p<.01, \eta_p^2 = .19$; Adult Faces $F(1, 40) = 6.88, p<.05, \eta_p^2 = .15$; Adult Paralanguage $F(1, 39) = 4.55, p<.05, \eta_p^2 = .10$; Face Composite $F(1, 40) = 10.93, p<.01, \eta_p^2 = .22$; Body Composite $F(1, 40) = 12.14, p<.01, \eta_p^2 = .23$; Adult Stimuli $F(1, 39) = 13.84, p<.01, \eta_p^2 = .26$; and Child Stimuli $F(1, 40) = 5.97, p<.05, \eta_p^2 = .13$. Significant interactions of group and age were found on two individual measures; Postures $F(1, 40) = 7.03, p<.05, \eta_p^2 = .15$ and Child Faces $F(1, 40) = 4.50, p<.05, \eta_p^2 = .10$. In addition, interactions bordering on significance were found on two additional measures; Dynamic Faces $F(1, 40) = 3.78, p = .06, \eta_p^2 = .09$ and Adult Paralanguage $F(1, 39) = 3.75, p = .06, \eta_p^2 = .09$. There were also significant interactions of group and age on the Face Composite $F(1, 40) = 4.93, p<.05, \eta_p^2 = .11$; the Body Composite $F(1, 40) = 4.53, p<.05, \eta_p^2 = .10$; and the Adult Stimuli Composite $F(1, 39) = 6.30, p<.05, \eta_p^2 = .14$.

To further understand the above interactions, t-tests were performed examining the age effects within each group for the above variables. Within the FASD group, it was found that the 8-10 year olds performed significantly worse on Postures, $t(20) = 3.73, p<.01; d = 1.60$; Child Faces, $t(20) = 3.04, p<.01, d = 1.30$; and on the Adult Paralanguage task, $t(19) = 3.26, p<.01, d = 1.44$. In addition, the younger children with FASD also performed significantly worse on the Face Composite, $t(20) = 3.32, p<.01, d = 1.42$; the Body Composite, $t(20) = 3.96, p<.01, d = 1.70$; and on Adult Stimuli, $t(19) = 3.90, p<.01, d = 1.72$. Within the control group there were no group differences between the 8-10 year olds and the 11-14 year olds on any of the above tasks or composites.
The performance of the younger (8-10 year old) children with FASD on the above variables was compared to the younger control children’s performance on these variables. The younger children with FASD performed significantly worse than the younger typically developing children on Postures, $t(18) = 3.50$, $p < .01$, $d = 1.57$ and Adult Paralanguage, $t(17) = 3.04$, $p < .01$, $d = 1.39$. The younger children with FASD also made significantly more errors on the Faces Composite, $t(18) = 2.76$, $p < .05$, $d = 1.23$; the Body Composite, $t(18) = 2.27$, $p < .05$, $d = 1.02$; and on Adult Stimuli, $t(17) = 3.84$, $p < .01$, $d = 1.75$.

Finally, the performance of the older (11-14 year old) children with FASD on Postures, Child Faces, Faces Composite, Body Composite and Adult Stimuli was compared to the older control children’s performance on these same variables. The older children from the two groups did not differ significantly on any of these variables ($p > .05$, $d = .15$ - .51).
Discussion

Difficulties with social functioning in children with Fetal Alcohol Spectrum Disorders have been well documented in the literature (Coles et al., 1991; Kelly et al., 2000; Laugeson et al., 2007; Schonfeld et al., 2006; Streissguth et al., 1991a; Thomas et al., 1998; Whaley et al., 2001). Difficulties with social functioning may predate more serious forms of psychopathology in children, and could place children with FASD at increased risk for developing secondary disabilities such as involvement with the law, school failure and dropping out, and mental health and addictions (Greenbaum, 2004). Therefore, it is very important to identify the early manifestations of social impairments in order to develop appropriate interventions and reduce the likelihood of secondary disabilities (Greenbaum, 2004).

To date, the majority of studies conducted have used parent or teacher reports to document impairments in social functioning (Coles et al., 1991; Kelly et al., 2000; Schonfeld et al., 2006; Streissguth et al., 1991a; Thomas et al., 1998; Whaley et al., 2001) rather than directly assessing aspects of social functioning in children with FASD. These parent-report measures of behavioural or adaptive functioning broadly assess social skills or social functioning, but do not provide information about the specific aspects of social function that need remediation. More recently, a few studies have directly examined aspects of social functioning such as affective processing, social cognition, and social information processing (Coggins et al., 2007; Greenbaum, 2004; O’Connor et al., 2006; Timler, 2000). However, these studies have been limited by either small sample sizes and/or a lack of a theoretical foundation for social functioning. The current study aimed to address these limitations by applying a social-emotional information processing model.
(Crick & Dodge, 1994; Lemerise & Arsenio, 2000) as a theoretical framework and examining the first step of this model within a group of children with Fetal Alcohol Spectrum Disorders.

The current study builds on the literature on social functioning in children with FASD by directly examining a specific aspect of social functioning, namely emotion recognition. Emotion perception and recognition were investigated from several non-language modalities, including facial expressions, prosody, body postures, and body movement. Emotion recognition was assessed from both static and dynamic stimuli and in child and adult stimuli. Overall, findings suggest that children with FASD do have more difficulties than age-matched typically developing peers in emotion recognition, with particular difficulties in recognizing emotions from more complex or subtle emotional information. Finally, emotion recognition skills were not related to parent-reported social functioning or aggressive behaviour.

Six primary hypotheses were tested in the present study; the findings of each are discussed in turn below.

**Hypothesis #1: Emotion Recognition and Intensity of Emotions**

The primary hypothesis for the present study was to determine whether children with FASD make significantly more errors on measures of emotion recognition compared to age-matched typically developing peers. Children with FASD made significantly more errors on one emotion recognition task that assessed emotional content from short sentences said by an adult actor (DANVA-2 Adult Paralanguage). Children with FASD also had more difficulty on a task assessing emotions from facial expressions
of adult actors (DANVA-2 Adult Faces) when the effect of age was covaried out. In addition, children with FASD performed significantly worse on tasks using adult stimuli (Adult Paralanguage, Adult Faces, and Adult Postures) compared to the typically developing controls, but not on tasks using child stimuli (Child Paralanguage, Child Faces). These findings support the primary hypothesis that children with FASD do have more difficulties with emotion recognition compared to typically developing age-matched peers.

A subsequent hypothesis was that children with FASD would have significantly more difficulty on more subtle forms of emotion recognition, as evidenced by more errors on low-intensity stimuli on the DANVA-2. This hypothesis was not supported by the low-intensity data: the groups did not significantly differ in the number of errors made on low intensity emotion stimuli. However, closer examination of the types of emotion recognition difficulties experienced by children with FASD (i.e. more difficulties on adult stimuli than child stimuli) suggests that children with FASD may in fact have more difficulties with subtleties in emotion displays. This will be further discussed below.

The specific tasks on which group differences were detected were from the DANVA-2 battery (Nowicki, 2006), a battery of nonverbal emotion accuracy that has been used with several clinical populations, including traumatic brain injury (TBI; Spell & Frank, 2000), ADHD (Cadesky et al., 2000; Guyer et al., 2007; Hall et al., 1999; Sprouse et al., 1998) conduct problems (Cadesky et al., 2000; Guyer et al., 2007) mood disorders (Guyer et al., 2007), verbal and nonverbal learning disabilities (Cadesky et al., 2000; Hall et al., 1999; Petti et al., 2003; Sprouse et al., 1998), Williams syndrome (Plesa-Skwerer, Faja, Schofield, Verbalis, & Tager-Flusberg, 2006), and autism spectrum
disorders (Serra et al., 1998). Because this measure has been used so extensively with
different groups of children, it is possible to compare the pattern of performance of
children with FASD to those of different clinical populations. Only two of these studies
specifically reported effect sizes (Guyer et al., 2007; Hall et al., 1999) and both found
medium to large effect sizes for their group differences, consistent with the findings in
the present study. Guyer and colleagues (2007) found that the effect size for their group
difference in face-emotion labelling errors was medium to large (partial eta squared =
.12) with youth with bipolar disorder making more errors than children with ADHD/CD
or anxiety/mood disorders. They also found that all subjects made more errors on angry
stimuli than the other three emotions with a small effect size (partial eta squared = .04).
Hall and colleagues (1999) reported a large effect size for Paralanguage (eta squared =
.28) but not for Faces or Postures. It is important to note, however, that these researchers
were using the original version of the DANVA and not the DANVA-2, as in the present
study, though likely the abilities assessed by both are similar.

Overall, the pattern of performance seen by the children with FASD in this study
(i.e. significant weakness on measures using adult stimuli compared to child stimuli) is
most consistent with the performance of adults with TBI’s (Spell & Frank, 2000) and
children with nonverbal learning disabilities (Petti et al., 2003). Spell and Frank (2000)
found that the individuals with TBI in their study had significantly more difficulty than
control participants in recognizing facial expressions and vocal prosody when looking at
or listening to adult stimuli. They did not find any group differences on child stimuli
(Spell & Frank, 2000). Petti and colleagues (2003) also found that children with
nonverbal learning disabilities (NLD) made significantly more errors on adult stimuli
compared to child stimuli. Other groups have found trends in the same direction, with clinical populations making somewhat more errors on adult stimuli, but these differences have not reached statistical significance (e.g. Hall et al., 1999; Plesa-Skwerer et al., 2006).

It was unexpected that children with FASD did not differ in their performance on the child stimuli tasks compared to typically developing children, especially in light of the well-documented reports of children with FASD having peer social difficulties (e.g. Greenbaum, 2004; Thomas et al., 1998; Timler, 2000; Whaley et al., 2001). There could be several explanations for why individuals with FASD did not differ from typically developing peers in recognizing child facial expressions and emotional prosody. One highly plausible explanation has to do with the task stimuli used in the DANVA-2. The child actors used in the Child Faces task were between 6-12 years of age, and the children used to create the emotional prosody items in the Child Paralanguage task were 9 years of age. It is possible that the child actors had not yet developed the ability to express more subtle forms of facial expressions and emotional prosody and therefore the emotional displays were easier to decipher for the children with FASD in this study. It is likely that even low intensity emotions in children are more obvious than low intensity stimuli in adults, who have learned more about the subtleties of emotional displays over their life span and therefore can create more subtle low intensity stimuli. The normative data that has been collected for the DANVA-2 thus far also suggests that the child tasks are somewhat “easier:” participants in this age range (8-14 years old) make the least errors on the Child Faces task, and the second least errors on the Child Paralanguage task, although the number of errors made on Child Paralanguage in the child normative sample is
Children with FASD had significantly more difficulty recognizing emotions in the adult stimuli compared to their age-matched non-exposed peers. There are several reasons this may have occurred. First and foremost, adult displays of emotion tend to include more subtle aspects that child actors may not have developed in their own displays of emotions. The adult stimuli may detect more subtle difficulties with emotional displays than child stimuli, and therefore may be more sensitive to subtle difficulties in emotion recognition. Other studies using the DANVA have seen this trend in increased errors on adult more than child stimuli (e.g. Cadesky et al., 2000; Plesa-Skwerer et al., 2006) suggesting that the task items may have contributed to this finding. Finally, the normative mean errors published in the DANVA-2 manual (Nowicki, 2006) corroborate this claim: children between the ages of 8-14 made the most errors on the Adult Paralanguage task and second most errors on the Adult Faces task (there are no norms for the Postures task for this age range) suggesting that these adult stimuli tasks are more difficult. The finding that children have more difficulties on adult stimuli, which tend to include more subtleties, lends support to the hypothesis that children with FASD have more difficulties with subtle emotional information.

Another hypothesis for why children with FASD have more significant difficulties with adult stimuli is that children with FASD very often have had disrupted early experiences (Coggins et al., 2007; Mauren, 2008) and thus potentially disrupted
early attachments with significant adults. It is plausible that by being placed under the care of different primary caregivers during early childhood, children with FASD may not develop knowledge or recognition of emotions in adults in the same way as their same-age peers who have been raised by one set of caregivers throughout their lives. Children with FASD may experience disrupted learning of emotions from adult caregivers or they may end up learning to identify emotions from several very different adult caregivers. This may lead to confusion and insecure knowledge of emotional displays in adults. Finally, many adults with alcoholism also present with comorbid affective illnesses (Coggins et al., 2007), which can lead to inconsistent displays of emotional information (e.g. Feng, Shaw, Skuban, & Lane, 2007; Self, 1999; Sunew, 2004). The relationship between negative early experiences and performance on the adult tasks was examined in the present study and it was found that negative early experiences were not related to performance on the adult emotion recognition tasks. However, it is possible that the number of placements and confirmed abuse history were too crude a measure to predict performance on adult stimuli tasks.

One study to date has examined the effect of multiple foster home placements on various aspects of functioning (e.g. academic achievement, executive functioning, adaptive functioning, behavior ratings) in a group of children prenatally exposed to alcohol (Mauren, 2008). Mauren (2008) found that the number of foster care placements was only related to the Motor Skills scale of adaptive functioning, but was not significantly related to any other measures of behavioural, adaptive, academic or executive functioning. She noted that it is possible that number of placements may be too simple a measure of early experiences, as the quality of placements was not considered in
her study (Mauren, 2008). It is possible that number of placements and confirmed abuse were also not adequate measures of negative early experiences in the present study.

Pollak and Kistler (2002) examined emotion recognition in a group of children who had been abused, but not prenatally exposed to alcohol (it is unclear whether prenatal alcohol exposure was directly assessed in their study). They found that children with histories of maltreatment did differ from non-maltreated controls in their ability to identify and discriminate emotions. However, they found that this difference was specific to the facial expression of anger, suggesting that early experiences do affect emotion recognition abilities. Pollak and Kistler’s (2002) study was the first study of its kind to assess early negative experiences and emotion recognition. Henry and colleagues (2007) found that children who have been both prenatally exposed to alcohol and have experienced postnatal traumatic histories are more likely to experience neurodevelopmental impairments than children who have experienced trauma with no prenatal alcohol exposure. Consistent with the findings of Henry and colleagues (2007), Coggins and colleagues (2007) have written about the effects of maltreatment and prenatal alcohol exposure, noting that children with FASD may be living in a state of “double jeopardy” as a result of both the teratogenic effects of alcohol exposure and the erratic and atypical social experiences that are associated with living in a maltreating environment.

In summary, this study suggests that children with FASD may have difficulties recognizing emotions in adults. However, we must still consider the impact of negative early life experiences that may also be a factor in these difficulties. Adults living or working with children with FASD need to be aware that some of these children may have
difficulty picking up emotions from facial expressions or tone of voice. If teachers or caregivers notice that a child with FASD is having difficulty recognizing emotions, it may be helpful to accompany nonverbal forms of emotional expression with verbal descriptors of emotions. This can help the child with FASD to clearly understand the emotion of the adult and to learn to recognize emotional expressions more successfully.

Hypothesis #2: Faces, Prosody, and Postures

Children are most often taught to interpret emotions from facial expressions and are rarely asked to label emotions from postures, prosody, or body movement. Therefore, it was hypothesized that children with FASD would make significantly more errors on the prosody, postures and point-light walker tasks compared to the faces tasks. Analyses revealed that children with FASD made more errors on the faces tasks as a group and on the prosody tasks as a group, but did not differ from controls on the body composite, which was made up of the postures and point-light walker tasks. The differences detected were most likely a result of the group differences on the two DANVA-2 tasks discussed above, Adult Faces and Adult Paralanguage. Therefore, the hypothesis that children with FASD would make more errors on tasks assessing prosody, postures and body movement compared to their performance on the faces tasks was not supported.

The pattern of emotional accuracy found in this study, with significant group differences on the facial expression tasks and on the prosody tasks is interesting given the literature assessing nonverbal emotional accuracy in different groups of children. The literature and norms suggest that in general individuals make fewer errors on the faces tasks than the prosody tasks (e.g. Cadesky et al., 2000; Nowicki, 2006; Petti et al., 2003;
Emotion Recognition in Children with FASD

Plesa-Skwerer et al., 2006; Sprouse et al., 1998). Although the children with FASD made slightly more errors on the prosody tasks, overall their performance was not significantly different from their performance on the faces tasks, suggesting that children with FASD may have more difficulties recognizing emotions in facial expressions than many other clinical groups. These findings need to be replicated, but caregivers and teachers should be aware that some children with FASD might have difficulties recognizing facial expressions.

In addition to examining the emotional modality composites, analyses were conducted to examine whether children with FASD differed from typically developing controls on visual (faces and body composites combined) vs. auditory (prosody composite) emotion recognition tasks. This is especially important given the literature suggesting that many children with FASD have greater nonverbal or visual cognitive abilities compared to their verbal cognitive skills (e.g. Carmichael Olson et al., 1998; Mattson & Riley, 1998; Rasmussen et al., 2006). Children with FASD demonstrated significantly more difficulty on auditory tasks and a marginal difference from the controls in their ability to recognize emotions displayed within the visual modality. This finding suggests that some children with FASD might have greater difficulties with both visual and auditory emotion recognition. Therefore, it may be helpful to pair nonverbal displays of emotion (i.e. facial expressions, tone of voice, postures, movement) with verbal labels for those children demonstrating difficulties recognizing emotions.
Hypothesis #3: Hostile Attributions

It has been well-documented in the literature that aggressive, rejected, or unpopular children tend to misattribute ambiguous situations as hostile (Cadesky et al., 2000; Crick & Dodge, 1996; Dodge et al., 1986; Dodge & Tomlin, 1987) and physically abused children over-interpret subtle or ambiguous emotions as anger (Pollak & Kistler, 2002). As such, it was hypothesized that children with FASD would be more likely to erroneously attribute the emotion anger to more subtle stimuli. The proportion of erroneous angry errors compared to total errors was calculated for each task and an angry composite of all emotion recognition tasks was created. The groups did not differ in the proportion of angry errors made, suggesting that children with FASD were no more likely than controls to attribute the emotion anger to more subtle or challenging emotional stimuli. This finding is interesting given that 41% of the children in the FASD group had a confirmed history of abuse (emotional, physical or sexual) and 55% of the children with FASD had socialization scores below the average range on the Vineland Adaptive Behavior Scales. One would expect, given the literature on hostile attributions, that these children would be more likely to make hostile attributions than their typically developing counterparts. Consequently, despite the socialization difficulties and the negative early experiences of many of these children, this group of children did not respond to emotion recognition tasks in the same way as children with histories of physical abuse and or children with conduct problems.

To determine whether making erroneous angry attributions was related to performance on parent-report measures of externalizing or acting-out behaviours in the children with FASD, further analyses were conducted. Findings suggest that there was
no relationship between making hostile attributions and parent-reported externalizing, aggressive, and rule-breaking behaviours.

A few studies have examined whether clinical populations differed from typically developing controls in their distribution of incorrect responses (Cadesky et al., 2000; Plesa-Skwerer et al., 2006; Pollak & Kistler, 2002). For example, Pollack and Kistler (2002) found that abused children did not differ in their emotion responses from non-abused controls except in their angry responses; abused children were more likely to respond “angry” erroneously. Plesa-Skewer and colleagues (2006) found that children with Williams syndrome and those with learning/intellectual disabilities did not demonstrate a consistent bias toward any specific emotion label. Finally, Cadesky and colleagues (2000) found that children with conduct problems (CP) were more likely to incorrectly attribute “anger” erroneously compared to children with ADHD, children with ADHD and CP, or typically developing controls. They reported that the children with ADHD made errors in a fairly random fashion, consistent with the typically developing control group. Children with ADHD and CP were fairly consistent with the controls, but made somewhat fewer fear misattributions and made somewhat more sadness misattributions than the control group (Cadesky et al., 2000).

In the present study, the children with FASD did not demonstrate any consistent response bias in their emotional responses (see Figure 5). In addition, they did not differ from controls in the types of stimuli on which they made errors (e.g. happy, sad, angry, scared; Figure 6). Both groups made the most errors on fear stimuli, consistent with the literature indicating that the development of fear recognition develops later than the recognition of happiness, sadness, and anger (Camras & Allison, 1985).
Hypothesis #4: Perception Tasks

The literature clearly indicates that children with FASD have impairments in attention and concentration (e.g. Kodituwakku, 2007; Mattson, Calarco, & Lang, 2006; Mattson & Riley, 1998; Nanson & Hiscock, 1990; Rasmussen et al., 2006; Riley & McGee, 2005). Therefore, it was hypothesized that children with FASD would demonstrate perceptual deficits on non-emotional stimuli compared to typically developing peers due to differences in attention and concentration. Findings from this study did not support this hypothesis: there were no group differences on the purely perceptual tasks or on a composite measure created by summing the performance on all of the perceptual tasks. In fact, both groups made very few errors on these perceptual tasks. Therefore, analyses were conducted to see if the frequency of participants making any errors differed between groups; it was found that no group differences existed.

Caregivers of children with FASD did endorse significantly more difficulties with attention on the CBCL compared to parents of the typically developing controls. However, despite these attentional difficulties, children with FASD did not demonstrate increased difficulties on the perceptual tasks. Neither group made very many errors on these tasks, most likely because the tasks themselves were very simple and quite brief. In addition, three of the perceptual tasks included teaching items at the beginning to ensure that the child fully understood the task. Finally, the primary investigator sat next to each participant throughout the computer tasks, ensured that the child understood the task, and provided additional structure and support for completing the tasks. This individualized attention likely influenced the children with FASD’s ability to maintain focus throughout the perception tasks. Consequently, given the perceptual tasks were simple and brief and
the individualized attention children received throughout the tasks, it is likely that the perception tasks were not adequately sensitive to detect difficulties with attention and concentration.

The perceptual tasks described above did not require the participants to discriminate any emotional information. However, two perceptual tasks (one visual and one auditory) were included in the battery to assess discrimination of emotional stimuli: Facial Affect Discrimination and Emotional Prosody Discrimination. These measures were included to detect impairments in emotion perception, rather than emotion recognition. The children with FASD did not differ from the controls on the Emotional Prosody Discrimination (EPD) task where they had to identify if the emotional tone of voice was the same or different in two otherwise identical sentences said by the same actor. However, the children with FASD did demonstrate significantly weaker performance than the controls on the Facial Affect Discrimination (FAD) task. The FAD task required the child to determine whether the emotions displayed on the faces of two different females were the same or different. This finding suggests that children with FASD not only have difficulties recognizing and labelling emotions on the faces of adults, but also may have difficulty discriminating whether two facial expressions on two different people represent the same or different emotions.

The children with FASD only had difficulties with the facial expressions discrimination task but not the task assessing discrimination of emotional prosody. This may have been impacted by differences in the presentation of the two tasks. The Facial Affect Discrimination task used two different female actors in each item who were either displaying the same or different emotions. The fact that different actors were used added
to the complexity of this task, but also made it more ecologically valid. It would be rare that a child would have to discriminate emotional facial expressions of the same person in day-to-day life; it would be more probable that they would need to discriminate the emotions of various peers or adults in a group situation, or that they would have to discriminate changes in emotional facial expressions within one person, which was not assessed in this study. Because each individual displays emotions in slightly different ways, although the prototype of facial expressions is universal (e.g. Ekman & Friesen, 1971), assessing emotion discrimination using two different models is clearly an ecologically valid way to assess emotional discrimination.

The Emotional Prosody Discrimination task did not reveal any group differences in emotion discrimination, despite the fact that children with FASD had significantly more difficulties on the prosody composite and on the Adult Paralanguage task. The lack of group difference was likely a result of the task itself; items used the same actor repeating the same sentence twice with either the same emotional tone of voice in both repetitions or different emotional tone in the two sentences. However, prior to administering the Emotional Prosody Discrimination task, each participant completed the Nonemotional Prosody Discrimination task in which participants had to determine if two sentences were the same or different based on the tone of voice of the actor. The actor said each sentence either as a statement or a question and varied tone accordingly. From this task, subjects likely learned to listen for tone of voice differences on the two sentences. On the Emotional Prosody Discrimination task, it was observed that participants often realized that the approach needed for this task was the same as the previous task. The sentence pairs that used the same emotional tone sounded identical;
the same sentence was repeated identically. However, if the emotion differed, the sentences sounded different. Therefore, the complexity of the two emotion discrimination tasks differed: the Emotional Prosody Discrimination task was simpler because the same person spoke in each item, whereas the Facial Affect Discrimination task was more complex because it required the child to make judgements about emotions of two different people. In essence, the Emotional Prosody Discrimination task was not very different from the purely perceptual tasks and the lack of group difference on this measure is consistent with the findings on the other perceptual tasks. It is recommended that, in the future, the task be modified to use different same-sex pairs of actors repeating the same sentence with the same or different emotional tone. This would more validly tap into emotional discrimination from tone of voice and would possibly be more sensitive to difficulties in emotion perception in children.

In summary, the present study found that children with FASD have difficulties with emotion discrimination in facial expressions. This is most likely due to the complexity of discriminating emotions in two different individuals with whom the child is completely unfamiliar: the visual discrimination and emotion recognition demands likely lead to increased information processing demands which are often limited in children with FASD. Difficulty discriminating facial expressions could place one at risk for difficulties in social interactions. It will be important for future studies to examine emotion discrimination in children with FASD; upon replication, interventions could be developed to address this difficulty in children with FASD.
Hypothesis #5: Caregiver Reports of Social Functioning and Emotion Recognition Tasks

The social-emotional information processing model of Lemerise and Arsenio (2000) hypothesizes that impairments in early steps of the model affect social functioning. For example, a child with emotion discrimination or recognition difficulties would be more likely to interpret social cues incorrectly, form inappropriate social goals and strategies, make a behavioural decision based on incorrect perceptions or attributions, and then behaviourally act inappropriately given the actual emotions of the individuals with whom the child is interacting. The end result would be poor social functioning. This study assessed current social functioning through parent or caregiver reports on the CBCL Social Scale and the VABS-2 Socialization Scale. It was hypothesized that children who made more errors on the emotion recognition tasks and the emotion perception tasks would be more likely to be rated by his/her primary caregiver as having poor social functioning.

Analyses did not support this hypothesis: the emotion recognition composites, the individual emotion recognition tasks, and the emotion perception tasks were not related to parent-reported measures of social functioning. This finding is inconsistent with the literature reporting a significant relationship between emotion recognition skills and social functioning or social competence in both typically developing children (e.g. Custrini & Feldman, 1989; Denham et al., 2003; Nowicki & Duke, 1992) and children with FASD (Greenbaum, 2004). It is unclear why the current study did not find a relationship between emotion recognition or emotion perception and social functioning in children with FASD or in typically developing children.
The lack of a relationship between emotion recognition skills and caregiver-reported social functioning in the present study suggests that a different step in the Lemerise and Arsenio’s (2000) model may be a better predictor of social functioning in children with FASD. Although emotion recognition abilities likely contribute to overall social functioning, it is possible that the broad measures of caregiver-reported social functioning used in this study were not able to detect the more subtle social difficulties that may be experienced by children with difficulties in emotion perception and recognition. It is possible that a later step in the social-emotional information-processing model may be more strongly related to global social functioning in children with FASD. For example, Schonfeld and colleagues (2006) have demonstrated a relationship between social skills and executive functioning in children with FASD using parent-report measures. The strong relationship between executive functioning and social skills in their study suggests that later steps in the model that tap more into executive skills may be more closely related to parent-reported social functioning. This is consistent with the findings of Timler (2000), who found that higher problem behavior scores on the Social Skills Rating System and on a measure of difficulty in social situations were related to the production and selection of less prosocial strategies. Interestingly, Timler (2000) found a stronger relationship between teacher report measures of social functioning and children’s performance on strategy production and selection tasks compared to the parent reports, suggesting that teachers may be better informants about a child’s social functioning.

Using teachers as informants about social functioning would have been useful, given that teachers only see these children in a highly social environment surrounded by
peers throughout the school day. However, parents or caregivers primarily see the child interacting with siblings and caregivers, with more infrequent peer interactions at home. Siblings may be at a different developmental stage or also have social difficulties and may not allow the parent to adequately assess the age-appropriate social functioning abilities of the child with FASD. In addition, caregivers may be adding sufficient structure to their child’s social environment to mitigate or diminish some of the social difficulties experienced by their child with FASD. As such, caregivers might not see the full extent of the child’s social difficulties and may have reported social functioning based on the supported or structured environment they are providing for their child. In conclusion, it would have been interesting to assess teacher reports of social functioning for the present study in addition to caregiver reports. Future studies should include teacher reports, in addition to parent reports, of social functioning.

Hypothesis #6: Fetal Alcohol Behavior Scale and Emotion Recognition

The Fetal Alcohol Behavior Scale (FABS; Streissguth et al., 1998) was included in the present study to assess the relationship between FASD symptom severity and emotion recognition in children with FASD. The findings reveal that the degree of difficulties with behaviours characteristic of FASD was not related to performance on any emotion recognition composites and was only related to performance on the Postures task from the DANVA-2. These findings suggest that children with more challenging behaviours or greater impairments as a result of their FASD did not have more difficulty with emotion recognition.
The one significant finding, in which performance on the FABS was significantly related to performance on one measure, the Postures subtest, is difficult to explain. The Postures task seemed difficult for many of the children in this study, but both groups found it to be difficult with no significant group differences. However, within the FASD group, children who had more FASD symptoms made more errors on the Postures task. One could hypothesize that the Postures task required more cognitive processing due to the complexity of the task and that children with more “severe” FASD behaviours were more impacted by the complexity. The normative information collected on the Postures task suggests that adolescents (it has not yet been normed in children younger than age 13) do find this task harder than the Adult Paralanguage task, with even young adults making more errors on this task compared to the other DANVA-2 tasks. The normative data, in addition to the relationship between caregiver reports on the FABS and performance on the Postures task, lend support to the hypothesis that children with FASD find the Postures task to be complex and difficult. It is likely that those children with greater FASD symptomatology are most vulnerable to the complexity demands of the task, as they have fewer cognitive resources to fall back on when the complexity of a task or situation becomes too great.

The finding that greater symptom severity was not related to overall emotion recognition abilities is notable because it suggests that the more impaired child is not the only child who struggles with this aspect of emotional social information processing: this difficulty is independent of level of FASD severity. As such, it will be important to keep in mind that even those children who are not as impacted from the teratogenic effects of
prenatal alcohol exposure may be struggling with basic aspects of emotion recognition and therefore may be at risk for social difficulties.

**Complex Emotion Recognition from Real-Life Scenarios**

Arsenio and colleagues’ measure of emotion attributions or expectancies (Arsenio et al., 2004) was used to assess whether the performance on the emotion recognition tasks was related to how children with FASD attribute emotions to real-life scenarios. Analyses showed that the children with FASD did not significantly differ from typically developing controls on the Complex Emotion Task (CET). However, multiple regressions revealed that the emotion composites as a group (e.g. faces, voices and body composites) were related to performance on the CET for the children with FASD, suggesting that children with FASD who made fewer errors on the emotion recognition tasks also made more appropriate emotion attributions to real-life scenarios on the CET.

This finding suggests that how children with FASD perform on the emotion recognition tasks in this study was related to how these same children attribute emotions to real-life scenarios in day-to-day life. The emotion recognition tasks and the CET seemed to tap into the same construct of emotion recognition or emotion knowledge: the emotion recognition tasks assessed this construct at the more basic or molar level, while the CET assessed emotion recognition from a “meso” level looking at recognition of emotions in more complex daily situations (the molecular level in this framework would be overall social functioning). The molar level emotion recognition tasks do not adequately predict performance at the molecular level, as evidenced by the absence of a
relationship between the emotion recognition tasks and parent-reported social functioning, but do predict performance at this in between level, the “meso” level.

  Regressions were conducted to determine whether performance on the CET (which assessed emotion recognition at the meso level) was related to parent-reported social functioning (which represents the molecular level) in children with FASD. Analyses reveal that performance on the CET was not related to parent-reported social functioning (as measured by the VABS-2 Socialization and CBCL Social scales combined) in children with FASD, suggesting that aspects other than emotion recognition abilities are likely playing a more significant role in parents’ perceptions of social impairments. However, closer examination revealed that performance on the CET was significantly related to performance on the Social scale of the CBCL, confirming an association between the meso level of functioning and the molecular level of social functioning.

  Interestingly, there were no group differences on the CET, suggesting that children with FASD do not have more difficulties with identifying emotions in real-life scenarios. Calculation of the effect size (d=0.40) of the difference between the groups revealed that a much larger sample would be needed to detect this effect as statistically significant. This may be representative of how this difficulty is shown in real-life for children with FASD, with children with FASD possibly exhibiting more subtle difficulties in emotion recognition in daily life. A larger scale study would need to be conducted to better assess whether children with FASD have more subtle difficulties with emotion recognition at the “meso” level, compared to typically developing peers.
One of the shortfalls of this task is that although it urges the participants to think about the different emotions they may feel in a situation and respond accordingly, it penalizes participants for endorsing more than one emotion, while in many real-life situations individuals often feel more than one ‘emotional’ response to the situation. In this task, the total score is created by summing the total number of tokens the child places on the target emotion(s) for each item and therefore children who acknowledge more than one emotion receive a lower total score. As a result, a second scoring system was developed in which participants were categorized dichotomously into simple or complex responders. Simple responders were those that placed all of the tokens on one emotion for 5 or more items and complex responders were those that split up their tokens on two or more emotions for 6 or more of the items. It was expected that more children with FASD would be “simple responders” on this task, as children with FASD are often more concrete in their information processing styles and have difficulties thinking flexibly (Carmichael Olson et al., 1998; Kodituwakku, 2007; Mattson, Goodman, Caine, Delis, & Riley, 1999). Analyses revealed that the groups did not differ significantly in the frequency of complex or simple responders, although there was a trend in the direction of fewer children with FASD displaying complex responses compared to the typically developing children.

Effect of Age on Emotion Recognition in Children with FASD

The literature indicates there is a developmental acquisition of emotion recognition abilities, with children demonstrating intact emotion recognition abilities by approximately age ten (Camras & Allison, 1985). In addition, the literature on social
functioning in children with FASD suggests that this population tends to have more pronounced social difficulties in adolescence, which could contribute to the high incidence of secondary disabilities (e.g. inappropriate sexual behaviour, drug and alcohol addictions, mental health difficulties, and involvement in illegal activities) experienced by adolescents and young adults with FASD (Sampson et al., 1997; Streissguth et al., 1991a). Therefore, it was important to examine the effect of age on emotion recognition in children and youth with FASD.

Results suggest that age was significantly related to performance on almost all of the emotion recognition tasks for both groups. However, significant interactions were found on five variables (Postures, Child Faces, Face Composite, Body Composite, and Adult Stimuli), suggesting that on these particular variables the age of the child affected performance differently for the two groups. Further analyses revealed that younger (8-10 year old) children with FASD performed worse than older (11-14 year old) children with FASD on these variables, and younger children with FASD performed significantly worse on Postures and the three composite measures (Faces, Body, and Adult Stimuli) compared to younger controls, while older children with FASD did not differ significantly from older control children on any of these variables.

These findings suggest that on some aspects of emotion recognition, younger children with FASD have considerably more difficulty compared to older children with FASD and compared to same-age typically developing controls. This runs counter to what one would expect from the literature indicating that social difficulties become more pronounced in adolescents with FASD. It is unclear why younger children with FASD had considerably more difficulty on the Postures and Child Faces tasks. Postures seemed
to be a more difficult task for all of the children and it is possible that the information processing demands led to significantly more errors on this task. However, it is unclear why younger children with FASD had more difficulty on the Child Faces task.

Finally, younger children with FASD performed significantly worse on the Faces, Body, and Adult Stimuli composites. This may suggest that the younger children with FASD experienced more difficulty recognizing emotions within the visual modality and recognizing emotions in subtle adult stimuli. Because the older children with FASD did not differ from same-age typically developing peers on these variables, this may suggest that younger children with FASD experience a delay in developing aspects of emotion recognition. Younger children with FASD may be more vulnerable to the complexity of the tasks than older children with FASD, who may have developed more cognitive resources to draw from when the complexity of the task is increased. It is also possible that the older children with FASD have developed stronger emotion recognition abilities by early adolescence but are struggling with other aspects of social information processing such as flexibility, strategy generation and selection, and self-monitoring. It is possible that these later steps in the social information-processing model contribute more to social difficulties in adolescents with FASD. Further research is needed to better understand the effect of age on emotion recognition and on social information processing as a whole to better support the social development of children with FASD throughout childhood and adolescence.
Potential Clinical Implications

Findings from the present study must be viewed as preliminary and are in need of replication before changing clinical practice. In addition, it is important to keep in mind the unique aspects of the particular group of children with FASD that were used in this study when considering generalizing the findings to other children with FASD. For example, all of the children with FASD had received a formal diagnosis of FAS, FAE, ARND, or partial FAS at some point in their life and all of the children had IQ’s greater than 70. These are all unique aspects of this group of children with FASD that might limit how much these findings can be generalized. Also, the children in the study all fell between the ages of eight and fourteen and all of the children with FASD were currently living within stable environments, primarily with adoptive and foster parents. This is not always the case for children with FASD, who often experience disrupted living situations. Finally, it is important to note that some of the variables used to describe the children with FASD were caregiver-reported. For example, ethnicity, diagnosis, social functioning, FASD symptomatology, abuse history, and placement history were all provided by the current primary caregiver and were not verified by any other sources.

Despite some of the limitations of the sample, these findings suggest that children with FASD have some difficulties recognizing emotions in others compared to age-matched peers, with younger children with FASD having more difficulty with certain aspects of emotion recognition. In particular, children with FASD have difficulties recognizing facial expressions and emotional tone of voice in adult actors compared to child actors. This is most likely because adults tend to be subtler in their emotional displays and consequently, recognition of their emotions can be more challenging. The
finding that children with FASD had significantly more difficulty recognizing emotions in adults lends support to the hypothesis that children with FASD have more difficulties with subtle displays of emotion as adult emotional displays tend to be more subtle than those made by children.

In addition to recognition of emotions, children with FASD had significantly more difficulty discriminating whether the facial expressions on two different actors represented the same emotion or two different emotions. If replicated, these findings could have significant implications for individuals working with children with FASD. Teachers, parents, caregivers, and other adult professionals interacting with children with FASD would need to be aware that these children may be having difficulty perceiving and recognizing the emotions being projected by these adults, whether through their facial expressions or through their tone of voice. Children who misinterpret emotions may be perceived as insensitive or apathetic. They may also seem socially “off.” If adults interacting with these children notice that they are having difficulties perceiving or recognizing emotions, it is recommended that adults explicitly verbalize their own emotions as well as the emotions of others in situations where the child may be struggling. Adults need to be sensitive to choosing the appropriate time to help the child with this; it is important not to alienate the child further from his/her peers by pairing emotion labels with nonverbal displays of emotion in front of peers. This may help the children learn the connection between facial expressions or emotional tone of voice and the emotion being felt. It is important to note that this verbal-nonverbal pairing should only be done for those children where caregivers or teachers notice the child is struggling to recognize emotions and not for all children and youth with FASD. As these children
approach adolescence, peer emotional displays will take on more subtle forms and youth with FASD who have difficulties discriminating and recognizing emotions in peers could be at risk for peer rejection and isolation. These difficulties could lead to an increased risk for developing secondary disabilities in youth with FASD.

Age was found to be an important factor in the recognition of emotions in children with FASD. The current findings suggest that younger children with FASD demonstrate difficulties in aspects of emotion recognition abilities as compared to typically developing peers. Interestingly, by age 11 – 14 children with FASD in the current study did not perform worse than their typical peers in emotion recognition. This suggests that poor emotion recognition abilities may not be a major contributor to the social functioning difficulties experienced by adolescents and young adults with FASD. However, early emotion recognition difficulties can place children at risk for earlier peer isolation or rejection, which could then determine the types of peer groups these children associate with as they move into adolescence and young adulthood.

Another important finding was that symptom severity, as measured by the FABS, was largely unrelated to emotion recognition difficulties. This finding suggests that even those children with fewer FASD symptoms or behaviours may have difficulties with emotion recognition. It will be important for individuals working with children with FASD to keep in mind that it is not necessarily the more severely impaired children who have difficulties with this aspect of social-emotional information processing, but that all children with FASD are at risk for emotion recognition difficulties.

O’Connor and colleagues have developed a social skills training program for children with FASD that is designed to teach social knowledge to a group of children.
with FASD (O’Connor et al., 2006). This intervention program also teaches parents and caregivers to facilitate the development of more appropriate social behaviour in day-to-day living. Findings from the present study suggest that the children receiving this intervention may also benefit from learning more about how emotions are displayed in peers and adults, both on individuals’ faces and from their tone of voice. In addition, their parents and caregivers may benefit from being taught to help children and youth better discriminate and recognize emotions in day-to-day life.

Another finding that is important to discuss is that, in the present study, children with FASD did not demonstrate a tendency towards making hostile attributions. The children with FASD did not erroneously choose the emotion “anger” more than typically developing children. The literature has clearly shown that rejected and hostile children tend to demonstrate hostile attributions to more ambiguous situations or stimuli (Cadesky et al., 2000; Crick & Dodge, 1996; Dodge et al., 1986; Dodge & Tomlin, 1987). In addition, Pollak and Kistler (2002) have shown that physically abused children demonstrate particular difficulties with the recognition of anger and tend to over-endorse this emotion when exposed to more ambiguous stimuli. In the current study, the children with FASD did not demonstrate any response bias but rather seemed to make errors randomly, much the same way as the typically developing controls.

The fact that children with FASD did not make hostile attributions could be explained in two possible ways. On the one hand, it is possible that this group of children were more resilient than children who have been physically abused or rejected by peers in previous studies. It is possible that these children were currently in positive, safe, nurturing environments that had countered the effects of their early negative, disruptive,
chaotic environments. Another hypothesis is that the children with FASD were more likely to make errors in a random fashion because of their information processing difficulties, or more specifically, their emotion processing difficulties. Coggins and colleagues (2007) described children with FASD who had also experienced abuse as living in a state of “double jeopardy.” Coggins and his colleagues described children with FASD as being particularly vulnerable to social communication deficits as a result of their prenatal alcohol exposure and adverse early experiences. In addition, Henry and colleagues (2007) found that children with FASD who had also been abused had more neurocognitive difficulties compared to children who had been abused but not exposed to alcohol prenatally. These findings suggest that many of the children with FASD in this study likely have greater neurocognitive difficulties than children who have experienced abuse but have not been prenatally exposed to alcohol, such as the children in Pollak and Kistler’s (2002) study. The children with FASD in the present study did not demonstrate a response bias consistent with a history of abuse, but rather demonstrated a random pattern of errors, which is more consistent with general information processing difficulties.

This finding is notable because it suggests that although children with FASD are often victimized, rejected, or more behaviourally disruptive than their peers, they are not necessarily more likely to make hostile attributions. Consequently, these children likely interpret social situations differently from many of their non-exposed behaviourally disruptive or rejected peers. Therefore, it may not be appropriate to place children with FASD in the same social skills remediation group or class as non-exposed disruptive children, as they are likely not making the same attributions of peer interactions.
Finally, when examining the areas within this study with which children with FASD experienced the most difficulties, the pattern that emerges is that the children with FASD seem to experience greater difficulties when the information processing demands become more complex. For example, children with FASD had the most difficulties on tasks that both groups found to be difficult (as evidenced by the number of errors made). However, the children with FASD often made significantly more errors on these tasks compared to their typically developing, age-matched peers. This suggests that when items or tasks became difficult for all of the children, the children with FASD had less information processing resources to fall back on and were more likely to make errors, resulting in poorer performance on the more complex or more subtle tasks. This finding has significant implications when thinking about children with FASD and their social challenges. Social situations are very complex: one needs to consider the nonverbal and verbal responses of one’s peer or multiple peers in a group situation while also considering one’s own goals, emotions, and reactions. Not only is this a great deal of information to absorb in a very short amount of time, but the information tends to be rapidly changing within the dynamic social setting, suggesting that one needs to be flexible and process internal and external information rapidly. Children with FASD have difficulties with cognitive flexibility, information processing, speed of processing, and goal setting, which likely lead to difficulties within dynamic social situations.

The findings from this study suggest that overall, children with FASD have fairly intact basic emotion recognition abilities with difficulties recognizing and discriminating emotions from more subtle adult stimuli. The difficulties found in the present study suggest difficulties recognizing and discriminating emotions when the cognitive load is
increased or the child has to “think harder” to come up with an answer. It is important to note that the tasks administered were simple and brief and administered within a very structured environment free of distractions. However, as soon as the complexity of the task increased, the ability to recognize emotions was affected. Parents, caregivers, and teachers need to be aware that these children may have the basic abilities necessary to recognize emotions, but may not be able to use those abilities when overwhelmed in complex dynamic social situations. Adults working with children with FASD should be encouraged to structure the social environment for these children and help them to consider individual aspects of the social situation and to decrease the information processing demands of the child.

In conclusion, the findings from the present study suggest that children with FASD might benefit from specific remediation in recognizing emotions in more subtle facial expressions. Adults working with children with FASD need to be aware that some children within this particular clinical population may not always interpret their nonverbal emotional displays correctly: if they notice this occurring, adults may want to try pairing verbal explanations of emotions with nonverbal displays. Social skills interventions should be developed specifically for children with FASD, as their pattern of responses seems to be different from other clinical populations, such as those that are aggressive, rejected, or those with a history of physical abuse. When social skills interventions are developed for this clinical population, professionals may want to consider including a component on teaching children and youth how to recognize subtle nonverbal displays of emotions from facial expressions and tone of voice using child,
adolescent, and adult stimuli. However, the findings from the present study need to be further replicated prior to developing specific emotion recognition interventions.

Limitations and Directions for Future Research

The most significant limitation of the present study is the small sample size. This is a common problem in research on FASD (e.g. Rasmussen et al., 2006), due to the prevalence of FASD and also due to the difficulties finding diagnosed children. Because children with FASD are often not in their biological homes and there is often no clear documentation of prenatal alcohol exposure, many prenatally exposed children are missed and do not undergo a formal multidisciplinary assessment leading to a diagnosis. Therefore, the prevalence of diagnosed children with FASD versus the actual prevalence of children with FASD is likely quite discrepant. As this is the first study to examine emotion recognition in all of the nonverbal modalities in children with FASD, there remains a need to replicate this study with a larger sample of prenatally exposed children to confirm and further refine our knowledge of the particular difficulties with emotion recognition that children with FASD may face.

A second limitation of the study was that the parent, caregiver, and social worker’s reports of the child’s diagnosis were taken as valid without any verification of the diagnosis through copies of an assessment report or by conducting an independent diagnostic evaluation. All children needed to have a confirmed diagnosis of an FASD, and most often that diagnosis came through a multidisciplinary assessment. However, some children were diagnosed many years ago prior to the implementation of multidisciplinary diagnostic teams and therefore it was impossible to verify how detailed
an assessment was conducted or the knowledge level of the diagnostician. It is recommended that future studies independently evaluate the children being referred for the study, require concrete documentation of the diagnosis, or only accept children who were diagnosed through a multidisciplinary assessment team specifically designed to diagnose FASD.

A third limitation of the study was the inability to obtain a control group that could help reduce the impact of various important confounds. For example, the groups were not matched by First Nations status, although a large majority of participants with FASD were of First Nations descent (as defined by their primary caregiver). It is very likely that being of First Nations descent could impact one’s emotion recognition abilities, especially since the vast majority of the stimuli used in this study were created using Caucasian actors and actresses, with some stimuli using African-American or Asian actors and actresses. However, all of the children of First Nations descent in the study were living within the mainstream dominant culture in their cities or towns (none were living on First Nations reserves) and the vast majority were living within Caucasian families with Caucasian caregivers and siblings. For these reasons, and because of the difficulties using ANCOVA to statistically equate non-randomly assigned groups (see Pedhazur, 1997 for a discussion of the controversy around the use of ANCOVA to equate unequal groups), it was decided not to use First Nations status as a covariate. However, it will be important for future studies to further explore the influence of First Nations status on emotion recognition in children with FASD.

In addition to First Nations status, the groups were not matched by abuse history and therefore it was difficult to detect whether group differences were influenced by
negative early experiences or were a result of prenatal alcohol exposure. Also, the groups were not matched by intelligence, and it is unclear what kind of role intelligence played in the findings of this study. In addition, the sample sizes were not large enough to statistically adjust the groups for potential confounds. Future studies should try to obtain a large enough sample of children with FASD so that the role of IQ, ethnicity, and abuse in emotion recognition abilities could be more thoroughly examined. With respect to measures, it is important that more research be conducted on the influence of First Nations status in the recognition of emotions in primarily Caucasian stimuli. The measures being used to assess emotion recognition should be examined with the dominant Canadian ethnic groups to demonstrate their cross-cultural validity. Furthermore, it is not appropriate to use child or adult stimuli to determine how youth with FASD recognize emotions in their peers. It will also be important for stimuli to be developed that use adolescent actors to assess peer emotion recognition abilities in this age group.

Finally, the present study only included parent- or caregiver-reports of social functioning rather than also including teacher reports of social functioning. As discussed above, teachers may be strong informants of social functioning as they exclusively see these children within a highly social environment (i.e. classrooms, the schoolyard), whereas parents mostly see their child interacting with adults and siblings (who may be at different developmental stages), and may sporadically observe peer interactions. Teachers may have a better sense of age-appropriate social functioning or how that child is functioning within a highly social environment. Future studies should include teachers as informants of social functioning.
Conclusions

The findings from the current study lend support to the model modified by Lemerise and Arsenio (2000) by demonstrating that emotion recognition at the more molar level is related to emotion recognition in more complex real-life situations, which is then related to social outcomes as reported by parents on the CBCL. In addition, Timler (2000) also found that children with FASD have difficulties in particular points within the social information processing model (i.e. strategy generation and selection), and that deficits in these steps of the model were related to parent-reported social functioning (Timler, 2000). Both the current study and Timler’s study lend support to the validity of this social-information processing model as a way to further explore social functioning impairments in children with FASD.

Future studies should continue to use this model to determine which aspects of social-information processing are impaired in children with FASD. It will be important to fully explore each of the steps of the model as well as the interactions between steps prior to developing a social intervention for this clinical population. When assessing higher levels of the social-information processing model, it will be important to examine the relationship between executive functioning and performance on each step of the model. For example, generating appropriate goals for the situation takes planning and cognitive flexibility; generating appropriate strategies to reach the goal also takes planning and cognitive flexibility; deciding on an appropriate behaviour requires monitoring, planning, and solid reasoning skills; and finally evaluating one’s own response takes self-monitoring, flexibility to come up with an alternate response, and monitoring of peer reactions to determine how the response was received. It will be
important for future studies to examine the relationship between executive functioning and performance on the more advanced steps of the social-information processing model in order to better understand the impact of neurocognitive functioning in social-information processing.

The current study only examined step one of Lemerise and Arsenio’s (2000) model, but found that children with FASD had difficulties in aspects of emotion recognition compared to age-matched peers. This finding suggests that children with FASD may also have difficulties on later steps of the model, as each step builds upon having been successful on the previous step of the model. If some children with FASD have difficulties recognizing emotions in others, they may also misinterpret cues, select inappropriate goals, generate inappropriate strategies, select an inappropriate response and act inappropriately. However, the lack of a relationship between basic emotion recognition tasks and parent-reported social functioning in the present study suggests that the steps following emotion recognition likely play a greater role in the difficulties with social functioning observed by parents and caregivers. Future studies need to be conducted to better evaluate the relationship between each step of the social-information processing model and parent-reported social functioning.

To the author’s knowledge, the present study is the first of its kind to assess emotion recognition in different nonverbal modalities, including facial expressions, prosody, postures, and movement in children with FASD. The findings suggest that children with FASD do demonstrate impairments in their ability to discriminate emotions in facial expressions and to recognize emotions in faces and voices, with particular difficulties recognizing emotions in adults. At this point, the findings from this study
should be considered preliminary: these findings need to be replicated prior to making 
broad recommendations that would change clinical practice with this population. Future 
studies are needed to continue to evaluate the role of social-information processing on 
social functioning in children with FASD and to develop appropriate social interventions.
References


Davidson, R. J., & Slagter, H. A. (2000). Probing emotion in the developing brain: Functional neuroimaging in the assessment of the neural substrates of emotion in


*Psychological Bulletin, 97*(3), 412-429.


Monnot, M., Lovallo, W. R., Nixon, S. J., & Ross, E. (2002). Neurological basis of deficits in affective prosody comprehension among alcoholics and fetal alcohol-
Emotion Recognition in Children with FASD


Nowicki, S., Jr. (2006). A manual and reference list for the Diagnostic Analysis of Nonverbal Accuracy: Unpublished manuscript. Department of Psychology, Emory University, Atlanta, GA.


Appendix A

Parent/Caregiver Consent Form

DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF VICTORIA

Emotion Recognition in Children with Fetal Alcohol Spectrum Disorders

You are invited to participate in a research study being conducted by me, Susan Siklos, a doctoral student in the department of Psychology at the University of Victoria, under the direct supervision of Dr. Kimberly Kerns. I am completing this project as a part of my requirements towards completing the doctoral program in Clinical Neuropsychology at the University of Victoria. This research is being funded by a Canada Graduate Scholarship awarded by the Social Science and Humanities Research Council.

Through my training towards becoming a child neuropsychologist, I have had the opportunity to work with children with a range of difficulties in their day-to-day lives. In particular, I have conducted assessments and been involved in treatment with children/youth who have been prenatally exposed to alcohol. I also recently had the opportunity to volunteer at Whitecrow Village camp and spent a whole week with children/youth with prenatal alcohol exposure (PAE) and their families. Through all of my interactions with this group of children and adolescents, I have been struck by how many have difficulties socially interacting with their peers and feel isolated by their peers. Many parents have described to me the difficulties that their child faces making and keeping friends or being taken advantage of by their peers. When I started reading the research that has been done on social functioning in children with fetal alcohol spectrum disorders (FASD), I was surprised at how little there was. Most research noted that these children have significant social difficulties, but did not describe what those difficulties were. However, most of the reports state that early social problems place children/youth with FASD at risk for developing greater problems in adolescence or adulthood. Therefore, it is important to develop treatments early on that might prevent these later problems.

In order to develop treatments to help children with social challenges, we first must know what it is about social interactions that these children/youth find difficult. The goal of this project is to look at some of the most basic aspects of social behaviour, emotion recognition, in an effort to start identifying specific difficulties with social functioning. Recognizing and understanding the emotions people display through their faces, postures, body movements, and voices is important for dealing appropriately with people around us. This study is designed to examine emotion recognition by comparing children/youth with FASD and those without.

This study should take between 60-90 minutes of your time. You will be asked to complete a set of questionnaires describing your child’s behaviours and some basic
information about your child’s family and historical background. You can decline to answer any question. If you need to ask me something to answer a question, make a note of it in the margin and we can go over your questions once I am done testing your child. Your child will be asked to complete a set of computerized tasks (13 brief tasks in total), a noncomputerized measure of complex emotions, plus a brief measure of intelligence that I will administer. The computerized tasks will involve looking at pictures and video clips of people to decide what emotion is being shown or to decide if they are the same or different. The complex emotion task will involve listening to 12 brief stories and deciding how one might feel in that situation. There are no known or anticipated risks to you by participating in this research. Your help in this project will help professionals develop appropriate treatments for children with FASD and will help individuals understand better the social challenges experienced by children/youth who have been prenatally exposed to alcohol.

In an effort to keep responses completely anonymous, I will not collect any information with you or your child’s name on it. All of the questionnaires will have a participant identification number on it. The responses to the computerized tasks and the brief measure of intelligence will also have this participant identification number only. There will be no link between this number and your name. The only material that will have your names on it are these consent forms which will be stored in a locked filing cabinet until they are shredded once the project is complete. To ensure confidentiality, all of the completed questionnaires will be stored in a locked filing cabinet and the electronic data will be stored on the primary investigator’s computer and backed up on a disk that will be stored in the locked filing cabinet. All of the electronic data will be destroyed 5 years after the completion of the study. Although every step will be taken to maintain confidentiality throughout the research process, if while testing your child, or as a result of answers on any of the questionnaires, concerns come up about the safety of the child/youth or of someone else (e.g. current abuse, intention to harm self or others), confidentiality would have to be broken and I would need to discuss these concerns with the appropriate people.

It is important to note, that because this is the start of a line of research in social functioning in children with FASD, which is of great interest to both myself and my supervisor, Dr. Kimberly Kerns, it is possible that this collected data will be used in future related research that has undergone ethical approval by the University of Victoria or some other university or hospital ethics committee. Once again, it will be impossible to link subject identification numbers with your names, so the data will remain anonymous and confidentiality will be maintained within the group of researchers devoted to the project. If you have any concerns about your data being used in future studies please discuss this with me. If you decide that you do not want your responses used in future studies, tick the box below, and we will remove your data from the database at the end of this study so it cannot be used in future studies.

☐ I do NOT want my data used in future studies
☐ I give permission for my data to be used in future studies
Your participation in this study is completely voluntary. In order to compensate you for your time and the gas expenses it took for you to get here, you will be given $20 after all of the tasks and questionnaires are completed ($10 for you and $10 for your child). However, you can withdraw at any point during the study. That means, if either of you do not want to complete the tasks (questionnaires or computerized) just let me know and we will stop immediately. Your responses will not be used in the study. You will receive $10 compensation for your time and gas expenses.

It is anticipated that the results of this study will be shared with others in the following ways: writing up the results for my doctoral dissertation, sharing them in front of a supervisory committee, publishing the data in a peer-reviewed journal, and presenting the results at a conference. If you are interested in receiving a brief written report detailing the results of this study (once it has been completed) you may notify me of this by writing your mailing address or email address under your signature below. Note that the project will likely not be completed until the fall of 2008.

If you have any questions regarding this project, please feel free to contact me at (604) 862-7331, or by email at ssiklos@uvic.ca. You can also contact my supervisor, Dr. Kimberly Kerns, at (250) 721-7553, or by email at kkerns@uvic.ca. In addition to being able to contact myself and my supervisor at the above phone numbers, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Board at the University of Victoria at (250) 472-4545.

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

Name of Parent/Caregiver
Participant
Signature
Date

Name of Researcher
Signature
Date

I would like to receive a brief report of the findings from this study and my mailing address is:

Or my email address is:

A copy of this consent will be left with you, and a copy will be taken by the researcher.
Emotion Recognition in Children with Fetal Alcohol Spectrum Disorders

You are invited to participate in a research study being conducted by me, Susan Siklos, a graduate student in the department of Psychology at the University of Victoria, under the direct supervision of Dr. Kimberly Kerns. I am completing this project as a part of my requirements towards completing the doctoral program in Clinical Neuropsychology at the University of Victoria.

Through my training towards becoming a psychologist, I have had the opportunity to work with children with a range of difficulties in their day-to-day lives. I have worked with children/youth who have been prenatally exposed to alcohol and volunteered at Whitecrow Village camp where I spent a whole week with children/youth with prenatal alcohol exposure (PAE) and their families. Through all of my interactions with this group of children and adolescents, I have been struck by how many have difficulties with their peers and feel isolated or lonely or like they don’t fit in. Many parents have told me that their child has a hard time making friends. I think it is important to develop social skills treatments early on so that children with PAE do not have to feel lonely and isolated.

In order to develop treatments to help children with social challenges, we first must know what it is about social interactions that these children/youth find difficult. The goal of this project is to look at emotion recognition. Recognizing and understanding the emotions people display through their faces, postures, body movements, and voices is important for social interactions. This study is designed to examine emotion recognition by comparing children/youth with FASD and those without.

This study should take between 60-90 minutes of your time. Caregivers/parents will be asked to complete a set of questionnaires describing your behaviours and some basic information about your history. You will be asked to complete a set of games on the computer (13 short games in total), a game where you listen to short stories and place chips above emotion words to show us how you would feel in that situation, and a short measure of intelligence that Susan will administer. The computerized tasks will involve looking at pictures and video clips of people to decide what emotion is being shown or to decide if they are the same or different. There are no known or anticipated risks to you by participating in this research. Your help in this project will help professionals develop social treatments for children with FASD and will help individuals better understand the social challenges experienced by children/youth who have been prenatally exposed to alcohol.
So that nobody can tell how you answered your questions or what your parent/caregiver answered about you on the questionnaires, none of the questionnaires or computer games will have your name on them. All of the questionnaires will have a participant identification number on it. The answers to the computerized tasks and the brief measure of intelligence will also have this participant identification number on it. There will be no link between this number and your name. The only material that will have your names on it are these consent/assent forms which will be stored in a locked filing cabinet until they are shredded once the project is complete. Although every step will be taken to maintain confidentiality throughout the research process, if while testing something comes up that worries Susan about your safety or someone else’s (e.g. current abuse, intention to harm self or others), confidentiality would have to be broken and Susan would need to discuss these concerns with the appropriate people.

Your participation in this study is completely voluntary. In order to compensate you for your time and the gas expenses it took for you to get here, you and your parent/caregiver will be given $20 after all of the tasks and questionnaires are completed ($10 for parent/caregiver and $10 for you). However, you can stop at any point during the study - just let me know and we will stop immediately. You will each receive $5 compensation for your time and gas expenses if you stop before completing all of the games.

If you have any questions regarding this project, please feel free to contact me at (604) 862-7331, or by email at ssiklos@uvic.ca. You can also contact my supervisor, Dr. Kimberly Kerns, at (250) 721-7553, or by email at kkerns@uvic.ca. In addition to being able to contact myself and my supervisor at the above phone numbers, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Board at the University of Victoria at (250) 472-4545.

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

Name of Child/Youth Participant __________________________ Signature __________________________ Date __________________________

Name of Researcher __________________________ Signature __________________________ Date __________________________

A copy of this consent/assent will be left with you, and a copy will be taken by the researcher.
Appendix B

DEMOGRAPHICS QUESTIONNAIRE

Subject ID Number:____________________

Date: ______________________

1. Who filled out the questionnaires? (Relationship to child)__________________
   (If more than one person, specify relationship of both)
   _________________________________________________________________

2. Age of child:_______________

3. Gender of child: ____________

4. Ethnicity of child:__________       Ethnicity of family:______________

5. Has your child been formerly diagnosed with a Fetal Alcohol Spectrum Disorder?_________________ If yes, please specify when the diagnosis was made and by who (and please provide a copy of the report to Ms. Siklos)
   _________________________________________________________________
   _________________________________________________________________

6. Was your child exposed to alcohol at any time during the pregnancy (this could also include before the mother knew she was pregnant)?________________________
   
   If yes, please provide as many details as possible about the duration of prenatal alcohol exposure and the average amount that was consumed during pregnancy (e.g. 3 drinks per week or 5 drinks per month or 1 drink per day)
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

7. Was your child exposed to any other substances besides alcohol during the pregnancy (e.g. cocaine, heroine, marijuana, nicotine, etc.)?______________________________
   
   If yes, please provide as many details as possible about the duration of prenatal exposure and any known amounts that were consumed/used?
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
8. Has your child been physically abused? _____________________________
   emotionally abused? _____________________________
   sexually abused?______________________

If yes, please provide the age of the child at the time of abuse.

9. Who does your child currently live with (e.g. both biological parents, parent
   and stepparent, single parent, adoptive parents, foster parents – (be as specific
   as possible)?

   _________________________________________________________________

10. If your child is adopted or is a foster child, how long has he/she been living
    with you?_______________________________________________________

11. How many placements has your child been in including the current one?
    Please list duration of each placement.___________________________
        ____________________________________________________________
        ____________________________________________________________
        ____________________________________________________________

12. How many siblings does your child currently live
    with?________________________

13. What is the occupation of each of the caregivers?
    ________________________________________________________________
    ________________________________________________________________

14. How many years of education does each caregiver have (specify which
    caregiver has how many years of education)?
    ________________________________________________________________
    ________________________________________________________________

15. Does your child have any diagnosed psychological disorders (besides
    FASD)?__________ If Yes, please specify:
        ____________________________________________________________
        ____________________________________________________________
        ____________________________________________________________

16. Does your child have any medical conditions or problems?___________
    If Yes, please specify:
        ____________________________________________________________
        ____________________________________________________________
17. Is your child currently taking any medications?___________________ If yes, please specify which medications and what they are prescribed for:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

18. Has your child ever been in trouble with the law or incarcerated?__________If yes, please provide details (e.g. when they were incarcerated, for how long, what for?):

_________________________________________________________________
Appendix C

Training For Complex Emotion Task

NOTE - This training needs to come at the beginning of the interview session regardless of which emotion interview comes first.

“We’re going to be doing a couple of different things today. One of the things I’m going to do is read you different kinds of really short stories and ask you to imagine how the stories might make you feel. To help you with this I’m going to give you 10 chips (produce chips) and have you put them on the pieces of paper that match how you would feel.” (produce small pieces of paper with the words “happy,” “sad,” “mad,” “scared” and “neutral/OK”). “Ok - here are some feelings.” (Point to each.) “Here’s happy, sad, mad, scared and neutral or OK. What do you think this neutral/OK means?” (have subject guess) Yes, it means you’re just ok, not happy sad or anything. Could you give me an example of when you might just feel Okay?

“Now when I ask you how you’d feel you can put all the chips on one feeling, or if you think you might be feeling more than one thing you can divide them up the way you want. So let’s try a couple.”

“Imagine you just won the lottery and it was ok for you to have the money. How do you think you would feel? Put the chips down wherever you want and show me.”

“OK, lets try another one. Say you’re playing with somebody’s cat, and that cat bites you really hard. Use the chips to show me how you’d probably feel. Alright you’ve got it. You can put all the chips on one face or you can divide them up anyway you want, depending on whether you think you would be feeling just one thing or maybe a mix of different things.”