Errata

p. 25 line 2: delete "a"

p. 30 line 20: "were" for "was"

p. 35 line 10: "A greater proportion" for "A larger number"

p. 44 line 2: "many" for "a number of"

p. 51 line 5: "many" for "a number of"

p. 63 line 4: "many" for "a number of"

p. 69 line 1: "Many" for "A number of"

p. 108 line 20: "participants' " for "participants"

p. 112 line 10: "were" for "was"

Addendum

p. 7 lines 10-12: replace first sentence with "This thesis includes 3 original papers accepted for publication in peer reviewed journals."

p. 8: modify Publication Status of Chapter 5 from "Submitted" to "Accepted"

p. 18 lines 14-17: replace first sentence of paragraph with –
"Epidemiological data estimate the prevalence of ASD to be 60 to 70 in 10,000 (Elsabbagh et al., 2012; Fombonne 2009), and approximately 70 to 75 percent of individuals with autism are estimated to have a comorbid intellectual disability (Cotugno, 2009; La Malfa, Lassi, Bertelli, Salvini, & Placidi, 2004)."

p. 24 last line: between "with" and "typically developing" add "research suggesting that most"

p. 24 last line: "achieve" for "achieving"

p. 25 lines 5 -6: delete "By seven months of age TD infants show different patterns of brain-wave activity in response to different emotional expressions (Shaffer, 2009)"

p. 25 line 7: "appear able" for "begin"

p. 28 line 1: replace "Whilst TD children appear to understand desires and intentions around the age of two years, they appear to develop an understanding of knowledge and belief around the age of three to four years..." with "Research suggests that many TD children are able to understand desires and intentions around the age of two years and understand knowledge and belief around the age of three to four years"

p. 28 line 5: delete the last three sentences of this paragraph

p. 29 line 10: add "(APA, 2000)" to the end of the first sentence of this paragraph

p. 29: prior to the last paragraph add the following two paragraphs –
" A search for peer-reviewed publications was conducted using MEDLINE and PSYCINFO, with the following search terms: *autism/autism spectrum disorder* and *emotion recognition/ emotions.* Search results were limited to English-language publications from 1985 to June 2011. Publications were selected if the study fulfilled the following criteria: (a) participants had a diagnosis of autism, Asperger's Disorder or PDD-NOS (b) the mean age of participants was 12 years or younger (c) the study included one or more objectively quantified outcome measures of emotion recognition. Studies were excluded if they involved single case studies, unpublished manuscripts, non-English-language publications, or if no participants in the study had a diagnosis of Autistic Disorder (i.e., Asperger's Disorder or PDD-NOS only). Selected studies were divided into two groups (a) studies with mean FSIQ scores less than 80 and (b) studies with mean FSIQ scores above 80. These two groups were further divided into studies with mean chronological ages less than seven years and studies with mean chronological ages seven to twelve years.

Eighty was chosen as the mean FSIQ cut off for the groups because many of the studies with children with ID used mixed groups of children with ID and children with borderline IQ scores (70-79) and low-average IQ scores (80-89), meaning that some mean FSIQ scores were above the ID cut-off despite including children with ID in the sample. The cut off age of seven years for the 'young children' category was chosen because it is the maximum age of the children in our study, allowing for comparison of the data. The cut off age of 12 years was chosen for the 'older children' category because we were interested in results for children only."

p. 51 line 18: replace "improvements" with "the same level of improvement"

p. 51 last line and p.52 first two lines: delete "suggesting that emotion recognition skills of individuals with HFA do not appear to improve with age (Rump et al., 2009)."

p. 64 line 5: "is often of low frequency" for "is of low frequency"

p. 88 line 9: "Additional aims and hypotheses based on the baseline data for the whole sample:" for "Additional aims and hypotheses included:"

p. 108 line 14: add the following sentence to the end of the paragraph.
"Two of these children were in the control group and one was in the intervention group."

p. 129 line 2: "accepted for publication by" for "submitted to"

p. 132 line 19: delete the first sentence of this paragraph and replace with "Some research suggests that young children with autism and comorbid ID may not differ significantly from chronological age-matched typically developing children in their ability to recognise facial expressions of emotion."

p. 141 lines 10-11: delete "whilst correlations with the WPPSI VIQ and the Vineland-II Communication domain approached significance."

p. 141 line 14: delete "IQ, communication skills"

p. 141 lines 15-23: delete the last paragraph and replace with:
"ADOS severity scores were significantly negatively correlated with the emotion identification task, whilst SRS scores were significantly negatively correlated with the emotion matching task, suggesting that higher scores (greater autism severity) were associated with reduced emotion recognition accuracy on these tasks. There were also significant positive correlations for performance on the emotion tasks with chronological age and WPPSI IQ (VIQ and PIQ) scores and Vineland-II Adaptive Behaviour Composite scores."

p. 142 line 10: add the following to the end of the paragraph. "Results were the same for both the ADOS and the SRS."

p. 143 lines 2-5: delete paragraph beginning "As shown in Table 4 ... did not reach significance"

p. 143 lines 17-18: delete "with a trend towards reduced accuracy in the matching of expressions of anger."

p. 146 lines 19-20: add the following paragraph before the last paragraph (discussion of the limitations) –

"Correlational analysis indicated that ADOS severity scores were not significantly correlated with scores on the SRS (another measure of the severity of autism symptomatology). This may have been because the ADOS and SRS focus on different symptoms. The SRS emphasises social behaviours over restricted and repetitive behaviours (i.e., only 18.5% of the SRS questions (the mannerisms subscale) relate to restricted and repetitive behaviours). Conversely, the revised ADOS algorithms include a greater proportion of items related to restricted and repetitive behaviours (28.6%).

Additionally, the lack of a significant correlation between the ADOS and SRS may have been due to the SRS being influenced by chronological age and adaptive behaviour. Specifically, the SRS was significantly correlated with chronological age and adaptive functioning scores whilst the ADOS was not significantly correlated with age, IQ or adaptive functioning. Collectively these results suggest that the ADOS severity scores may be a better measure of autism symptomatology because they include a wider range of symptoms and are independent of age and adaptive behaviour."

p. 158. Table 2. remove all single " * " next to numbers. Delete "* $p < .05$" from bottom row of Table 2.

p. 159 Table 3: replace all p-values of ".00" with ".01"

p .160 replace all p-values of ".00" with ".01"

p. 200 lines 4-5: add the following reference between Ekman and Friesen (1976) and Fein et al., (1992) –
"Elsabbagh, M., Divan, G., Koh, Y-J., Kim, Y. S., Kauchali, S., Marcin, C., Montiel-Nava, C., Patel, V., Paula, C. S., Wang, C., Yasamy, M. T. & Fombonne, E. (2012). Global prevalence of autism and other Pervasive Developmental Disorders. *Autism Research. 5*(3), 160-179."

p. 205 lines 3-4: Add reference between Lacroix et al., (2009) and Lambert & Windmiller (1981) –
"LaMalfa, G., Lassi, G., Bertelli, M., Salvini, R., & Placidi, G. F. (2004). Autism and intellectual disability: A study of prevalence on a sample of the Italian population. *Journal of Intellectual Disability Research, 48,* 262–267."

EVALUATION OF AN EMOTION TRAINING PROGRAMME

FOR YOUNG CHILDREN WITH AUTISM

Candidate: Beth Therese Williams

Supervisors: Dr Kylie Gray and Prof. Bruce Tonge

A thesis submitted in partial fulfilment of the requirements of the

Doctor of Psychology (Clinical)

School of Psychology and Psychiatry

Monash University

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CHAPTER 7: INTEGRATED DISCUSSION AND CONCLUSIONS

LIST OF TABLES AND FIGURES

Errata

p. 29 line 2: delete "a"

p. 34 line 20: "were" for "was"

p. 39 line 10: "A greater proportion" for "A larger number"

p. 48 line 2: "many" for "a number of"

p. 55 line 5: "many" for "a number of"

p. 67 line 4: "many" for "a number of"

p. 73 line 1: "Many" for "A number of"

p. 112 line 20: "participants' " for "participants"

p. 116 line 10: "were" for "was"

Addendum

p. 11 lines 10-12: replace first sentence with "This thesis includes 3 original papers accepted for publication in peer reviewed journals."

p. 12: modify Publication Status of Chapter 5 from "Submitted" to "Accepted"

p. 22 lines 14-17: replace first sentence of paragraph with –
"Epidemiological data estimate the prevalence of ASD to be 60 to 70 in 10,000 (Elsabbagh et al., 2012; Fombonne 2009), and approximately 70 to 75 percent of individuals with autism are estimated to have a comorbid intellectual disability (Cotugno, 2009; La Malfa, Lassi, Bertelli, Salvini, & Placidi, 2004)."

p. 28 last line: between "with" and "typically developing" add "research suggesting that most"

p. 28 last line: "achieve" for "achieving"

p. 29 lines 5 -6: delete "By seven months of age TD infants show different patterns of brain-wave activity in response to different emotional expressions (Shaffer, 2009)"

p. 29 line 7: "appear able" for "begin"

p. 32 line 1: replace "Whilst TD children appear to understand desires and intentions around the age of two years, they appear to develop an understanding of knowledge and belief around the age of three to four years…" with "Research suggests that many TD children are able to understand desires and intentions around the age of two years and understand knowledge and belief around the age of three to four years"

p. 32 line 5: delete the last three sentences of this paragraph

p. 33 line 10: add "(APA, 2000)" to the end of the first sentence of this paragraph

p. 33: prior to the last paragraph add the following two paragraphs –
" A search for peer-reviewed publications was conducted using MEDLINE and PSYCINFO, with the following search terms: *autism/autism spectrum disorder* and *emotion recognition/ emotions.* Search results were limited to English-language publications from 1985 to June 2011. Publications were selected if the study fulfilled the following criteria: (a) participants had a diagnosis of autism, Asperger's Disorder or PDD-NOS (b) the mean age of participants was 12 years or younger (c) the study included one or more objectively quantified outcome measures of emotion recognition. Studies were excluded if they involved single case studies, unpublished manuscripts, non-English-language publications, or if no participants in the study had a diagnosis of Autistic Disorder (i.e., Asperger's Disorder or PDD-NOS only). Selected studies were divided into two groups (a) studies with mean FSIQ scores less than 80 and (b) studies with mean FSIQ scores above 80. These two groups were further divided into studies with mean chronological ages less than seven years and studies with mean chronological ages seven to twelve years.

Eighty was chosen as the mean FSIQ cut off for the groups because many of the studies with children with ID used mixed groups of children with ID and children with borderline IQ scores (70-79) and low-average IQ scores (80-89), meaning that some mean FSIQ scores were above the ID cut-off despite including children with ID in the sample. The cut off age of seven years for the 'young children' category was chosen because it is the maximum age of the children in our study, allowing for comparison of the data. The cut off age of 12 years was chosen for the 'older children' category because we were interested in results for children only."

p. 55 line 18: replace "improvements" with "the same level of improvement"

p. 55 last line and p.52 first two lines: delete "suggesting that emotion recognition skills of individuals with HFA do not appear to improve with age (Rump et al., 2009)."

p. 68 line 5: "is often of low frequency" for "is of low frequency"

p. 92 line 9: "Additional aims and hypotheses based on the baseline data for the whole sample:" for "Additional aims and hypotheses included:"

p. 112 line 14: add the following sentence to the end of the paragraph.
"Two of these children were in the control group and one was in the intervention group."

p. 133 line 2: "accepted for publication by" for "submitted to"

p. 136 line 19: delete the first sentence of this paragraph and replace with "Some research suggests that young children with autism and comorbid ID may not differ significantly from chronological age-matched typically developing children in their ability to recognise facial expressions of emotion."

p. 145 lines 10-11: delete "whilst correlations with the WPPSI VIQ and the Vineland-II Communication domain approached significance."

p. 145 line 14: delete "IQ, communication skills"

p. 145 lines 15-23: delete the last paragraph and replace with:
"ADOS severity scores were significantly negatively correlated with the emotion identification task, whilst SRS scores were significantly negatively correlated with the emotion matching task, suggesting that higher scores (greater autism severity) were associated with reduced emotion recognition accuracy on these tasks. There were also significant positive correlations for performance on the emotion tasks with chronological age and WPPSI IQ (VIQ and PIQ) scores and Vineland-II Adaptive Behaviour Composite scores."

p. 146 line 10: add the following to the end of the paragraph. "Results were the same for both the ADOS and the SRS."

p. 147 lines 2-5: delete paragraph beginning "As shown in Table 4 ... did not reach significance"

p. 147 lines 17-18: delete "with a trend towards reduced accuracy in the matching of expressions of anger."

p. 150 lines 19-20: add the following paragraph before the last paragraph (discussion of the limitations) –
"Correlational analysis indicated that ADOS severity scores were not significantly correlated with scores on the SRS (another measure of the severity of autism symptomatology). This may have been because the ADOS and SRS focus on different symptoms. The SRS emphasises social behaviours over restricted and repetitive behaviours (i.e., only 18.5% of the SRS questions (the mannerisms subscale) relate to

restricted and repetitive behaviours). Conversely, the revised ADOS algorithms include a greater proportion of items related to restricted and repetitive behaviours (28.6%).

Additionally, the lack of a significant correlation between the ADOS and SRS may have been due to the SRS being influenced by chronological age and adaptive behaviour. Specifically, the SRS was significantly correlated with chronological age and adaptive functioning scores whilst the ADOS was not significantly correlated with age, IQ or adaptive functioning. Collectively these results suggest that the ADOS severity scores may be a better measure of autism symptomatology because they include a wider range of symptoms and are independent of age and adaptive behaviour."

p. 162. Table 2. remove all single " * " next to numbers. Delete "* $p < .05$" from bottom row of Table 2.

p. 163 Table 3: replace all p-values of ".00" with ".01"

p .164 replace all p-values of ".00" with ".01"

p. 204 lines 4-5: add the following reference between Ekman and Friesen (1976) and Fein et al., (1992) –
"Elsabbagh, M., Divan, G., Koh, Y-J., Kim, Y. S., Kauchali, S., Marcin, C., Montiel-Nava, C., Patel, V., Paula, C. S., Wang, C., Yasamy, M. T. & Fombonne, E. (2012). Global prevalence of autism and other Pervasive Developmental Disorders. *Autism Research. 5*(3), 160-179."

p. 209 lines 3-4: Add reference between Lacroix et al., (2009) and Lambert & Windmiller (1981) –
"LaMalfa, G., Lassi, G., Bertelli, M., Salvini, R., & Placidi, G. F. (2004). Autism and intellectual disability: A study of prevalence on a sample of the Italian population. *Journal of Intellectual Disability Research, 48*, 262–267."

DECLARATION

General Declaration

In accordance with Monash University Doctorate Regulation 17/ Doctor of Philosophy and Master of Philosophy (MPhil) regulations the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes 2 original papers accepted for publication in peer reviewed journals, and 1 unpublished manuscript submitted to a peer reviewed journal for review. The core theme of the thesis is an evaluation of an emotion recognition training programme for young children with autism. The ideas, development and writing up of all of the papers were the principal responsibility of myself, the candidate, working within the Monash University Centre for Developmental Psychiatry and Psychology, under the supervision of Dr. Kylie Gray and Prof. Bruce Tonge. The inclusion of co-authors reflects the fact that this work came from active collaboration between researchers and acknowledges input into team-based research.

In the case of chapters 4, 5 and 6 my contribution to the work involved the following:

Thesis chapter	Publication title	Publication status	Nature of candidate's contribution
4	Teaching emotion recognition skills to young children with autism: A randomised controlled trial of an emotion training programme.	In Press	The candidate drafted these research papers and edits were provided by her supervisors.
5	Are emotion recognition skills related to autism symptom severity in children with autism?	Submitted	
6	Short report: The relationship between emotion recognition ability and social skills in young children with autism	Accepted	

Nature of and Assistance Given

This research involved the administration and scoring of psychological tests and parent questionnaires, data entry and data analysis. Two Psychology students from the Centre for Developmental Psychiatry and Psychology assisted with the administration of some of the assessments until I was trained in administration. A research assistant was employed to assist me in the administration and scoring of the psychological tests and questionnaires. I completed all of the data entry myself. Support and supervision were provided by my supervisors throughout the research. For example, Dr Kylie Gray assisted me in obtaining training in the administration of tests, reviewing cases and discussing directions of the research. Prof Bruce Tonge provided input into the research ideas. Dr John Taffe provided advice on data analysis.

Pagination

I have renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Copy write Notice 1

Under the Copyright Act 1968, this thesis must be used only under the normal conditions of scholarly fair dealing. In particular no results or conclusions should be extracted from it, nor should it be copied or closely paraphrased in whole or in part without the written consent of the author. Proper written acknowledgement should be made for any assistance obtained from this thesis.

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Candidate's signature:		Date:

Acknowledgements

I have been indebted in the preparation of this thesis to my supervisor, Dr. Kylie Gray of Monash University, whose academic experience, support and guidance have been invaluable. I am also extremely grateful to Prof. Bruce Tonge, Deborah Sweeney, Caroline Keating, Carlie Park and Upeka Embuldeniya of the Monash University Centre for Developmental Psychiatry and Psychology for their support, and assistance with training and data collection. I would like to extend my thanks to Dr. John Taffe for his invaluable statistical advice, and to the families who participated in our research - we could not have achieved this work without their help. Finally to my husband Michael and my parents Annette and Rodney for all of their support during this long process. This thesis would not have been possible without your support. Thank you.

ABSTRACT

The main aim of this thesis was to evaluate the efficacy of an emotion training intervention for young children with autism. Further aims were to investigate the relationship between emotion recognition ability, autism symptom severity and social skills in young children with autism. The first chapter of this thesis provides a review of the literature on emotion recognition skills of children with autism. It has been suggested that difficulties in recognising and responding to emotions may underlie the social deficits that are a core feature of autism (Baron-Cohen, Golan, & Ashwin, 2009). However research varies regarding the exact nature of emotion recognition skills of children with autism. Review of the literature suggests that children with autism and comorbid ID have some difficulty matching and labelling basic facial expressions of emotion, for both human and non-human faces, across static and dynamic conditions, when compared with typically developing children and those with other clinical disorders matched for mental age, VIQ or PIQ. For children with high-functioning Autism Spectrum Disorders (ASD), results vary due to large differences between studies. In general, research suggests that children with high-functioning autism have emotion recognition difficulties relative to typically developing children matched for chronological age and cognitive ability, and that these difficulties may be specific to the recognition of complex, but not basic, emotional expressions. These findings highlight the importance of emotion training programmes for young children with autism.

Chapter 1 also discusses research in to the relationship between emotion recognition ability and social skills for individuals with autism. Some research has reported a specific association between reduced accuracy in the recognition of

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expressions of sadness and reduced social skills for adolescents and adults with ASD (Boraston, Blakemore, Chilvers & Skuse, 2007; Wallace et al., 2011) but no research has investigated this association for children with autism. It was suggested that future research might benefit from the investigation of the relationship between emotion recognition skills and social skills in young children with autism.

Chapter 2 of this thesis provides a review of research evaluating emotion recognition interventions for children with autism, with the aim of identifying areas of research requiring further investigation. Review of the literature suggested that most emotion training programmes designed for children with autism have been evaluated with older, high-functioning children. Few of these programmes have been evaluated with young children with autism and none have been trialled with young children with autism and comorbid intellectual disability. One of the intervention programmes reviewed in Chapter 2 (the *Transporters;* Changing Media Development, 2006) was designed for use with young children with autism but had only been evaluated with high-functioning children with ASD. Further research was needed to evaluate its efficacy with young children with autism with a lower range of cognitive ability.

The main focus of the current study was to investigate the efficacy of an emotion training programme (the *Transporters*) for use with a group of 55 young children with autism of a lower range of intellectual ability. To address limitations in previous research the current study also investigated the relationship between emotion recognition ability, autism symptom severity and social skills for young children with autism, with analyses based on the intervention study's baseline assessment data. Three research papers were developed from this data and are presented in Chapters 4 to 6 as submitted journal articles.

Paper 1 was a randomised controlled trial evaluating the efficacy of the *Transporters* emotion recognition training programme for use with a group of 55 young children with autism, aged four to seven years (FSIQ 42-107). Previous research evaluating the use of the *Transporters* programme suggested that it was effective in teaching emotion recognition skills to high-functioning children with ASD (e.g., Golan et al., 2010). However in the current study the *Transporters* programme showed limited efficacy in teaching basic emotion recognition skills to young children with autism of a lower range of cognitive ability. Improvements were limited to the recognition of expressions of anger, with poor maintenance of these skills at follow-up, and with no generalisation of skills to Theory of Mind or social skills. These findings provide limited support for the efficacy of the *Transporters* programme for young children with autism of a lower cognitive ability, with results suggesting that the *Transporters* may be more efficacious for older, higher-functioning children with autism.

Paper 2 assessed the relationship between degree of autism symptom severity and emotion recognition ability for 55 young children with autism. Only two previous studies had been published on this topic, with findings suggesting that increased autism symptom severity was related to reduced accuracy in emotion recognition in older children and adolescents with ASD. More research was needed to investigate the relationship between autism symptom severity and emotion recognition skills in young children with autism. In support of previous findings, the current study showed that higher autism severity scores were associated with reduced accuracy in the recognition of facial expressions of fear and anger, as well as decreased accuracy in the identification of desire-based but not situation-based emotions. These

findings suggest that emotion recognition difficulties may be more pronounced for children with more severe levels of autism symtomatology.

Paper 3 investigated the relationship between emotion recognition ability and social skills for a sub-group of 42 young children with autism. Three previous studies had been published on this topic, but further research was needed into the association between accuracy in the recognition of specific emotions (happiness, sadness, anger and fear) and social skills in young children with autism. In the current study, analyses indicated that accuracy in the recognition of expressions of sadness (but not happiness, anger or fear) was associated with better social skills. These findings extend previous research with adults with ASD, suggesting that accuracy in the recognition of sadness is also related to better social skills in children with autism.

The discussion chapter comments on the limitations of the current study, as well as the clinical implications and future research directions generated by this research. The main limitation of the current study was that outcome measures were limited the use of four basic facial expressions of emotion. This was due to the young developmental age of the participants, the cognitive demands of the emotion recognition tasks, and difficulty obtaining standardised measures of emotion recognition ability that could be reliably used with children with autism of a young developmental age. As a result, it is unknown whether children improved in their recognition of the more complex emotions that were also targeted in the *Transporters* programme. Further research is needed to develop and evaluate emotion recognition stimuli for use with young children with autism of a young developmental age. These materials would assist in the evaluation of emotion training programmes for young children with autism.

The main conclusion of the current study was that the *Transporters* emotion training programme showed limited efficacy for use with young children with autism of a lower range of cognitive ability. The *Transporters* programme may instead be more efficacious for older, higher-functioning, children with autism. Collectively the current findings suggest that there is a need to identify more effective interventions to help teach emotion recognition skills to children with autism of a young developmental age, including those with comorbid ID.

CHAPTER 1. | Emotion Recognition Research with Children with Autism

1.1 Overview of Autism

Autism Spectrum Disorders (ASD, sometimes referred to as Autism Spectrum Conditions) include Autistic Disorder (autism), Asperger's Disorder (AD) and Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). In the DSM-IV-TR (American Psychiatric Association; APA, 2000) these disorders fall under the broader classification of Pervasive Developmental Disorders (PDD), which are defined by extensive or pervasive delays in the development of basic functions, including socialisation and communication skills.

Autism is characterised by marked impairments in social interaction and communication skills, and a markedly restricted repertoire of activity and interests (APA, 2000). To meet DSM-IV-TR diagnostic criteria for Autistic Disorder an individual must meet at least six diagnostic symptoms across the three categories of (1) social interaction (2) communication and (3) restricted/repetitive/ stereotyped behaviours (APA, 2000). At least two of the six symptoms must be related to social impairment, including difficulties with non-verbal behaviours, failure to develop appropriate peer relationships, inability to spontaneously seek and share enjoyment or interests or achievements with others, or problems with social or emotional reciprocity. One of the six symptoms must include a deficiency in communication, including delay in the development of spoken language, difficulty in initiating or sustaining conversation, stereotypic or repetitive or idiosyncratic language, or absence of developmentally appropriate spontaneous pretend or social imitative play. Finally one of the six symptoms must include a symptom of restricted/repetitive/stereotyped patterns of behaviour, including preoccupation with one or more stereotyped or restricted

patterns of interest, an inflexible adherence to routines or rituals, stereotyped or repetitive motor mannerisms, or preoccupation with parts of objects. Additionally, delayed or abnormal functioning must have been demonstrated by the individual in at least one of these three categories before the age of three years.

Whilst Asperger's Disorder (AD) shares many characteristics with autism, a diagnosis only requires symptoms in two of the three main diagnostic categories, namely impairment in social interaction skills and presence of restricted/repetitive patterns of behaviour (APA, 2000). AD is differentiated from autism by the absence of a delay in the development of functional language skills, cognitive ability, and adaptive behaviour skills. Similarly, PDD-NOS has many similarities with autism but is diagnosed when an individual has impairment in the areas of social interaction, communication or restricted/repetitive patterns of behaviour that do not met full diagnostic criteria for autism or another PDD (APA, 2000).

Epidemiological data estimates the prevalence of ASD to be 60 to 70 in 10,000 children (Fombonne, 2005, 2009), and approximately 75 to 80 percent of individuals with autism appear to have a comorbid intellectual disability (Cotugno, 2009; Critchley et al., 2000). High-functioning autism (HFA) refers to those individuals with autism who have intellectual functioning in the average to high-average range, whilst Intellectual disability (ID or Mental Retardation) is characterised by significant limitations in intellectual functioning and adaptive behaviour (APA, 2000). ID is diagnosed by the presence of significantly sub-average intellectual functioning two standard deviations below the mean on a measure of intelligence, such as a score below 70 on a Wechsler test of intelligence (APA, 2000). Intellectual disability is also diagnosed by accompanying impairment in three areas of adaptive behaviour; conceptual skills (e.g.,

language, reading and writing, money concepts), social skills (e.g., interpersonal skills, responsibility, self esteem), and practical skills (e.g., instrumental activities of daily living, occupation and maintaining a safe environment) (American Association on Mental Retardation, 2002). Intellectual Disability may be classified as mild, moderate, severe or profound according to the level of intellectual impairment (APA, 2000).

1.1.1 The Clinical Distinction between Autism and Asperger's Disorder

The clinical distinction between autism and AD can be difficult, especially when the individual has an IQ in the normal range (Rinehart, Bradshaw, Brereton, & Tonge, 2002). This has led some researchers to question whether AD is a distinct diagnostic category or just a milder form of autism (Macintosh & Dissanayake, 2004). In research, diagnoses of HFA and AD are often grouped together resulting in mixed samples of participants with ASD.

There is a body of research suggesting that the symptomatology and specific cognitive profiles of children with HFA differ from those of children with AD. Saulnier and Klin (2007) compared symptomatology of 32 adolescents with HFA and 35 with AD, aged 7-18 years, matched for chronological age and gender. Adolescents with HFA had significantly lower verbal IQ (VIQ) scores, lower Vineland-II (Sparrow, Cicchetti, & Balla, 2005) communication, expressive language and play/leisure domain scores, and significantly more autism symptomatology (greater impairment on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000)) compared with adolescents with AD.

Similar findings have been reported in research comparing 23 adolescents with HFA and 12 with AD, aged 6-20 years and matched for chronological age, gender

and intellectual ability (Ozonoff, South, & Miller, 2000). Parent report indicated that at age 4 to 5 years children with HFA had; significantly greater impairment according to scores on the Autism Diagnostic Interview (ADI-R; Lord, Rutter, & Le Couteur, 1994), a later age in the development of the use of single words, more DSM-IV symptoms, and more years in special education schools, compared to children diagnosed with AD. It was concluded that HFA and AD may have different developmental trajectories, with HFA beginning with more severe symptomotology at an earlier age (Ozonoff et al., 2000).

Klin and colleagues investigated the neuropsychological profiles of 19 adolescents with HFA and 21 with AD matched for chronological age and FSIQ (Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995). Adolescents with HFA typically had higher Performance IQ (PIQ) scores than VIQ scores, whilst those with AD typically had higher VIQ than PIQ scores. Further, HFA was specifically associated with difficulties in articulation, verbal output, auditory perception, vocabulary and verbal memory, whilst AD was specifically associated with difficulties in visual-motor integration, visual-spatial perception, non-verbal concept formation, fine- and gross-motor skills, and visual memory (Klin et al., 1995). These results suggest that individuals with HFA and AD may have different neuropsychological profiles.

HFA and AD have also been shown to differ in relation to neuromotor functioning, specifically in research comparing gait functioning (e.g., stride length, base of support, variability) of individuals with HFA and AD. For example, Rinehart et al. (2006) compared neuromotor behaviour of 10 children with HFA, 10 children with AD and 10 typically developing (TD) children (mean ages 10.57 to 10.76 years), matched for age, gender, height, weight and FSIQ. Analyses indicated that children with autism

had cerebella gait patterning differentiating them from those with AD. A similar study compared neuromotor behaviour of 11 children with HFA, 11 with AD, and 11 TD children, aged 7 to 18 years and matched for age, height, weight and IQ (Nayate et al., 2011). Individuals with HFA were shown to have a wider base of support and increased stride length variability compared with individuals with AD and TD controls, further suggesting differential neuromotor functioning in autism compared with AD.

Children with HFA and AD may also differ in relation to emotion recognition skills and theory of mind (TOM) ability (the ability to attribute mental states, such as beliefs, desires and intentions, to others and to oneself (Baron-Cohen, 1995)). For example, Mazefsky and Oswald (2008) compared emotion recognition ability of 14 children with HFA and 16 children with AD, aged 8 to 15 years, matched for chronological age and FSIQ. Diagnosis was confirmed according to ADI-R and ADOS criteria (Lord et al., 1994; Lord et al., 2000). Participants were assessed on their ability to identify facial and vocal expressions (happy, sad, angry or scared). Children in the HFA group were less accurate in identifying expressions of emotion compared with children in the AD group, whilst the AD group performed equivalent to the standardised sample of TD children. These results suggest that there may be differences in the emotion recognition skills of children with autism compared to those with AD.

Paynter and Peterson (2010) compared TOM ability for 19 children with HFA, 24 children with AD, and 20 TD children, aged 5 to 12 years, matched for chronological age, gender, and verbal and non-verbal mental ability. Participants completed false-belief tasks to measure TOM ability. Children in the HFA group scored significantly

lower than those in the AD group on the false-belief tasks, whilst those in the AD group performed equivalent to the TD children.

Collectively these results suggest that individuals with autism and AD may differ in relation to ASD symptomatology, cognitive profiles, neuromotor functioning, and social perception skills (emotion recognition and TOM ability). As a result, our study investigated the emotion recognition skills of children with a specific diagnosis of Autistic Disorder, excluding children with Asperger's Disorder or PDD-NOS. Additionally, the following literature review has focused on studies specific to individuals with autism, or mixed samples of children with HFA and AD. Research studies with exclusive samples of individuals with Asperger's Disorder have been excluded from the literature review.

1.1.2 Social Functioning in Autism

Social skills encompass a range of abilities including communications skills, the understanding of emotions, and the appropriate use of posture, gesture and proximity in social interaction (Ryan & Charragain, 2010). Social impairments are a key diagnostic feature of Autistic Disorder as outlined in the DSM-IV-TR (APA, 2000). In autism, social interaction is of low frequency and poor quality, and is more likely to involve ritualistic behaviours and poor social skills (Bauminger, 2002). Difficulties in reciprocal social interaction in autism range in severity and may include unusual patterns of eye contact during social interaction or a complete absence of friendships (Boraston et al., 2007).

When compared to mental-age matched TD children and those with non-PDD ID, infants with autism appear to lack early preferences for social stimuli and social

features of faces (such as the eyes) (Klin, Jones, Schultz, Volkmar, & Cohen, 2002). Children with autism have demonstrated impairments in social orienting (spontaneous orientation towards naturally occurring social stimuli in the environment), in joint attention (the ability to coordinate attention between social partners with respect to events or objects) and in attention to distress displayed by others (Dawson, et al., 2004). Toddlers with autism also spend less time looking at people and longer durations looking at objects, as compared with TD children and children with non-PDD ID (Swettenham et al., 1998). This reduced orientation to social stimuli is one of the earliest social impairments in autism and may be related to later social and communicative impairments (Dawson et al., 2004).

Social deficits are posited to be a core feature of autism because they appear to underlie the development of the communication deficits and ritualistic/ repetitive behaviours seen in autism (Pelphrey & Carter, 2008). For example, for children with autism, social deficits (such as reduced social orienting, pointing and responding to one's name) appear by the age of 12 months (Osterling & Dawson, 1994; Osterling, Dawson, & Munson, 2002), predating difficulties in communication and the onset of restricted/repetitive behaviours (Pelphrey & Carter, 2008), and potentially contributing to the delay in the development of language (Thurm, Lord, Lee, & Newschaffer, 2006).

Social skills deficits are a central characteristic in the diagnosis of both autism and ID. However for individuals with autism and comorbid ID there are additional limitations in social skills (de Bildt et al., 2005b). For individuals with non-PDD ID, delays in social skills are often equivalent to delays in other areas of development and behaviour, whilst for individuals with PDD and comorbid ID, limitations in social skills are often greater than limitations in other areas of adaptive behaviour (de Bildt et al.,

2005b). It has been suggested that difficulties in recognising and responding to emotions may underlie these social skills deficits that are a core feature of autism (Baron-Cohen et al., 2009).

1.2 Empathising and Emotion Recognition

Emotions are defined as observable behaviours that communicate feelings and internal states, and may be expressed verbally through semantics and prosody or non-verbally through facial expressions and body posture (Herba & Phillips, 2004). Emotion recognition is defined as the ability to distinguish the various affective expressions in facial, gestural, and verbal displays, in oneself and in others, and to understand the social-contextual meaning of these behaviours (Buitelaar, Van Der Wees, Swaab-Barneveld, & Van Der Gaag, 1999b). Emotion recognition skills serve an important purpose in communication because they allow humans to deal quickly with interpersonal situations (Ekman, 1999), subsequently mediating one's safety in social situations (Curby, Willenbockel, Tanaka, & Schultz, 2010). The ability to recognise emotional expressions and other socially relevant information from facial expressions is fundamental to normal social interactions (Pelphrey, Morris, McCarthy, & Labar, 2007), is important for understanding social experiences, and is closely related to accuracy in the identification and regulation of one's own affective states and emotional behaviours (Phillips, Drevets, Rauch, & Lane. 2003).

1.2.1 Development of Emotion Recognition in Typically Developing Children

Research into the development of emotion recognition skills suggests that these abilities do not develop at one specific age but rather emerge gradually over time (Herba & Phillips, 2004), with typically developing children achieving an adult level of

interpretation around the age of 10 to 11 years (Tonks, Williams, Frampton, Yates, & Slater, 2007). Children as young as a three-months of age have been shown to discriminate between happy, sad and angry faces, responding gleefully to their mother's happy face, and becoming distressed by her angry and sad expressions (Shaffer, 2009). By seven months of age TD infants show different patterns of brain-wave activity in response to different emotional expressions (Shaffer, 2009). However it is not until around the age of three years that TD children begin to accurately identify and label basic expressions of emotion (Widen & Russel, 2003).

Happiness is the first and most accurately recognised emotion by TD children, followed by sadness, anger and fear, then surprise and disgust (Brechet, Baldy, & Picard, 2009). By the age of three to four years TD children appear able to understand causes of happiness and sadness, and between the ages of five to seven years they appear to understand that a person can have two compatible emotions at the same time (Shaffer, 2009). Research also suggests that there may be a sex-difference in emotion recognition ability, with meta-analysis results indicating that females are more accurate than males in the identification of facial affect, with sex differences present from infancy (McClure, 2000).

1.2.2 Basic and Complex Expressions of Emotion

In the English language there are at least 412 distinct emotions and mental states, with their own individual descriptors (Baron-Cohen, Golan, Wheelwright, & Hill, 2004). These emotions can be divided into the basic expressions of affect, complex expressions of affect, and mental states.

Basic Expressions of Emotion

The basic expressions of emotion are defined as six universally recognised and expressed facial expressions of affect; happiness, sadness, anger, fear, surprise, and disgust (Ekman & Friesen, 1976). Ekman and Friesen (1976) conducted cross-cultural research into the recognition of facial affect from photos, for individuals from an isolated community in a remote region of New Guinea. It was found that participants could reliability identify six basic emotional expressions, suggesting that the basic expressions of emotion may have a universal biological basis. As previously discussed, these basic expressions of emotion are thought to develop early in life and TD children begin to accurately identify and label them around three years of age (Widen & Russel, 2003).

Complex Expressions of Emotion

Complex emotions have been referred to as 'social' or 'self conscious' emotions because they are in some ways culturally constructed (Williams & Happe, 2010). Some examples of complex emotions include pride, embarrassment, shame, guilt, and jealousy. The understanding of complex emotions is dependent upon social-cognitive processes including the ability to evaluate situations against standards of behaviour (Bosacki & Moore, 2004). For example, one's understanding of complex emotions is influenced by one's understanding of social rules of behaviour, the ability to evaluate oneself against others, and the ability to take responsibility for one's own behaviour (e.g., pride) (Bauminger, 2002).

Research suggests that TD children understand pride and embarrassment around the ages of three to four years (Russell & Paris, 1994) and

other complex emotions around the ages of four to five years (Haan & Nelson, 1998). It is posited that children's developing emotional vocabularies allow them to identify and label more subtle expressions of emotion with age (McClure, 2000).

1.2.3 Mentalizing and Theory of Mind

The term 'Theory of Mind' (TOM) was originally coined by Premack (1976) in his research into intelligence and intentionality in primates. TOM is defined as the ability to attribute mental states (such as beliefs, desires and intentions) to others and to oneself, whilst the process of identifying mental states has been referred to as 'mentalizing' or 'mind reading' (Baron-Cohen, 1995). TOM allows humans to understand our own and others' lives, to interact socially, to predict behaviour and to communicate with others (Wellman et al., 2002). It also enables an individual to make inferences about other people's current behaviour and to predict future behaviour (Leudar, Costall, & Francis, 2004). TOM skills are thought to be useful in social understanding and communication because (a) they allow for deception (the ability to make someone believe that something is true when it is actually false), (b) they enable empathy (the ability to make inferences about how someone might be feeling), (c) they allow for self-consciousness and self-reflection, with the possible advantage of rehearsing solutions to problems in one's mind, and (d) they enable one to teach through understanding that one can change another person's beliefs, desires, thoughts and intentions by providing them with information (Howlin, Baron-Cohen, & Hadwin, 1999).

As with emotion recognition skills, mentalizing ability and TOM skills appear to follow a pattern of gradual development in typically developing children (Amsterlaw &

Wellman, 2006). Whilst TD children appear to understand desires and intentions around the age of two years, they appear to develop an understanding of knowledge and belief around the age of three to four years (Sodian & Thoermer, 2008; Wellman, 2002; Yirmiya, Erel, Shaked, & Solomonica-Levi, 1998). There is some debate regarding the exact age at which TD children actually acquire a TOM. Some researchers have suggested that infants as young as 15 months old posses TOM understanding (Onishi & Baillargeon, 2005). However this difference may be due to variations in the tasks used to assess TOM (Yirmiya et al., 1998).

1.2.4 Relationship between Emotion Recognition, Mentalizing and TOM Skills

Emotion recognition skills are thought to be a key component in the development of mentalizing and TOM ability (Ashwin, Chapman, Colle, & Baron-Cohen, 2006). Specifically, it appears that complex emotion recognition ability may underlie TOM development. For example, Heerey and colleagues (2003) reported that for children with HFA, TOM ability was significantly correlated with accuracy in the identification of self-conscious (complex) emotions (e.g., embarrassment and shame) but not with the identification of basic emotions (Heerey, Keltner, & Capps, 2003).

There is some theoretical overlap between measures of complex emotion recognition, mentalizing (mind-reading) and TOM because complex emotion recognition may involve mental state understanding. For example, understanding that a person feels embarrassed for losing a race may require an understanding that the person had a desire to win the race or that they thought they would win. In some cases it can be difficult to differentiate between tasks measuring complex emotion recognition, mentalizing ability and TOM because these tasks often require the use of

multiple skills. Research studies differ in their classification of complex emotions and mental states, with some referring to measures of situation-based or desire-based emotions as complex emotion tasks, whist others refer to them as mind-reading or TOM tasks. For the purpose of this literature review and research study, complex emotions were defined as those that are social or self-conscious emotions. Tasks measuring situation-based and desire-based emotions were referred to as measures of mentalizing ability.

1.3 Emotion Recognition Skills of Children with Autism

There is consensus that autism involves social deficits and these deficits appear to be a primary feature of the disorder. However there is less agreement whether the social impairment in autism is specific to emotion recognition difficulties. The following review summarises a large body of research evaluating the emotion recognition skills of children with autism. The majority of research supports the notion of reduced emotion recognition accuracy in children with autism compared with TD children. However there remains a considerable body of research finding no difficulties in emotion recognition in autism compared with TD children. The reasons for these differences are discussed in the following review.

The majority of research has focused on children with HFA because these children are better able to follow instructions and complete experimental tasks. Research with individuals with HFA also controls for the confounding influence of intellectual disability (ID) on emotion recognition performance. This review has been divided into studies with children with comorbid ID (where some or all of participants have a comorbid ID or developmental delay), and studies with children with high-

functioning ASD. Few emotion recognition studies have focused exclusively on the skills of children with autism. Instead the majority of research has used mixed groups of children with Autistic Disorder (autism), Asperger's Disorder (AD) and/or PDD-NOS. As a result this review has included studies with mixed ASD groups but has excluded those that did not include any children with autism (i.e., research studies that only included children with Asperger's Disorder and/or PDD-NOS).

1.3.1 Emotion Recognition Skills of Children with Autism and Comorbid ID

The following review includes some studies where all participants had a comorbid ID or developmental delay, and other studies where children with autism had a range of cognitive ability including some children with a comorbid ID. Of the studies reviewed here, the mean FSIQ scores were less than 80. The following is further divided into research with young children (mean age less than seven years) and research with older children (mean age seven to twelve years).

Young Children with Autism and Comorbid ID (mean age less than seven years)

Five studies have investigated the emotion recognition ability of young children with autism with developmental delay. One study compared the facial emotion recognition ability of 12 male children aged 2-6 years (with a DSM-III-R (APA, 1987) diagnosis of Autistic Disorder and FSIQ of 43-106) to 12 typically developing male children aged 2-7 years (Feldman, McGee, Mann, & Strain, 1993). Groups were not matched on IQ and IQ data was not available for most of the TD children. Participants watched short video vignettes containing two children displaying different emotions within a social context. At the end of each vignette the video was frozen on a scene showing the child's facial expression and participants were asked to point to a matching target

emotion (happiness, sadness or anger). Children with autism scored significantly lower than TD children in identification of all three emotions. Children with autism performed higher than chance in the identification of happiness but not for identification of sadness or anger. No significant correlation was found between IQ and emotion recognition ability for children with autism. Feldman and colleagues (1993) concluded that children with autism were less accurate than TD children in their ability to identify emotions, but that they showed some accuracy in the identification of happiness. It was acknowledged that they could not rule out the possible effect of group differences in mental age on these findings.

Another study investigated emotion recognition performance of children with autism compared to a group of TD children matched for verbal mental age (VMA) (experiment 1) and a group of TD children matched for non-verbal mental age (experiment 2) (Ozonoff, Pennington, & Rogers, 1990). In experiment 1, Ozonoff and colleagues compared 14 children aged 3 -10 years with autism with developmental delay to a group of 14 TD children aged 2 -3 years matched for VMA. Selection criteria for the autism group included having a score of 30 or over on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, de Vellis, & Daly, 1980). Participants completed tasks with emotional and non-emotional components; sorting pictures of faces based on facial identity or emotional expression (happiness or sadness), matching emotional faces (happiness, sadness and anger) and matching non-affective objects with sounds, matching either objects or emotional faces with contextual pictures, and an expressive vocabulary questionnaire which included affective and neutral words. The only significant difference found between groups was on the vocabulary task where

children with autism were found to use significantly less emotional and non-emotional words than the TD children.

Ozonoff and colleagues then conducted a second experiment comparing children with autism (those who participated in the first experiment) with a second group of TD children matched for non-verbal mental age. Participants were 13 children aged 3-10 years with autism with developmental delay and 13 TD children aged 2-8 years matched for non-verbal mental age (Ozonoff et al., 1990). Participants completed the same measures as previously described. For the first two tasks children with autism had significant difficulty sorting and matching emotional faces, but not in sorting and matching the non-affective stimuli, as compared with the TD children. On the latter two measures the children with autism were significantly less accurate than the TD group on both the affective and non-affective components of matching objects and faces with situations and on the vocabulary task. It was concluded that, previously reported differences in emotion recognition ability between children with autism and TD children may have been due to previous studies not controlling for differences in VMA between groups (Ozonoff et al., 1990).

More recent studies have controlled for differences in developmental age and/or cognitive ability between groups. For example, Gepner and colleagues compared facial emotion recognition ability of 13 children aged 4-7 years with a DSM-IV (APA, 2000) diagnosis of Autistic Disorder and developmental delay to 13 TD children aged 1-5 years, individually matched for gender and developmental age (Gepner, Deruelle, & Grynfeltt, 2001). Participants were presented with a short video clip of a woman displaying a facial expression and following each clip were required to

select a photo displaying the matching facial expression. Facial expressions consisted of four emotional expressions (joy, surprise, sadness and disgust) and four non-emotional facial expressions (e.g., pronunciation of vowels) under three conditions (dynamic expression, static expression, and a strobe condition). Analyses showed no significant differences between the groups on any of the tasks.

Further analyses by Gepner and colleagues (2001) indicated that emotion recognition performance was positively correlated with age in the TD group but not in the autism group. When each group was separated into the six oldest children and six youngest children, the six oldest children with autism performed significantly worse than the six comparison TD children in emotion recognition ability. However there was no significant difference between the youngest six children with autism and the six comparison TD children. It was concluded that there may be a delay in the development of facial emotion processing for children with autism. Specifically, very young children with autism may not show abnormal performance relative to TD children, but that as age increases emotion recognition accuracy relative to TD children may decrease (Gepner et al., 2001). One limitation of this study was the inclusion of a small sample (n = 12, with n = 6 for the post-hoc analyses).

More recently Lacroix and colleagues compared emotion recognition skills of 12 children aged 4-8 years with autism and a range of cognitive ability with 12 children aged 6-15 years with Williams Syndrome and a group of 12 TD children aged 3-9 years matched for VMA (Lacroix, Guidetti, Rogé, & Reilly, 2009). Diagnosis of autism was made according to DSM-IV (APA, 2000) criteria and confirmed through the use of the ADOS and ADI-R (Lord et al., 1994; Lord et al., 2000). Participants completed two non-

affective tasks involving identification of faces based on gender and matching of faces based on identity. They also completed three emotion tasks which involved giving a verbal label for six different emotional faces (anger, fear, happiness, surprise, sadness and neutral), matching faces that displayed the same emotion (anger, fear, happiness, sadness and surprise), and pointing to a face displaying one of five target emotions from a selection of three faces. For the non-affective tasks, children with autism had greater difficulty identifying gender (difficultly identifying female faces) compared with the Williams Syndrome and TD children. For the emotion tasks the Williams Syndrome group were found to produce significantly fewer correct verbal labels for happiness than the autism group who in tum produced significantly fewer correct verbal responses for happiness than the TD children. For the emotion matching task both the autism and the Williams Syndrome groups provided significantly fewer correct responses for sadness but not for any other emotion, compared with the TD control group. For the identification task there was no significant difference between the autism group and TD group in the identification of each emotion. Collectively these results showed that children with Williams Syndrome and autism both had difficulties in emotion recognition ability relative to VMA-matched TD children, suggesting that emotion recognition impairments may not be specific to autism.

In summary, the nature of the control group appears to be an important consideration for research into the emotion recognition skills of young children with autism and comorbid ID. Early research suggests that there may be no difference in the emotion recognition ability of children with autism and TD children when groups are matched for VMA (Ozonoff et al., 1990). Subsequent research matching children on developmental age suggested that children with autism may have some difficulties

in emotion recognition ability relative to TD children, but this finding was not specific to children with autism and was also shown for children with Williams Syndrome (Lacroix et al., 2009). Further findings suggested that very young children with autism and comorbid ID may not show abnormal performance on emotion recognition tasks relative to TD children, but that as age increases emotion recognition performance relative to TD children appears to decrease (Gepner et al., 2001). These results suggest that emotion recognition difficulties may be more pronounced in older children with autism and comorbid ID.

Older Children with Autism and Comorbid ID (mean age seven to twelve years)

A larger number of studies have investigated the emotion recognition skills of older children with autism and comorbid ID, with the majority of research suggesting that these children have a general facial emotion recognition deficit. For example, Tantam and colleagues compared 10 children with autism and comorbid ID to 10 children with non-PDD ID (mean age 12 years, and matched for age, gender and PIQ) (Tantam, Monaghan, Nicholson, & Stirling, 1989). Participants completed two tasks; one requiring them to label the six basic facial expressions of emotion as well as label non-emotional pictures, and another requiring them to identify the face that was the odd-one-out (either a face displaying an incongruent emotion or a incongruent identity). Analyses indicated that children with autism were less accurate than the non-PDD ID children in labelling emotional faces but not in labelling non-emotional pictures. For the identification task children with autism were less accurate than the control children in identifying the odd-one-out for both the emotional and non-emotion faces.

Further analyses were conducted by Tantam et al (1989) comparing a subset of children matched for VIQ. Group differences on the labelling task were found to persist when differences in VIQ were accounted for. These results suggest that when compared to children with non-PDD ID, children with autism may be more impaired in their ability to label basic expressions of emotion, and that this difference persists when children are matched for VIQ. It was concluded that difficulties in emotion recognition ability may be specific to autism and may underlie the social interaction problems characteristic of autism (Tantam et al., 1989). One limitation of this study was the inclusion a small sample size (n = 10, with n = 5 for the post-hoc analyses).

In a similar study Celani and colleagues compared facial emotion recognition ability of 10 children aged 5-16 years with a DSM-III-R (APA, 1987) diagnosis of Autistic Disorder and FSIQ range from 45-105, to 10 children aged 7-16 years with Down Syndrome and 10 TD children aged 4-9 years, all matched for VMA (Celani, Battacchi, & Arcidiacono, 1999). Participants were shown photographs of emotional faces (sad or happy) and neutral faces on a video display. After viewing each target face participants were shown three faces and asked to select the photograph displaying the same emotion as the target face (emotional condition) or the photograph displaying the same person as the target face (non-emotional condition). The children with autism were found to be less accurate than both the Down Syndrome and the TD control children for the emotion matching task but not for the identity matching task. There was no significant difference between the Down Syndrome group and the TD group on either task. It was concluded that individuals with autism may have specific difficulties in the recognition of happy and sad faces, and that this difficulty was not merely a factor of ID (Celani et al., 1999).

Gross (2004) investigated emotion recognition ability of children with different developmental disorders in an attempt to control for differences in performance due to variations in intellectual or verbal ability. Emotion recognition ability of 27 children aged 4-15 years with DSM-IV (APA, 2000) diagnosed Autistic Disorder and IQ range 45-112 were compared to 28 children aged 4-13 years with developmental language disorders without ID, 26 children aged 4-13 years with non-PDD ID, and 27 children aged 4-11 years with a clinical diagnosis that was not a language disorder, ID or PDD (e.g., mild cerebral palsy, epilepsy or ADHD) (Gross, 2004). Participants were compared on their ability to identify four basic emotions (happiness, sadness, anger or surprise) from three sets of facial expressions (human, orang-utan and canine) (Gross, 2004). To control for differences in IQ and verbal ability between groups, IQ and Vineland Adaptive Behaviour Scale (VABS; Sparrow et al., 2005) communication domain scores were included as covariates in the analyses. In general, children with autism recognised fewer emotions than children in the non-autism groups, across the three species. For some conditions children with autism did not significantly differ from the children with non-PDD ID (e.g., canine surprise, orang-utan anger). Interestingly there were no differences between groups in the recognition of human happiness. It was concluded that children with autism were generally less accurate than children in all control groups in the identification of basic facial expressions of emotion for both human and non-human faces (Gross, 2004).

Gross (2005) extended upon previous work by comparing emotion recognition skills of 24 children (mean ages 7-9 years) with DSM-IV (APA, 2000) diagnosed Autistic Disorder, 18 children with non-PDD ID, 20 children with a developmental language disorder, and a control group of 21 children with another clinical disorder (e.g., ADHD

or epilepsy). Participants completed four matching tasks; two involved matching human and canine faces for age and two required matching human and canine faces for emotional expression (happiness, sadness or anger). Children with autism were shown to be less accurate than children in all control groups in their ability to match canine age, human emotional expression and canine emotional expression, but they performed equally well in matching human age. Interestingly, children with non-PDD ID performed significantly better than the autism group on the emotion recognition tasks despite having a significantly lower IQ and comparable VABS communication domain scores. These findings further suggest that difficulties in emotion recognition may be specific to autism beyond difficulties attributable to ID.

In a further study Gross (2008) investigated the recognition of emotional expressions and facial immaturity for 18 children (mean age 6-11 years) with a DSM-IV (APA, 2000) diagnosis of Autistic Disorder, 18 children with non-PDD ID, 18 children with language disorders, and 18 typically developing children, all groups matched for PIQ. Participants completed two matching tasks, one matching age and one matching emotional expressions (happy or sad). During each task participants were presented with a target face (either a child or adult, feeling happy or sad) and were required to select another photograph which displayed a face of the same age or the same emotional expression. The response photographs included congruent photos (i.e., the face was completely adult or child, happy or sad) or incongruent photos (i.e., the face was half child and half adult, or half happy and half sad). Analyses indicated that children with autism had more difficulty recognising age and emotional expressions relative to children with language disorders and TD children. Children with autism were also more likely to attend to the lower half of the face when making judgements

about age and emotional expression. It was concluded that children with autism appear to have deficits in facial information processing for both emotion recognition and facial immaturity relative to children without autism (Gross, 2008). Contrary to previous findings, the autism group did not perform significantly worse than the non-PDD ID control group. Whilst the autism group's scores for age and emotion matching were lower than the non-PD ID control group, this difference did not reach significance.

Further research has compared the emotion recognition skills of 12 children aged 7-14 years with a DSM-IV (APA, 2000) diagnosis of Autistic Disorder and developmental delay to two control groups; 12 TD children aged 3-7 years individually matched for gender and VMA, and 12 TD children aged 3-11 years individually matched for gender and non-verbal mental age (Tardif, Lainé, Rodriguez, & Gepner, 2007). Participants were presented with a short video clip of a woman displaying a facial expression and following each clip participants were required to select a photo displaying the target facial expression from a selection of photographs. Facial expressions consisted of four emotional expressions (joy, surprise, sadness and disgust) and four non-emotional facial expressions (e.g., pronunciation of vowels), under different conditions (static photographs and dynamic clips with three speeds; normal, slow or very slow). Children with autism had significantly lower scores than both control groups on all tasks, and their performance on the emotion tasks was significantly lower than on the non-emotional tasks. Collectively, children with autism were less accurate than TD children matched for VMA and non-verbal MA in matching basic facial expressions of emotion in both static and dynamic conditions.

Back et al. (2007) compared complex emotion recognition of 18 children aged 10-14 years with ASD (DSM-IV; autism *n* =7 and Asperger's Disorder *N* = 11) and FSIQ of 53-107 to 18 children individually matched for chronological age, FSIQ and gender. 13 control children were classified as TD and 5 with having a non-PDD developmental delay (Back, Ropar, & Mitchell, 2007). Participants watched short video clips displaying faces changing from a neutral expression to one of eight complex emotional expressions (e.g., disapproving, relaxed) and were required to select the appropriate label for each. Children in the ASD group had significantly lower accuracy than children in the control group in the identification of all complex emotions (Back et al., 2007).

A smaller body of research has found that older children with autism and developmental delay may not have specific difficulties in emotion recognition ability. For example, Prior and colleagues investigated emotion recognition ability of children with a specific diagnosis of autism and developmental delay, comparing 20 children aged 5-15 years with DSM-III (APA, 1987) diagnosed Autistic Disorder to 20 control children aged 5-14 years, individually matched for sex, chronological age and VMA (Prior, Dahlstrom, & Squires, 1990). Six children in the autism group had normal VMAs and were matched with TD children, whilst the remaining 14 children were matched with control children with learning disorders or global developmental delay. Participants were required to match pictures of facial affect (happy, sad, scared and angry) with affective sounds, gestures, and contextual pictures. In the non-affective task, participants were required to match items (a bird, dog, train and car) with sounds and contextual pictures. No significant difference was found between the autism and control group on any of the tasks. A VMA of six years appeared to be related to children's ability to pass the emotion tasks. It was suggested that emotion recognition

ability may be related to developmental level but not autism diagnosis (Prior et al., 1990).

Fein and colleagues compared 15 children aged 7-15 years with a PDD (autism *n* = 10, PDD-NOS *n* = 5) to two control groups; a group of 15 TD children aged 3-7 years matched for gender and non-verbal ability, and 15 TD children aged 2-6 years matched for gender and verbal ability (Fein, Lucci, Braverman, & Waterhouse, 1992). Participants completed two tasks; an object-matching task (non-emotional task) and a context-affect matching task (emotion task), the latter requiring children to select a photograph of an emotional face (happy, sad, angry or scared) to describe how a character was feeling in a specific context. No significant difference was found between the PDD and typically developing children on the emotion task. One limitation of this study is that the use of a mixed sample of children with autism and PDD-NOS makes it difficult to draw direct conclusions about the emotion recognition skills of children with autism.

Williams and Happe (2010) compared 21 children with DSM-IV (APA, 2000) diagnosed ASD and developmental delay (autism *n* = 18, Asperger's Disorder *n* = 2, PDD-NOS *n* = 1) to 21 children with a general learning disability matched for VMA. Participants were measured on their ability to identify basic and complex expressions of emotion. Children watched nine short video clips portraying nine emotions (six basic and three complex emotions) and were required to generate or choose a descriptive word for each. Children in the ASD group performed equally well to children in the general learning disability control group in their ability to label all emotions.

Summary of Research

The majority of research suggests that children with autism and developmental delay have difficulty with emotion recognition relative to TD children and control children with other clinical diagnoses. Review of the research with young children with autism and comorbid ID/developmental delay (mean age under seven years) suggests that very young children with autism may not show atypical performance relative to control children but that as age increases emotion recognition accuracy relative to controls appears to decrease. In support of this theory, a large body of research has reported general facial emotion recognition difficulties for older children with autism and comorbid ID, in the matching and labelling basic facial expressions of emotion, for both human and non-human faces, across static and dynamic conditions. These difficulties persist when children with autism and comorbid ID are compared with TD children matched for verbal and non-verbal IQ, and when they are compared with children with non-PDD-ID, learning disabilities or other clinical disorders matched for mental age, VIQ or PIQ. There remain some studies reporting no significant differences in emotion recognition ability between older children with ASD and TD children, however some have used mixed ASD groups making it difficult to draw direct conclusions about emotion recognition skills specific to children autism and comorbid ID.

1.3.2 Emotion Recognition Skills of Children with HFA

Many research studies have investigated the emotion recognition skills of children with HFA in an attempt to control for the confounding influence of ID and developmental delay on task performance. The following review is divided in to research with young children (mean age less than seven years) and research with older children (mean age

seven to twelve years), with the majority of research focusing on older children with HFA.

Young Children with HFA (mean age less than seven years)

In one study, Golan and colleagues compared the emotion recognition ability of children with ASD to VMA matched TD children as part of a larger study evaluating the efficacy of a children's animated DVD series (the *Transporters*) in teaching emotion recognition skills (Golan et al., 2010). All children with ASD were diagnosed based on DSM-IV (APA, 2000) criteria for Autistic Disorder or Asperger's Disorder and diagnosis was confirmed through administration of the ADI-R (Lord et al., 1994). Researchers analysed the emotion recognition ability of 20 children aged 4-7 years with ASD from the intervention group and 18 children aged 4-8 years with ASD from the control group compared with 18 TD children aged 4-7 years. All groups were matched for sex, age and verbal ability. Participants completed tasks measuring their ability to define 16 emotional words and to match situations with emotional faces. Both ASD groups were significantly less accurate at defining emotional words and in matching situations with emotional expressions compared with the VMA-matched TD control children.

Further research investigated the emotion recognition ability of 19 children with HFA aged 5-7 years and 18 VMA-matched TD children. Participants were assessed on their ability to name happy, sad, angry or scared dynamic facial expressions from video stimuli (experiment 1, Rump, Giovannelli, Minshew, & Strauss, 2009). Children in the autism group met ADOS (Lord et al., 2000) criteria for autism. Analyses indicated that children with HFA were significantly less accurate than TD children in the identification of scared and angry facial expressions but not happy and sad

expressions. It was concluded that whilst children with HFA were able to accurately identify a number of briefly presented dynamic expressions they were not as proficient as the TD children in the identification of angry and scared expressions of emotion (Rump et al., 2009).

In summary, the two studies investigating the emotion recognition skills of young children with HFA/ASD have found that children with ASD were less accurate in their emotion recognition ability than TD children matched for VMA. This is in relation to their ability to define emotions and match emotional expressions with contexts (Golan et al., 2010) and in their ability to identify specific basic emotions (angry and scared facial expression) (Rump et al., 2009).

Older Children with HFA (mean age seven to twelve years)

A larger body of research has evaluated the emotion recognition ability of older children with high-functioning ASD. A recent study compared emotion recognition skills of 35 children aged 7-16 years with high-functioning ASD (FSIQ of 72-142), to 35 TD children aged 7-16 years matched for gender, age and IQ (Wright et al., 2008). Children in the ASD group met ICD-10 criteria for Asperger's Disorder (*n*=29) or Autistic Disorder (*n*=6), and met the ASD cut off criteria on the ADI-R (Lord et al., 1994) and ADOS (Lord et al., 2000). Participants completed two emotion recognition tasks measuring ability to label six basic expressions of emotion from photos of faces and measuring understanding of emotions in context (participants were required to give explanations for why a character in a picture was displaying a specific emotion). Children also completed a non-affective task involving identification of occupations from pictures. Children in the ASD group were significantly less accurate than TD

children in labelling expressions of anger and showed a trend towards reduced accuracy in the identification of happiness. Results indicated no significant difference between groups on the contextual emotion and non-affective tasks, suggesting that children with ASD showed poorer recognition of happy and angry facial expressions as compared with TD children (Wright et al., 2008). It was acknowledged that the use of a mixed sample of AD and autism may explain the lack of significant differences across all measures and it was recommended that future research investigate these diagnostic groups separately.

Similar results were reported by Bal and colleagues who compared 17 children with an ASD (autism or PDD-NOS) and 36 TD children, all aged 7-17 years and matched for verbal and non-verbal IQ. ASD diagnosis was confirmed according to ADOS (Lord et al., 2000) criteria (Bal et al., 2010). Children viewed short videos of faces transitioning from a neutral expression to one of the six basic emotional expressions, and were required to identify the emotional expression by selecting the appropriate emotional label. Children in the ASD group were slower in identifying all emotional expressions compared with the TD children, but only made significantly more errors than the TD children for the recognition of anger. These results support those of Wright et al. (2008) who also found a specific deficit in the recognition of anger for children with ASD compared with TD children.

Further research has compared the recognition of both basic and complex emotions, suggesting that difficulties in emotion recognition for children with high-functioning ASD may be specific to the recognition of complex but not basic emotions. Heerey and colleagues investigated emotion recognition ability of 25 children with ASD (HFA *n* = 10, Asperger's Disorder *n* = 15) and 21 TD children, aged 8-15 years and

matched for age, sex, VIQ and FSIQ. ASD diagnosis was confirmed according to ADI-R (Lord et al., 1994) criteria and all participants had VIQ, PIQ and FSIQ above 80 (Heerey, et al., 2003). Children matched emotional expressions with emotional labels, for non-self conscious/basic emotions (anger, contempt, disgust, fear, surprise, sadness and happiness) and self-conscious/complex emotions (embarrassment and shame). Participants also completed a TOM task using vignettes to assess understanding of white lies, jokes, pretence and indirect persuasion. Children in the ASD group had significantly more difficulty labelling complex emotions compared with TD children, but there was no difference between the groups in labelling basic emotions. When analyses controlled for TOM ability, the group difference in complex emotion recognition ability disappeared. It was concluded that individuals with autism may have difficulty with self-conscious (complex) emotions and that this difficulty may be related to underlying deficits in TOM (Heerey et al., 2003).

Golan and colleagues investigated recognition of complex emotions for 23 children aged 8-11 years with a DSM-IV or ICD-10 diagnosis of an ASD (autism or AD) compared to 24 TD children aged 8-12 years, individually matched for sex and IQ (Golan, Baron-Cohen, & Golan, 2008). All participants had VIQ and PIQ scores above 75. Participants watched short scenes from films depicting interactions between characters expressing complex emotions (e.g., guilt, loneliness). Children were required to select an emotional label to describe how the character in the film was feeling. Children in the ASD group were less accurate than the TD children in identifying all emotions. It was suggested that the film task was an ecologically valid task for assessing recognition of complex emotions, and that these findings indicated

that high-functioning children with ASDs may have difficulty recognising complex emotions in everyday life as compared with TD children (Golan et al., 2008).

Da Fonseca and colleagues recently investigated recognition of situation-based emotions for 19 children aged 7-18 years with DSM-IV (APA, 2000) diagnosed ASD (autism or Asperger's Disorder) and FSIQ above 75, compared to 19 TD children aged 7-18 years individually matched for gender and chronological age (Da Fonseca et al., 2009). Participants in the ASD group met ADI-R (Lord et al., 1994) criteria for ASD. Children were required to match emotional faces (fear, sadness, anger or happiness) with social situations and to match non-affective objects with non-affective contexts. Children in the ASD group were less accurate than TD children in matching emotional faces with social situations but not in matching objects with contexts. It was concluded that children in the ASD group may have failed to decode emotional information efficiently from multiple contextual cues (Da Fonseca et al., 2009). However one issue with this study's methodology was its failure to specifically match the ASD group and control group on IQ. As a result it is unknown whether the better performance of the TD group was due to better emotion recognition skills or higher IQ scores.

The studies previously discussed here included mixed groups of children with autism and Asperger's Disorder or PDD-NOS, making it difficult to draw direct conclusions about the nature of emotion recognition skills of children with autism. Two studies have investigated emotion recognition skills in older children with an exclusive diagnosis of Autistic Disorder. All have reported no specific emotion recognition deficit in children with HFA compared with control children. For example, Buitelaar and colleagues compared emotion recognition ability of 80 children aged 8-18 years across

four groups: 20 children with HFA, 20 children with PDD-NOS, 20 children with other psychiatric disorders (ADHD *n* = 9, Conduct Disorder *n* = 4 and Dysthymia *n* = 7) and 20 TD children, all matched for chronological age and VIQ (Buitelaar, Van Der Wees, Swaab-Barneveld, & Van Der Gaag, 1999a). All children had a FSIQ above 65 and met ASD cut-offs on the CARS (Schopler et al., 2002). Participants were required to match photographs of faces depicting basic emotions (happiness, sadness, anger and fear) and complex emotions (surprise, shame, disgust and contempt), and to match the same emotional faces with social situations. Children with autism had more difficulty across all emotion tasks compared to those in the TD control group, but no significant differences were found between the three clinical groups (autism, PDD-NOS and psychiatric controls) in their emotion recognition ability. It was suggested that these results contradict the notion that emotion recognition deficits are specific to autism (Buitelaar et al., 1999a).

Rump and colleagues investigated the emotion recognition ability of children with HFA in comparison to chronological age and IQ matched TD children (Rump et al., 2009). Analyses compared emotion recognition ability of 26 children aged 8-12 years with HFA to 23 typically developing children aged 8-12 years, matched for age, FSIQ, VIQ and PIQ (experiment 2). Children in the HFA group met ADOS (Lord et al., 2000) criteria for autism. Participants were assessed on their ability to label dynamic facial expressions for the six basic emotions from video stimuli. No significant difference was found between the children with HFA and the TD children in their ability to label the six basic expressions of emotion (Rump et al., 2009).

These findings of no significant difference in emotion recognition ability between children with autism and TD children or children with clinical diagnoses may be due to the use of measures of basic expressions of emotion as opposed to complex expressions. As previously discussed, children with high-functioning ASDs have difficulty with complex or situation-based emotions but not necessarily with basic emotion recognition ability (Heerey et al., 2003). Thus variations in the emotion recognition measures used across studies may account for differences in results.

Other research has found no specific impairment in emotion recognition ability for mixed groups of children with ASD compared with controls. For example, Castelli (2005) compared emotion recognition ability of 20 children with ASD (autism or Asperger's Disorder) and 20 TD children matched for VMA of 6-14 years. Children were required to match and name pictures of the six basic emotional expressions. There were no significant group differences in ability to match and name basic emotional expressions, and children with autism were found to make the same types of emotion recognition errors as TD children (Castelli, 2005).

Further research has compared emotion recognition ability of 29 children aged 9-17 years with ASD (autism $n = 11$, Asperger's Disorder $n = 15$ and PDD-NOS $n = 3$) to 31 TD children aged 8-17 years (Tracy, Robins, Schriber, & Solomon, 2011). ASD diagnosis was confirmed according to ADOS (Lord et al., 2000) criteria and all participants had a FSIQ over 70. Children were assessed on their ability to recognise the six basic expressions of emotion as well as socially complex emotions (contempt and pride). During the task participants were shown pictures of facial expressions and responded with yes or no as to whether the expression was an example of the target

emotions (e.g., 'is this happiness?'). Children were required to respond within a short time frame. There was no significant difference between the groups in their recognition of all emotions including the socially complex emotions, and no difference in their mean response times. These results contradict previously reported findings of reduced accuracy and response times in the recognition of complex emotions for older children with ASD compared with TD children. However, it could be argued that the outcome measure used here (use of yes/no responses to emotions) was easier than previous measures that required labelling or matching of multiple pictures.

Summary of Research

The majority of research suggests that children with high-functioning ASDs have difficulties in emotion recognition ability, although results vary regarding the exact nature of this deficit. There is a noticeable absence of research investigating the emotion recognition ability of young children with HFA. Of the two studies in this area, one found a general difficulty in emotion recognition ability for young children with high-functioning ASD (Golan et al., 2010), whilst the other found specific difficulties in the recognition of anger and fear for young children with HFA (Rump et al., 2009). Both studies compared children with ASD to VMA-matched TD children. Some similar findings were reported for older children with high-functioning ASD, suggesting a specific difficulty in the recognition of anger (Bal et al., 2010; Wright et al., 2008). However, the majority of research with older children with high functioning ASD has reported specific emotion recognition difficulties for complex emotions (Back et al., 2007; Da Fonseca et al., 2009; Golan et al., 2008; Heerey et al., 2003) but not basic emotions (Castelli, 2005; Heerey et al., 2003; Rump et al., 2009).

There remains a few studies finding no differences in complex emotion recognition ability between older children with high-functioning ASD and; typically developing children (Tracy et al., 2011), children with PDD-NOS and other psychiatric disorders (Buitelaar et al., 1999a), and children with learning disabilities (Williams & Happe, 2010). There are a number of differences between these studies in relation to participant demographics, research design characteristics and outcome measures, which may explain these different findings.

1.3.3 Influences on Emotion Recognition Performance and Research Findings

The following is a review of demographic variables and study design characteristics which appear to influence emotion recognition performance of children with autism. Variations in these factors may help to explain differences in emotion recognition findings across studies.

Age

As previously discussed, age plays a key role in the development of emotion recognition skills in TD children, and as age increases emotion recognition ability also increases (Herba & Phillips, 2004). However the effect of age on the emotion recognition ability of children with autism remains unclear. Some research suggests that, unlike TD children, children with ASD do not show improvements in emotion recognition ability with age. For example, Gepner and colleagues reported that emotion recognition performance was positively correlated with age in the TD control group but not in the autism group (Gepner et al., 2001). Another study also found no differences between groups of children, adolescents and adults with HFA in their ability to identify basic expressions of emotion from videos, suggesting that emotion

recognition skills of individuals with HFA do not appear to improve with age (Rump et al., 2009).

Further research has found group differences in emotion recognition ability for older children with ASD but not for younger children with ASD. For example, Kuusikko and colleagues found no significant difference in emotion recognition ability between high functioning children with ASD and TD children for those children aged under 12 years, but did find a group difference for children aged over 12 years (Kuusikko et al., 2009). A similar finding was reported by Gepner and colleagues (2001). When the sample of children with autism was divided into the six youngest and six oldest children, there was no significant difference between the youngest children with autism and TD control children, but older children with autism were found to be less accurate than age-matched TD children in their emotion recognition ability (Gepner et al., 2001).

Collectively these results suggest that differences in emotion recognition ability between children with autism and TD children may be less pronounced for young children and more apparent in the comparison of older children. It appears that the emotion recognition ability of children with autism may not improve with age at the rate seen in TD individuals, with some research reporting no difference between children, adolescents and adults with HFA in their emotion recognition skills. Thus emotion recognition difficulties may be more apparent in research comparing older children with autism to age-matched TD children, and may explain some of the different findings reported across the emotion recognition literature.

ASD Diagnosis

As previously discussed, research directly comparing the emotion recognition ability of individuals with HFA and AD has shown children with HFA to be less accurate than children with AD in the recognition of basic expressions of emotion, above and beyond the influence of IQ (Mazefsky & Oswald, 2007). The majority of research into emotion recognition in autism has used mixed groups of children with autism and AD or PDD-NOS making it difficult to compare findings across studies and draw direct conclusions about the emotion recognition ability of children with autism. More research is needed with specific groups of children with autism.

Direct comparison of findings across studies is also made difficult by the use of different diagnostic materials and criteria for ASD. Most studies report using clinical diagnosis based on the DSM-IV (APA, 2000) classifications for Pervasive Developmental Disorder. Recent research into emotion recognition in autism has adopted the use of the ADOS (Lord et al., 2000) and ADI-R (Lord et al., 1994) so as to provide additional ASD diagnostic information, making it easier to compare results across studies. Unfortunately not all of the studies reviewed here reported their diagnostic criteria for ASD, and not all have used DSM classifications or ADOS/ADI-R criteria. This makes it difficult to directly compare results across some studies, especially earlier research into the emotion recognition ability of children with autism.

Emotion recognition measures

The emotion recognition literature includes large variations in outcome measures, including whether emotions are examples of basic or complex facial expressions, whether facial expressions are static or dynamic, whether images are of whole faces or

specific parts of faces (e.g., the eye region only), whether images are drawings, photographs or video stimuli, whether images are presented on paper or on computers, and whether the child is required to respond to the stimuli non-verbally (e.g., by matching or pointing) or verbally (e.g., labelling).

It has been suggested that some emotion recognition tasks may be easier than others. For example, matching tasks are thought to be easier because they allow the child to use perceptual cues (such as matching faces with high eye-brows or open mouths) rather than understanding the emotions displayed (Ozonoff et al., 1990). In turn, contextual emotion tasks may be considered to be more difficult because the child is required to understand the meaning of the emotion displayed, including contextual information. Dynamic emotional expressions, such as those displayed in video clips, may be more difficult because they are usually subtle and briefly presented (similar to real-life social situations) as compared with static photos of emotional expressions which are often more exaggerated and allow the child to view the expression for longer. Thus it is difficult to directly compare results across studies due to the large variations in the characteristics of the outcomes measures used.

1.3.4 Summary of Emotion Recognition Skills of Children Autism

There is a noticeable absence of research into the emotion recognition ability of young children with autism and comorbid ID, which is likely due to difficulties in designing tasks to suit the requirements of children at this low developmental level. The majority of research with older children with autism and comorbid ID suggests that they have some difficulty matching and labelling basic facial expressions of emotion, for both human and non-human faces, across static and dynamic conditions. These difficulties

persist when they are compared to TD children matched for verbal and non-verbal IQ, children with non-autistic ID, children with learning disabilities, and children with other clinical disorders matched for mental age, VIQ or PIQ. For children with high-functioning ASD the results vary due to large differences between the studies in relation to participant age, ASD diagnosis and the nature of the outcome measures used. In general, research with children with high-functioning ASD suggests that they have some emotion recognition difficulty relative to TD children matched for chronological age and cognitive ability, and that this difficulty may be specific to the recognition of complex (rather than basic) emotional expressions.

1.4 The Neurobiology of Emotion Recognition in Autism

Emotion recognition requires a complex neurological process; humans need to become experts at distinguishing between many different expressions of emotion that are visually similar but yet socially highly distinctive (Adolphs, 1999). Several specific neurological structures have been linked with emotion processing skills including the amygdala, the fusiform face area (FFA) and the ventromedial prefrontal cortex, with research suggesting that these areas may function abnormally in individuals with autism.

1.4.1 The Amygdala Theory of Autism

The amygdala is a set of closely connected nuclei at the base of the temporal lobes and the amygdala is thought to play an important role in processing the social information that is received from faces (Dziobek, Bahnermann, Convit, & Heekeren, 2010). For typically developing (TD) individuals the amygdala has been implicated in early emotion perception as well as in the detection of, and learning about, emotionally

relevant and socially salient stimuli (South et al., 2008). In some research with TD individuals the amygdala has been found to be involved in the recognition of specific emotions related to danger and threat, including the recognition of fear (Adolphs, 1999). It is suggested that the amygdala reacts quickly to emotional stimuli and determines its salience, whilst the advanced processing of emotional expressions occurs in other brain regions including, but not limited to, cortical areas like the superior temporal sulcus (STS) (Schultz, 2005).

Research suggests that individuals with autism have structural and functional abnormalities of the amygdala, but results vary regarding whether the amygdala is increased or decreased in volume relative to TD individuals, and whether the amygdala is hypo- or hyperactive during emotion processing (South et al., 2008). With regards to amygdala volume, research suggests that amygdala volumes appear to be enlarged in children but not in adolescents with ASD, relative to TD individuals (Schumann et al., 2004). It has further been found that reduced amygdala volumes may be related to reduced emotion processing speed and more significant levels of impairment in social reciprocity for individuals with ASD (Nacewicz et al., 2006). Nacewicz and colleagues measured the amygdala volumes of 12 individuals aged 8-25 years with high-functioning ASD and 12 age-matched TD individuals during processing of basic emotional expressions. Results indicated that for individuals with ASD a smaller amygdala volume was predictive of slower processing of emotional expressions and greater gaze avoidance (Nacewicz et al., 2006).

With regards to research into amygdala activation, the majority of research suggests that the amygdala is less active during facial emotion recognition tasks for individuals with ASD compared to TD individuals (South et al., 2008). In one study

researchers compared functional Magnetic Resonance Imaging (fMRI) amygdala activity during a facial affect matching and labelling task for 12 male participants aged 8-23 years with high-functioning ASD and 12 TD individuals aged 8-16 years matched for VMA (Wang, Dapretto, Hariri, Sigman, & Bookheimer, 2004). TD participants showed increased amygdala activation for the emotion labelling but not the emotion matching task, whilst participants in the ASD group showed no increased amygdala activation on either task relative to controls.

Baron-Cohen and colleagues compared fMRI amygdala activity during a complex emotion identification task for six adults with HFA of mean age 26.3 years and for 12 TD adults matched for age and IQ (Baron-Cohen et al., 1999). During the emotion task participants were required to identify mental states from pictures of the eye-region of faces. There was reduced amygdala activation during the identification of complex emotions for individuals with HFA compared with TD adults.

However, it has been suggested that reduced amygdala activation during emotion recognition tasks may be mediated by reduced attention to facial stimuli during these tasks. For example, Dalton and colleagues investigated the association between gaze fixation and amygdala activation for adolescents with autism (Dalton et al., 2005). Magnetic Resonance Imaging (MRI) amygdala activation and patterns of gaze fixation were recorded during a facial emotion recognition task for 14 adolescent males with ASD of mean age 15.9 years and for 12 TD adolescent males matched for age and IQ. The adolescents with ASD showed reduced gaze fixation during emotion recognition tasks, and this was associated with reduced amygdala activation. It was concluded that gaze fixation, or attention to facial emotions, may mediate amygdala

activation during emotion recognition studies with individuals with autism (Dalton et al., 2005).

Similar results have been reported in a study by Monk and colleagues, which controlled for attention to faces during emotion recognition tasks (Monk et al., 2010). Researchers examined fMRI amygdala activity during an attention cueing task designed to control for the influence of attention on emotion processing. Participants were 12 adults aged 18-40 years with high-functioning ASD and 12 TD adults matched for age and IQ (Monk et al., 2010). When analyses controlled for attention to faces, the ASD group showed *greater* amygdala activation during emotion recognition tasks than TD adults. These results support Dalton et al. (2005), suggesting that results for amygdala hypoactivation for individuals with autism may be a function of reduced attention to faces during emotion recognition tasks.

In summary, it has been suggested that emotion recognition difficulties in autism may be related to abnormalities in amygdala volume and/or activation. However research differs regarding whether the amygdala is increased or decreased relative to TD individuals, and whether it is hypoactive or hyperactive, during emotion recognition tasks. It has been suggested that the amygdala may be hypoactive during emotion recognition tasks for individuals with autism compared with TD individuals, and that this may be related to reduced attention to faces during these tasks.

1.4.2 The Fusiform Face Area and Emotion Recognition in Autism

The amygdala in just one component of a larger neural system involved in the perception of emotions (Adolphs, 1999). Other neurological regions thought to be involved in emotion perception include the Fusiform Face Area (FFA). The fusiform

gyrus consists of a patch of cortex known as the FFA which is linked with the amygdala (South et al., 2008). The FFA is strongly activated during the perception of emotional and non-emotional faces and is distinct from other brain regions involved in the specific perceptual recognition of facial expressions (Schultz, 2005). The FFA is thought to be involved in the extraction of meaning from faces (such as emotion and identity) and activity in the FFA is modulated by the amygdala (Dziobek et al., 2010).

Research has consistently found hypoactivation of the FFA for individuals with ASD during face perception tasks and emotion recognition tasks. For example, Critchley and colleagues compared fMRI FFA activity during a basic emotion recognition task and a gender identification task for nine adults aged 26-47 years with ASD and nine TD adult males matched for age and IQ (Critchley et al., 2000). Adults in the ASD group had lower FFA activity than the TD adults when identifying facial expressions of emotion but not when identifying gender. In a similar study Piggot and colleagues compared fMRI FFA activity during an emotion matching and emotion labelling task for 14 adolescent males aged 9-17 years with high-functioning ASD and 10 TD adolescents matched for age and IQ (Piggot et al., 2004). When compared with the control group, children with ASD showed hypoactivation of the FFA during the facial expression matching but not the labelling task (Piggot et al., 2004). Collectively these results suggest that the FFA may be hypoactive during emotion recognition tasks for individuals with autism compared with TD individuals.

However, it has also been suggested that this hypoactivation of the FFA may be related to reduced attention to facial stimuli during these tasks (Dalton et al., 2005). In line with this theory, Dalton and colleagues compared patterns of MRI FFA brain activation and gaze fixation during a facial emotion recognition task for 14 adolescent

males with ASD of mean age 15.9 years and for 12 TD adolescent males. Compared with TD individuals, adolescents with ASD showed reduced gaze fixation during the emotion recognition task and this was associated with reduced FFA activation (Dalton et al., 2005).

Collectively these results suggest that the FFA may be hypoactive during emotion recognition tasks for individuals with autism compared with TD individuals, and that this may be related to reduced attention to faces during these tasks.

1.4.3 The Amygdala-Fusiform Modulation Theory of Autism

A recent theory has combined findings from the amygdala theory of autism and FFA research to propose an amygdala-fusiform modulation theory of autism whereby emotion processing difficulties in autism are thought to be related to reduced connectivity between the amygdala and FFA regions of the brain (Schultz, 2005). The amygdala is thought to play a key role in communicating information about the emotional salience of objects to other cortical areas, and disruption in this communication may impact on the development of emotion processing skills in other brain regions (Schultz, 2005).

The amygdala-fusiform modulation model of autism posits that the amygdala plays an important role in reinforcing early preferences for faces (Schultz, 2005). The amygdala is thought to influence social attention to faces, and subsequently modulate FFA activation and the degree to which individuals learn about faces and emotional expressions (Curby et al., 2010). It has been suggested that faces may be less emotionally engaging to individuals with autism, due to reduced reinforcement from the amygdala during facial affect processing. In turn, reduced reinforcement from the

amygdala during facial processing may result in reduced attention to facial stimuli and fewer opportunities for individuals with autism to develop face-specific skills (Schultz, 2005).

The amygdala-fusiform modulation model of autism may help to explain the difficulties that individuals with autism have in learning about emotions. However there are also other neurological regions implicated in the emotion recognition difficulties in autism.

1.4.4 The Ventromedial Prefrontal Cortex and Emotion Recognition in Autism

The ventromedial sectors of the prefrontal cortex (PFC), which include the orbitofrontal cortex, are highly involved in the processing of social information (Monk et al., 2010). These areas are thought to be involved in complex social perception processes including linking perceptual representations of stimuli with their social and emotional significance (Adolphs, 1999). TD individuals who acquire damage to the ventromedial PFC appear to lack empathy and concern for the wellbeing of others, and their cognitive processes appear to lack connection with emotional knowledge (Adolphs, 1999). They also appear to have difficulty on affective TOM tasks compared to TD individuals without ventromedial PFC damage, and compared to adults with acquired damage to other brain regions not implicated in social perception (Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006).

Pinkham and colleagues investigated fMRI activation in the ventrolateral prefrontal cortex (VLPFC) during a complex social perception task requiring judgement of the trustworthiness of faces (Pinkham, Hopfinger, Pelphrey, Piven, & Penn, 2008). Participants were 12 male adults aged 18-35 years with high-functioning ASD and 12

TD male adults, matched for age and cognitive ability. When making judgements about the trustworthiness of faces, individuals with ASD showed hypoactivation in the VLPFC (in addition to hypoactivation of the amygdala and FFA) compared with TD individuals. It was concluded that hypoactivation of the VLPFC may be related to the social cognitive impairments seen in autism (Pinkham et al., 2008).

However other research has reported *hyper*activation of the orbitofrontal cortex (part of the ventromedial PFC) in individuals with autism during emotion recognition tasks. Dalton and colleagues measured MRI activity during an emotion recognition task for 14 adolescent males with HFA of mean age 15.9 years and for 12 TD adolescent males matched for age and IQ. Increased activation of the orbitofrontal cortex was found for individuals with ASD compared with TD adolescents. It was suggested that difficulties in emotion recognition in adolescents with autism may be related to hyperactivation of the orbitofrontal cortex (Dalton et al., 2005).

Additionally, it has been suggested that for individuals with autism, the frontal cortex has reduced connectivity with other cortical regions but increased connectivity with itself (Courchesne & Pierce, 2005). This might impair one's ability to integrate information from different brain regions and may explain why cognitive processes in autism appear to lack connection with emotional knowledge (Courchesne & Pierce, 2005).

1.4.5 Summary and Limitations of Neurobiological Findings in Autism

Research indicates that the amygdala may be involved in emotion processing in TD individuals, and atypical functioning of the amygdala may be implicated in the emotion recognition difficulties seen in autism. One neurobiological model of autism, the

amygdala-fusiform modulation theory, hypothesises that abnormal connectivity between the amygdala and FFA may contribute to difficulties in acquiring emotion recognition skills for individuals with autism. However research also suggests that the amygdala is just one of a number of neurological regions that show abnormal functioning in individuals with autism (Baron-Cohen et al., 2000). Other neurological regions implicated in emotion recognition difficulties in autism include the FFA and the ventromedial prefrontal cortex.

Whilst the majority of research with individuals with autism has reported hypoactivity in neural regions related to emotion processing (e.g., the amygdala, the FFA and the ventromedial PFC), there have been some accounts of hyperactivity in these brain regions. However the fact that most neuroimaging studies find a difference between individuals with ASD and TD individuals suggests that group differences do exist (Harms, Martin, & Wallace, 2010), although in some cases the exact nature of these differences remains unclear. In general the consensus is that individuals with ASD have broad-based alterations in neurological processes when engaging in emotion processing (Monk et al., 2010), and that they show atypical patterns of neural activity in brain regions related to social perception (Ashwin, Baron-Cohen, Wheelwright, O'Riordan, & Bullmore, 2007).

1.5 The Relationship between Emotion Recognition and

Social Skills in Autism

Social interaction is defined as the reciprocal process in which individuals initiate and respond to social stimuli presented by their peers (Shores, 1987). As previously discussed, social interaction in autism is of low frequency and poor quality, and is more likely to involve ritualistic behaviours and poor social skills (Bauminger, 2002). Detecting emotions in other people is important in establishing relationships and in developing emotional reciprocity (Bal et al., 2010), and it has been suggested that difficulties in recognising and responding to emotions may underlie the social problems that are core diagnostic features of autism (Baron-Cohen, 1995; Baron-Cohen et al., 2009).

However, there is limited research comparing the association between emotion recognition skills and social skills in individuals with autism. Only three studies have investigated this direct association. Wallace and colleagues investigated the association between facial emotion recognition skills and both the Social Responsiveness Scale (SRS; Constantino and Gruber, 2005) and the ADOS (Lord et al., 2000) social and communication skills for a group of 42 adolescents with high functioning ASD (Wallace et al., 2011). Researchers measured sensitivity in identifying individual expressions of emotion (happiness, sadness, anger, fear, surprise, disgust) and accuracy in identifying all emotions (total score). Analyses controlled for age and IQ, indicating a significant correlation between diminished sensitivity in identifying sad faces and social-communication deficits (as measured by the SRS and the ADOS) and

lower adaptive behaviour skills as measured by the ABAS-II (Adaptive Behavior Assessment System; Harrison and Oakland, 2003).

Further research investigated the relationship between basic emotion recognition accuracy and ADOS (Lord et al., 2000) reciprocal social interaction subscale scores for a group of 11 adult males aged 19-60 years with high-functioning ASD (Boraston, Blakemore, Chilvers, et al., 2007). Participants were assessed on their ability to label basic expressions of emotion (happiness, sadness, anger and fear) from photos of faces and from the movement of animated shapes. Social skills ability was significantly correlated with accuracy in sadness recognition for the shape animation task. No significant correlation was found between ADOS RSI scores and facial emotion recognition accuracy. However analyses were limited by a small sample size and failure to control for the effects of age and IQ.

A final study investigated the relationship between emotion recognition ability and Vineland-II Socialization scores (Sparrow et al., 2005) for a group of 19 adults with ASD and comorbid intellectual disability (ID) (Garcia-Villamisar et al., 2010). Participants were required to label and match photos according to facial expressions (happy, sad or neutral (not happy or sad)), as well as according to age and identity (non-emotional tasks). Regression analyses showed no significant association between increased Vineland-II Socialization domain scores and increased emotion recognition accuracy (total for all emotions), above and beyond the influence of cognitive ability and non-emotional task performance. However the results for each individual emotion (happiness and sadness) were not reported, and analyses did not control for the influence of age on results.

Additional research has investigated the association between other social perception skills and social functioning for individuals with autism. Tager-Flusberg (2003) investigated the relationship between TOM skills and Vineland-II (Sparrow et al., 2005) scores for 69 children aged 4-14 years with autism. Diagnosis of autism was confirmed according to ADI-R (Lord et al., 1994) and ADOS (Lord et al., 2000) criteria. TOM tasks measured understanding of desires, lies and jokes, and first- and second-order false-belief tasks. TOM accuracy was shown to be the best predictor of Vineland-II Socialisation domain scores, above and beyond the influence of IQ and language ability. It was concluded that TOM appears to be significantly related to social skills in children with autism (Tager-Flusberg, 2003).

An eye-tracking paradigm was also used to investigate the association between visual fixation patterns during social videos and social functioning (Klin et al., 2002). Scores for 15 male adolescents with HFA were compared to 15 age and IQ matched TD adolescents. For the adolescents with autism, a decreased fixation time on the mouth region and an increased fixation time on objects (rather than faces) was significantly associated with poorer scores on the Vineland-II (Sparrow et al., 2005) socialization domain compared with TD adolescents. These results suggest that, during social interactions, individuals with ASD may spend less time than TD individuals looking at faces, and that this may contribute to poorer social skills for individuals with ASD.

In summary, these findings suggest an association between reduced social perception ability (emotion recognition and TOM skills) and poorer social skills for individuals with autism. Some research has reported a specific relationship between reduced sadness recognition and reduced social skills for adolescents and adults with

ASD but no research has investigated this association for children with autism. Future research would benefit from investigating the relationship between emotion recognition skills and social skills for young children with autism.

1.6 Conclusions

Autism is characterised by impairments in social skills and these deficits in reciprocal social interaction are a core feature of autism. A review of the literature suggests that children with autism, both high-functioning and those with comorbid ID or developmental delay, have difficulties in emotion recognition. These difficulties appear to be related to atypical neurological processes (e.g., hypoactiviation of the amygdala and the FFA), and may contribute to reduced social skills functioning. However it remains unclear whether emotion recognition difficulties are primary or secondary to the core social difficulties of autism (Harms et al., 2010). Specifically, do difficulties in recognising and understanding facial expressions of emotion lead to impairments in social interaction skills, or does reduced interest in social interaction result in reduced opportunity for learning about emotions? It has been suggested that early neurological abnormalities of the amygdala may cause children with autism to orient less to social stimuli (such as faces), thus impacting the development of emotion recognition skills in children with autism (Schultz, 2005).

Whilst there is still some uncertainty about the specific neurobiological processes underlying emotion recognition difficulties in autism, there is a general consensus that intervention programmes have the potential to target these emotion recognition difficulties. The following chapter reviews research studies that have evaluated the use of emotion training programmes with children with ASD.

CHAPTER 2. | **Emotion Training Programmes for Children with Autism**

2.1 Introduction

A number of interventions have been designed to help teach emotion recognition skills to children with autism. Recently, computer technology has become a popular medium for delivery of these interventions because multimedia programmes are well-liked by children with autism, are generally cost-effective, are readily available for use at home or school, and allow the child to control the learning at their own pace. Specifically, it is thought that computer programmes are favoured by children with autism because they provide a predictable, rule-based environment free from social demands (Golan, Baron-Cohen & Golan 2008).

Whilst computer and DVD programmes offer many advantages in engaging children with autism to learn about emotions, it is unknown whether the emotion recognition skills taught generalise to real-world social interactions. Many emotion-training intervention studies have reported improvements in *familiar-close* generalisation (improvements on stimuli presented during training) and in *unfamiliar-close* generalisation (improvements on stimuli similar to that presented during training), but difficulties in *feature-based* generalisation (limited improvements on stimuli measuring the same constructs but using different materials). It has been suggested that this is due to participants making an association between the correct response and irrelevant features of the stimuli used in training, as opposed to specifically learning about the emotions (Ryan & Charragain, 2010). It is therefore important for evaluation studies to include materials measuring feature-based generalisation, so as to determine whether improvements in emotion recognition skills generalise to other measures of emotion recognition.

As previously discussed, emotion recognition skills are thought to be a key component in the development of more complex social perception skills including mentalising ability and Theory of Mind (Ashwin et al., 2006). It is therefore important for emotion training studies to incorporate measures of *distant generalisation* to determine whether improvements in emotion recognition skills generalise to improvements in other areas of social perception distantly related to emotion recognition skills. It is also important for research to include measures of social skills, to assess the functional impact of any improvements in emotion recognition skills on broader social skills.

The following is a review of studies evaluating emotion training programmes designed to teach basic and complex emotion recognition skills to children with autism. This review is divided into programmes evaluated with young children with ASD (mean age under seven years) and programmes evaluated with older children with ASD (mean age seven to twelve years). This review includes both computer/DVD and non-computer-based interventions, with a focus on whether the emotion recognition skills taught during the intervention showed *feature-based generalisation* to other measures of emotion recognition, *distant generalisation* to other measures of social perception (e.g. TOM), whether improvements corresponded with improvements in social skills functioning and whether improvements were maintained over time. Tables 1 to 4 provide a summary of each intervention and the participant characteristics, as well as the results for each study.

2.2 Interventions Evaluated with Young Children with Autism

(mean age less than seven years)

Early intervention is important because it has the potential to impact long term outcomes for children with autism. It has been suggested that this is due to the high level of brain plasticity present in early childhood (Dawson & Zanolli, 2003). Interventions designed for young children with autism also have the potential to be used with older children with autism who have a comorbid intellectual disability (ID).

Only two emotion training programmes have been evaluated for use with young children with autism (Changing Media Development 2006; McHugh, Bobarnac, & Reed, 2010). A summary of these evaluation studies is presented in Tables 1 and 2. The *Transporters* DVD programme (Changing Media Development, 2006), which is an animated and narrated children's television series developed by the Autism Research Centre at Cambridge University. The *Transporters* programme features vehicles with human faces and is designed to engage children with autism in learning about emotions. The programme was designed to provide training in emotion recognition skills to children with Autism Spectrum Disorders (ASD) aged between three and eight years of age (Golan et al., 2010). It consists of 15 five minute episodes portraying 15 key emotions, including the six basic emotions (happy, sad, angry, afraid, disgusted and surprised) and nine more complex emotions and mental states (excited, tired, unfriendly, kind, sorry, proud, jealous, joking and ashamed). The *Transporters* programme includes interactive quizzes to reinforce learning.

Two studies to date have evaluated the efficacy of the *Transporters* programme for children with ASD. Golan et al. (2010) evaluated the use of the *Transporters* DVD

for a group of high-functioning children aged 4 to 7 years diagnosed with an ASD (AD and autism). Twenty children with an ASD were compared with two control groups matched for age, sex and verbal ability; a group of 18 children with an ASD and a group of 18 TD children. Participants in the intervention group watched the *Transporters* DVD at home for 15 minutes a day over four weeks, whilst those in the two control groups did not. All children were assessed before and after the intervention on their ability to match familiar situations and facial expressions taught in the *Transporters* DVD (familiar-close generalisation), to match novel situations and expressions similar to those taught in the *Transporters* DVD (unfamiliar-close generalisation), and to match novel situations and expressions from a different emotion training programme (feature-based generalisation). Participants in the intervention group improved significantly on all outcome measures compared to children in both control groups. However distant generalisation and social skills were not assessed, and children were not followed up in order to determine whether skills were maintained over time.

Young and Posselt (2012) evaluated the efficacy of the *Transporters* programme in comparison to a control DVD for a group of high-functioning children with ASD. Participants had a DSM-IV (APA, 2000) diagnosis of a Pervasive Developmental Disorder (PDD) and were aged 4 to 8 years. Children in the intervention group (*n*=13) watched the *Transporters* DVD at home for 15 minutes a day over three weeks, whilst children in the control group (*n*=12) watched episodes of *Thomas the Tank Engine* (specifically chosen for its focus on emotions) for 15 minutes a day over three weeks. All participants were assessed before and after the intervention on feature-based generalisation; their ability to recognise emotional expressions from pictures of basic and complex facial expressions, and from the

NEPSY-II Affect Recognition Task (Korkman, Kirk, & Kemp, 2007a). Children in the intervention group improved significantly on both measures of emotion recognition. Both groups also improved on parent reports of social peer interest and eye contact (as measured by the Social Communication Questionnaire; SCQ Rutter, Bailey, & Lord, 2003). However there was no measure of distant generalisation to determine whether improvements in emotion recognition skills generalised to improvements in other social perception skills. There was also no follow-up assessment to look at maintenance of skills over time.

The results of these two evaluation studies suggest that the *Transporters* programme has the potential to provide effective training in emotion recognition skills to young children with autism. However the evaluation of this intervention has been limited to high-functioning children with ASD. There has been no research evaluating the efficacy of the *Transporters* programme for use with young children with a specific diagnosis of Autistic Disorder including those with a lower range of cognitive ability including ID. This is important due to the high rate of comorbid ID/developmental delay in autism (Critchley et al., 2000). Additionally, research is needed to determine whether improvements in emotion recognition skills show distant generalisation to improvements in other social perception skills including TOM, and whether skills are maintained over time.

A second intervention programme designed for young children with autism used video stories of puppets to teach emotions (McHugh et al., 2010). In the evaluation study McHugh and colleagues investigated the efficacy of this puppet video programme for three male children with ASD. During the intervention participants watched video stories of puppets displaying basic expressions of emotion in different

contexts and an instructor helped to teach the correct emotion for each story. Training occurred at home for 10 sessions a day, six days a week, until participants reached 80% accuracy in identifying the emotions. Following the intervention phase children had significantly higher levels of accuracy in labelling happy, sad, angry and scared emotional expressions from novel cartoon scenarios (feature-based generalisation) and skills were shown to be maintained 15 days following completion of the intervention. However no measures of distant-generalisation or social skills were used. The absence of a control group also makes it difficult to draw specific conclusions about the efficacy of this intervention. More research is needed to evaluate this intervention for a larger sample of children compared with a control group of children with ASD, and to determine whether improvements in emotion recognition skills correspond with improvements in other social perception skills and social functioning outcomes.

Compared to the *Transporters* programme, McHugh and colleague's (2010) puppet-based video programme is less practical for every-day use by families, as it involves intense individual training by an instructor (ten times a day) six days a week. It is possible for parents to be trained in the role as the instructor but daily administration of this intervention may be seen to be intensive for parents. In comparison, the *Transporters* DVD programme requires much less parental/instructor involvement. Future research could compare these two interventions to determine whether frequent daily instruction has benefits over self-directed learning from a DVD.

2.3 Interventions Evaluated with Older Children with Autism

(mean age seven to twelve years)

Six studies have evaluated the efficacy of emotion training programmes for use with older children with ASD. A summary of these evaluation studies is provided in Tables 3 and 4. Of these six evaluation studies, four have evaluated the efficacy of *Mind Reading: The Interactive Guide to Emotions* (Baron-Cohen et al., 2004). *Mind Reading* is a computerised training programme designed to teach basic and complex emotions and mental states to individuals with autism aged from four years to adulthood. The *Mind Reading* programme provides training in 412 emotions and mental states at six developmental levels, with all examples of emotions provided by actors of different ages and ethnicities. *Mind Reading* consists of an emotions library with a catalogue of emotions for viewing, a learning centre where participants can engage in lessons and quizzes at a variety of levels, and a games zone with interactive tasks including identification and matching of emotions. For each group of emotions there are (a) six silent films of faces displaying the emotion (b) six voice recordings of the emotion being expressed in the appropriate tone and (c) six written examples of situations that may produce the emotion.

The first study to evaluate the use of *Mind Reading* with children evaluated its use with a group of eight children with Asperger's Disorder aged 8 to 11 years (LaCava, Golan, Baron-Cohen, & Myles, 2007). Children used the *Mind Reading* computer programme at home for 10 weeks at their own pace of learning. Analyses indicated a significant post-intervention improvement in the recognition of basic and complex emotional expressions from stimuli different to that used in the *Mind Reading*

programme (feature-based generalisation). However there was no control group, making it difficult to draw direct conclusions about the efficacy of the intervention. There was also no assessment of distant generalisation, maintenance of skills, or impact on social skills.

To extend upon this work LaCava and colleagues evaluated the use of the *Mind Reading* programme with four males with high-functioning ASD aged 7 to 11 years (LaCava, Rankin, Mahlios, Cook, & Simpson, 2010). Participants completed instructed training over 7 to 10 weeks under the supervision of a tutor. Significant improvements in the recognition of basic and complex emotions from the *Mind Reading* programme (familiar-close generalisation) and in the recognition of novel pictures of facial affect and contextual cartoons (feature-based generalisation) were demonstrated post treatment. Analyses also revealed a significant improvement in the number of positive social interactions that the child engaged in (as observed by the clinician). However there was no control group and no measure of distant generalisation or maintenance of skills over time.

A similar study evaluated the *Mind Reading* programme for use with a group of eight male children with high-functioning ASD aged 7 to 12 years (Thomeer et al., 2011). Children used the computer programme for twelve supervised sessions over six weeks under the guidance of a tutor. To reinforce learning the instructor also engaged in in-vivo rehearsal exercises of emotion recognition with the child. During rehearsal the instructor displayed an emotional expression which the child was required to identify. Parents rated their child's ability to identify and display 27 basic and complex expressions of emotion before and after the intervention, and the child's social skills using the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). Significant

improvements were reported by parents in their rating of children's emotion recognition skills, emotional displays, and SRS scores. However there was no control group for comparison. Also researchers did not include an objective measure of emotion recognition, did not use a measure of distant generalisation and did not evaluate whether skills were maintained over time. Whilst this study evaluated social skills following the intervention this was subjective (parent-rated questionnaire).

A fourth study evaluated the efficacy of the *Mind Reading* programme for a group of six children with ASD aged 7 to 11 years compared to a group of eleven TD children aged 7 to 12 years who received no *Mind Reading* training (Weigner & Depue, 2011). Participants in the intervention group completed five supervised *Mind Reading* training sessions over three weeks with a tutor. All children were measured pre- and post-intervention on their ability to identify ten complex emotional expressions taught in the *Mind-Reading* programme (familiar-close generalisation). Children in the intervention group showed significant improvements in their ability to identify these emotional expressions whilst the TD control children did not. However the study did not include measures of unfamiliar-close-generalisation, feature-based generalisation or distant-generalisation, making it difficult to determine whether the emotion recognition skills learnt generalised beyond the specific material used in training. Further, there was no measure of social skills or evaluation of whether improvements were maintained over time.

Collectively these results suggest that the *Mind Reading* programme has potential to provide emotion recognition training to high-functioning children with ASD. However more research is needed to evaluate its efficacy through the use of randomised controlled trials. Outcome measures need to include a variety of close-

generalisation and feature-based generalisation tasks to determine whether the skills learnt extend to materials not used during training. Research would also benefit from the addition of distant-generalisation tasks to determine whether improvements in emotion recognition skills correspond with improvements in other social perception skills including TOM. Future research should also include follow-up assessments to determine whether any improvements are maintained over time.

Further research is needed to evaluate the efficacy of the *Mind Reading* intervention for use with young children with ASD, including those with a specific diagnosis of Autistic Disorder and those with comorbid ID. Although level 1 of *Mind Reading* is designed for children with a mental age of 4 to 7 years, to date no research has evaluated *Mind Reading* with children with autism functioning at this developmental level.

Two studies have evaluated other emotion recognition training programmes for older children with autism. One study investigated the use of *Teaching Children with Autism to Mind-Read* (Howlin et al., 1999) for a group of thirty children with autism aged 4 to 13 years (Hadwin, Baron-Cohen, Howlin, & Hill, 1996). Ten participants in the intervention group received individual training in the recognition of basic emotions and mental-states from pictures of faces, cartoons of faces, and cartoons of contextual situations including desire-based and belief-based situations. Participants in the two control groups received training in perspective taking or were assessed on their play skills. Compared with children in the two control groups, children in the intervention group showed significant improvements in their ability to identify basic expressions of emotion from novel pictures and cartoons (unfamiliar-close generalisation). However these emotion recognition skills did not generalise to

perspective-taking skills (distant generalisation). Children in the intervention group maintained these improvements in emotion recognition skills at follow-up two months later.

Another intervention programme designed for older children with autism provided training in the recognition of the six basic expressions of emotion through teaching about the individual components of each emotion (e.g., the shape of the mouth and features of the eye region), with learning reinforced through role-play, drawing, games and homework tasks (Ryan & Charragain, 2010). This intervention was evaluated for a group of children (n=20) aged 6 to 14 years with autism. Outcomes were compared with a waitlist control group (n=10). Children in the intervention group showed greater accuracy in labelling novel photographs of the six basic emotional expressions (feature-based generalisation). These improvements were maintained three months later. However there were no measures of distant generalisation or social skills.

2.4 Conclusions and Future Directions

Research indicates that emotion training programmes show some efficacy in teaching emotion recognition skills to children with autism, for both computer/DVD and non-computer-based interventions. However the extent to which improvements in emotion recognition skills generalise to improvements on other emotion tasks, to improvements in other areas of social perception and to improvements in broader social skills remains unclear. Few studies have evaluated whether improvements are maintained over time. More randomised-controlled trials are needed to evaluate the

efficacy of these interventions, including their use with young children with Autistic Disorder, including those with comorbid ID.

Research suggests that the *Transporters* programme has the potential to provide effective training in emotion recognition skills to young children with autism (Golan et al., 2010; Young & Posselt, 2012). However its evaluation has been limited to high-functioning children with ASD. More research is needed to evaluate the efficacy of the *Transporters* programme for use with young children with a specific diagnosis of Autistic Disorder including those with a lower range of cognitive ability including ID. It would also be beneficial to determine whether any improvements in emotion recognition skills generalise to improvements in other areas of social perception and whether skills are maintained over time.

Table 1.

Summary of Intervention and Participant Characteristics for Intervention Studies with Young Children with Autism (mean age under seven years)

Intervention	Evaluation Study	Diagnostic Group	Diagnostic Instrument	Participant Demographics	Cognitive Ability	Intervention	Delivery Mode	Comparison Condition	Emotions Taught
Teaching Situation-Based Emotions to Children with ASD	McHugh et.al. 2010	ASD	DSM-IV diagnostic criteria	N = 3 male age m = 5.4 yrs	Not reported	Video stories with puppets. Participants taught correct emotions for each story. Ten training sessions a day.	At home with instructor and videos	No control group	Happy, sad, angry and scared in contexts.
The Transporters	Golan et.al. 2010	T = ASD C1 = ASD C2 = TD	ADI-R and CAST	T n = 20, 15 male T age m = 5.6 yrs C1 n = 18, 13 male C1 age m =6.2 yrs C2 n = 18, 12 male C2 age m = 5.4 yrs	VIQ (BPVS) T m = 98.3 C1 m = 99.4 C2 m = 103.3	*Transporters*: DVD watched for 15 minutes a day over four weeks and DVD quizzes completed.	At home with DVD	C1 and C2: No Transporters intervention	15 emotions and mental states in context
The Transporters	Young & Posselt (2012)	T = PDD C = PDD	DSM-IV diagnostic criteria and SCQ	T n = 13 T age 4-8 yrs C n = 12 C age 4-8 yrs	WPPSI /WISC Block design subtest (VIQ) T = 11.31 C = 8.67	*Transporters:* 3 DVD episodes per day over 3 weeks and DVD quizzes completed.	At home with DVD	C1: *Thomas the Tank Engine* DVD. 3 episodes per day over 3 weeks and quizzes.	15 emotions and mental states (as described previously)

ASD = Autism Spectrum Disorder;   ADI-R = Autism Diagnostic Interview-Revised (Lord et al., 1994);   BPVS = British Picture Vocabulary Scale (Dunn & Dunn, 1981; Dunn, Whetton, & Burley, 1997); C = Control group; CAST = Childhood Autism Spectrum Test (Scott, Baron-Cohen, Bolton, & Brayne, 2002);   DSM-IV (APA, 2000); ER = Emotion Recognition;   PDD = Pervasive Developmental Disorder;   SCQ = Social Communication Questionnaire, (Rutter, Bailey, & Lord, 2003); T = Treatment group;   TD = Typically Developing children;   WISC = Wechsler Intelligence Scale for Children (Wechsler, 2003);   WPPSI = Wechsler Preschool and Primary Scale of Intelligence (Wechsler 2002b); VIQ = Verbal Intelligence Quotient

Table 2.

Summary of Outcomes of Intervention Studies with Young Children with Autism (mean age under seven years)

Intervention	Evaluation Study	Outcome Measures	Impact of Training	Distant Generalization	Maintenance	Impact on Social Skills
Teaching Situation-Based Emotions to Children with ASD	McHugh et.al. (2010)	*Feature-based generalisation:* labelling of happy, sad, angry, scared emotions from novel cartoons	High levels of accuracy in ER and maintenance	Not measured	Over 96% accuracy for maintenance 15 days later	Not measured
The Transporters	Golan et.al. (2010)	*Familiar- close generalisation:* matching of familiar situations and facial expressions taught in the DVD *Unfamiliar-close generalisation:* matching of novel situations and expressions similar to those taught *Feature-based generalisation:* matching of novel situations and expressions for characters from a different emotion training programme	Significant improvements on all tasks for T compared with C1 and C2	Not measured	Not measured	Not measured
The Transporters	Young & Posselt (2012)	*Feature-based generalisation:* Affect recognition subtest of the NEPSY II (matching of basic facial expressions of emotion); The faces task (labelling of basic and complex facial expressions of emotion) *Social skills:* SCQ parent questionnaire	Significant improvements for T compared with C for both emotion tasks	Not measured	Not measured	Both groups improved on SCQ for peer interest & eye contact

C = Control group;   ER = Emotion Recognition;   NEPSY-II (Korkman, Kirk, & Kemp, 2007a);   SCQ = Social Communication Questionnaire (Rutter et al., 2003);   T = Treatment group

Table 3.

Summary of Intervention and Participant Characteristics for Intervention Studies with Older Children with Autism (mean age seven to twelve years)

Intervention	Evaluation Study	Diagnostic Group	Diagnostic Instrument	Participant Demographics	Cognitive Ability	Intervention	Delivery Mode	Comparison Condition	Emotions Taught
Teaching Children with Autism to Mind-Read (Howlin et.al. 1999)	Hadwin et. al. (1996)	Autism	DSM-III-R diagnostic criteria	T n = 10, 9 male T age m = 9.0 yrs C1 n = 10 male C1 age m = 9.0 yrs C2 n = 10, 8 male C2 age m = 9.0 yrs Age range: 4-13 yrs	VMA T m = 5.1 yrs C1 m = 5.0 yrs C2 m = 5.0 yrs	Participants taught correct emotions for: photos of faces; cartoons of faces; contextual situations; desire-based situations and belief-based situations.	Instructor and picture materials	C1 = training in perspective taking C2 = analysis of play skills only	Happy, sad, angry, scared from cartoons.
Mind Reading (Baron-Cohen et. al. 2004)	LaCava et. al. (2007)	AD	DSM-IV diagnostic criteria and ASDS	N = 8, 6 male age m = 10.3 yrs Age range: 8-11 yrs	HFA IQ not reported	*Mind Reading:* 10 weeks of self-directed learning.	At home or school with computer programme	nil	412 emotions and mental states
Mind Reading (Baron-Cohen et. al. 2004)	LaCava et. al. (2010)	ASD	DSM-IV diagnostic criteria	N = 4 male age m = 8.6 yrs Age range: 7-11 yrs	HFA IQ not reported	*Mind Reading:* Training for 7-10 weeks with a tutor (time m = 12.3 hrs)	At school. Instructor, computer programme	nil	412 emotions and mental states
Mind Reading (Baron-Cohen et. al. 2004)	Thomeer et.al. (2011)	ASD (1 Autism, 5 AD, 5 PDD-NOS)	DSM-IV diagnostic criteria ADI-R	N = 11, 8 male age m = 9.1 yrs Age range: 7-12 yrs	WISC-IV FSIQ m = 101.26	*Mind Reading* Twelve 90min sessions for six weeks with in-vivo practice of ER	Instructor and computer programme	nil	412 emotions and mental states

Table 3. Cont'd

Summary of Intervention and Participant Characteristics for Intervention Studies with Older Children with Autism (mean age seven to twelve years)

Intervention	Evaluation Study	Diagnostic Group	Diagnostic Instrument	Participant Demographics	Cognitive Ability	Intervention	Delivery Mode	Comparison Condition	Emotions Taught
Mind Reading (Baron-Cohen et. al. 2004)	Weigner & Depue (2011)	T = ASD C = TD	DSM-IV diagnostic criteria and AQ	T n = 6, 5 males T age m = 8.5 yrs C n = 11, 6 males C age m = 9.27 yrs Age range: 7-12 yrs	Not reported	*Mind Reading:* Five 30-45min sessions over three weeks	Instructor and computer programme	C: No Mind Reading training	412 emotions and mental states
Teaching Emotion Recognition Skills to Children with Autism	Ryan & Charragain (2010)	Autism	ADOS and CARS	T n = 20 T age m = 9.3 yrs C n = 10 C age m = 10.6 yrs Age range: 6-14 yrs	V IQ (PPVT-R) T m = 85.60 C m = 90.22 PIQ (SPM) T m = 104.6 C m = 98.6	Training in recognition of six basic emotions including individual components of each expression. Role play, drawing and games. Training for one hour a week for four weeks.	Instructor and paper-materials Homework book	C = waitlist control	Happy, sad, angry, scared, surprised and disgusted facial expressions.

AD = Asperger's Disorder;   ADI-R = Autism Diagnostic Interview-Revised (Lord et al., 1994);   ADOS = Autism Diagnostic Observation Schedule (Lord et al., 2000);   ASD = Autism Spectrum Disorder;   ASDS = Asperger's Syndrome Diagnostic Scale (Myles, Bock, & Simpson, 2001);   AQ = Autism Spectrum Quotient (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001); C = Control group;   CARS = Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 2002);   DSM-III-R (American Psychiatric Association, 1987);   DSM-IV (American Psychiatric Association, 2000);   ER = Emotion Recognition;   FSIQ = Full-Scale Intelligence Quotient;   HFA = High-Functioning Autism;   PDD-NOS = Pervasive Developmental Disorder-Not Otherwise Specified;   PIQ = Performance Intelligence Quotient;   PPVT-R = Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981);   SPM = Raven Standard Progressive Matrices (Raven, Court, & Raven, 1977);   T = Treatment group;   TD = Typically Developing children;   VIQ = Verbal Intelligence Quotient;   VMA = Verbal Mental Age;   WISC-IV = Wechsler Intelligence Scale for Children (Wechsler, 2003)

Table 4.

Summary of Outcomes of Intervention Studies with Older Children with Autism (mean age seven to twelve years)

Intervention	Evaluation Study	Outcome Measures	Impact of Training	Distant Generalisation	Maintenance	Impact on Social Skills
Teaching Children with Autism to Mind-Read (Howlin et.al. 1999)	Hadwin et. al. (1996)	*Unfamiliar-close generalisation:* ER recognition from novel photos and cartoons similar to intervention material (1) photos of faces (2) cartoons of faces, (3) contextual situations (4) desire-based situations and (5) belief-based situations. *Distant generalisation:* novel pictures and cartoons measuring perspective taking skills	Significant improvement in ER skills for T, compared with C1 and C2	Improvements in ER skills did not generalise to improved perspective taking	Improvements in ER skills maintained two months later	Not measured
Mind Reading (Baron-Cohen et. al. 2004)	LaCava et. al. (2007)	*Feature-based generalisation:* Cambridge face-voice battery (basic and complex ER from facial and vocal stimuli); Child feature-based auditory task (ability to recognise complex emotions from speech)	Significant improvements for both measures	Not measured	Not measured	Not measured
Mind Reading (Baron-Cohen et. al. 2004)	LaCava et. al. (2010)	*Familiar-close generalisation:* Identification of affective expressions from the *Mind Reading* programme *Feature-based generalisation:* Cambridge face-voice battery (basic and complex ER from facial and vocal stimuli); Identification of basic affective expressions from *The Pictures of Facial Affect* and cartoons from *Teaching Children with Autism to Mind-Read* *Social skills:* researcher observation of children	All participants significantly improved on all outcome measures	Not measured	Not measured	Significant improvement in number of positive social interactions observed by researchers

Table 4. Cont'd

Summary of Outcomes of Intervention Studies with Older Children with Autism (mean age seven to twelve years)

Intervention	Evaluation Study	Outcome Measures	Impact of Training	Distant Generalisation	Maintenance	Impact on Social Skills
Mind Reading (Baron-Cohen et. al. 2004)	Thomeer et.al. (2011)	Parent rating of children's ability to recognise and display 27 basic and complex emotions *Social skills:* Social Responsiveness Scale	Significant improvement in ratings of ability to recognise and display emotions	Not measured	Not measured	Significant improvements in severity of ASD symptoms (SRS scores)
Mind Reading (Baron-Cohen et. al. 2004)	Weigner & Depue (2011)	*Close-generalisation:* Identification of ten complex facial expressions taught in the *Mind Reading* programme	Significant improvement for T compared with C	Not measured	Not measured	Not measured
Teaching Emotion Recognition Skills to Children with Autism	Ryan & Charragain (2010)	*Feature-based generalisation:* Labelling of 24 novel photographs from *The Pictures of Facial Affect* for the six emotions taught in intervention.	Significant improvement for T compared with C	Not measured	Improvements maintained three months post-training	Not measured

C = Control group;   Cambridge face-voice battery (Golan, Baron-Cohen, & Hill, 2006);   Child feature-based auditory task (Golan et al., 2008);   ER = Emotion Recognition; SRS= Social Responsiveness Scale (Constantino & Gruber, 2005);   T = Treatment group;   The Pictures of Facial Affect (Ekman & Friesen, 1976)

2.5 Aims and Hypotheses

The main aim of the current study was to investigate the efficacy of the *Transporters* emotion training programme for use with a sample of young children with Autistic Disorder of a lower range of cognitive ability. In order to address current limitations in the autism emotion recognition literature, this study also aimed to investigate the relationship between emotion recognition ability, autism symptom severity and social skills for young children with autism.

The main aims and hypotheses of this study were:

Aim 1. To investigate whether an emotion recognition training programme (the *Transporters*) was effective in improving emotion recognition skills of young children with autism, through comparison of the emotion training intervention DVD with a control DVD.

> It was hypothesised that there would be a general improvement in emotion recognition skills following treatment, and that this would occur for children receiving the intervention DVD but not those receiving the control DVD.

Aim 2. To determine whether improvements in emotion recognition skills were maintained after treatment, at three month follow-up.

> It was hypothesised that treatment gains would be maintained at three month follow-up.

Aim 3. To investigate whether improvements in emotion recognition skills generalised to improvements in theory of mind ability and social skills.

>It was hypothesised that improvements in emotion recognition skills would show limited generalisation to measures of TOM and social skills.

Aim 4. To explore the predictors of successful outcomes on emotion recognition measures, for children who were in the treatment group.

>It was hypothesised that treatment gains would be positively associated with age and IQ, and negatively associated with autism symptom severity.

Additional aims and hypotheses included:

Aim 5. To determine whether emotion recognition skills were related to autism symptom severity in children with autism.

>It was hypothesised that higher autism severity scores would be related to reduced performance on emotion recognition tasks, irrespective of age or cognitive ability.

Aim 6. To determine whether emotion recognition skills were related to social skills in children with autism.

>It was hypothesised that higher emotion recognition scores would be related to better social skills for children with autism, irrespective of age, cognitive ability, or autism symptom severity.

Chapter 3. | **Methodology**

3.1 Participants

Fifty-five children were included in the total sample. All participants met the following inclusion criteria: (a) met DSM-IV-TR diagnostic criteria for Autistic Disorder (APA, 2000), with diagnoses based upon current assessment information including ADOS scores (Lord et al., 2000) and individual case review by supervisor KG; (b) were aged from 4 to 7 years (48 to 84 months) at baseline; (c) were able to complete a WPPSI-III cognitive assessment at baseline or had completed one in the past 12 months; and (d) had not previously watched the *Transporters* emotion recognition training DVD.

Participant demographic information is presented in Table 5. There were no significant differences between the intervention and control groups in relation to chronological age, IQ, Vineland ABC/Communication scores and ADOS severity scores. However children in the intervention group watched significantly more hours of their intervention DVD than children in the control group. Analysis of the distribution of FSIQ scores for the total sample indicated that 29% of children had FSIQ scores in the ID range (less than 70), 33% had FSIQ scores in the Borderline IQ range (70–79), and 38% had FSIQ scores above 79. Chi-squared analysis showed no significant difference in the distribution of FSIQ scores between groups (Table 5.).

Some participants were unable to complete the harder emotion recognition and TOM tasks because of the cognitive demands of these tasks. Task completion rates are presented in Table 6. The task completion rates are also presented as a function of cognitive ability (FSIQ < 70 and FSIQ ≥ 70). All participants were able to complete the emotion matching task.

Table 5.

Participant Demographic Information for the Intervention and Control Groups at Baseline Assessment

	Intervention Group (n = 28)		Control Group (n = 27)			
	M (SD)	Range	M (SD)	Range	t (df)	p
Male (%)	89.3%		85.2%			
Age (months)	62.83 (11.17)	48.20 – 84.24	61.93 (9.91)	48.10 - 83.09	.32 (53)	.75
WPPSI FSIQ	77.93 (13.96)	54 – 107	74.56 (13.58)	42 - 96	.91 (53)	.37
WPPSI VIQ	73.61 (14.26)	48 – 93	74.33 (14.59)	46 - 107	-.19 (53)	.85
WPPSI PIQ	87.89 (16.24)	59 – 122	82.22 (15.57)	47 - 112	1.32 (53)	.19
Vineland Com'	75.15 (13.55)	44 – 104	77.19 (12.69)	44 - 102	-.57 (52)	.57
Vineland ABC	73.41 (12.21)	49 – 100	73.48 (9.97)	49 - 93	-.02 (52)	.98
ADOS Severity Scores	6.79 (1.50)	3 – 10	7.56 (2.29)	2 - 10	-1.48 (53)	.15
DVD hours total	11.76 (9.16)	3.33 – 47.12	7.41 (3.21)	1.58 - 14.67	2.25 (49)	*.03*
% FSIQ < 70	25.0%*		33.3%*			
% FSIQ 70 -79	32.1%*		33.3%*			
% FSIQ > 79	42.9%*		33.3%*			
					*chi-square (df) = .66 (2)	.72

Vineland Com' = Vineland-II Communication Domain

Table 6.

Completion Rates and Scores on the Emotion Recognition and TOM Tasks

Outcome Measures	n	Mean (SD)	Range	Completion Rate* FSIQ < 70	≥ 70
Emotion Tasks					
Matching Task (total score)	55	10.69 (3.91)	3 - 16	100%	100%
Happiness		3.11 (1.19)	0 - 4		
Fear		2.74 (1.28)	0 - 4		
Sadness		2.57 (1.34)	0 - 4		
Anger		2.24 (1.43)	0 - 4		
Identification Task (4 faces)	49	7.57 (2.52)	3 - 12	63%	100%
Happiness		2.55 (0.71)	1 - 3		
Fear		1.86 (1.10)	0 - 3		
Anger		1.73 (1.11)	0 - 3		
Sadness		1.41 (0.98)	0 - 3		
Identification Task (6 faces)	43	5.91 (1.86)	2 - 10	44%	93%
Happiness		2.42 (0.76)	0 - 3		
Sadness		1.30 (0.89)	0 - 3		
Anger		1.16 (0.75)	0 - 3		
Fear		1.02 (0.83)	0 - 3		
NEPSY-II Affect Recognition	35	12.74 (3.94)	5 - 21	31%	77%
TOM and Mindreading Tasks					
NEPSY-II Contextual TOM	35	3.26 (1.50)	0 - 6	19%	82%
NEPSY-II Verbal TOM	28	6.86 (3.43)	1 - 14	13%	67%
Situation-based (n = 43)	43	4.44 (1.35)	1 - 6	38%	95%
Desire-based (n = 42)	42	4.12 (1.45)	1 - 6	31%	95%

* Percentage of participants in each FSIQ group who completed each outcome measure

3.2 Measures

3.2.1 Intervention Measures

The Transporters   The *Transporters* (Changing Media Development, 2006) is an animated children's television series developed by the Autism Research Centre at Cambridge University. The programme was designed to provide training in emotion recognition skills to children with Autism Spectrum Disorders aged between three and eight years (Golan et al., 2010). The *Transporters* program consists of 15 five minute episodes portraying 15 key emotions. These emotions include six basic emotions (happy, sad, angry, afraid, disgusted and surprised) and nine more complex emotions and mental states (excited, tired, unfriendly, kind, sorry, proud, jealous, joking and ashamed).

The *Transporters* is an animated series set in a child's bedroom. The eight characters are vehicles that display different emotional expressions and interact with one another. All animated vehicles have video footage of real human faces superimposed on their faces. Researchers chose to use a narrator for each episode so that children could focus on the whole facial expressions of the characters instead of focusing on the mouth area of the characters when they were talking (Golan et al., 2010).

According to the Empathizing-Systemizing (E-S) theory (Baron-Cohen, 2006, 2008, 2009) individuals with autism are 'hyper-systemizers', preferring predictable, repetitive, rule-based systems. From this it has been suggested that children with autism may prefer vehicles that move according to physical rules (e.g., along tracks or cables) over vehicles with variable motion (e.g., aeroplanes) (Golan et al., 2010). Based

on this theory the *Transporters* programme was designed using vehicles that run on tracks, so as to appeal to children with autism and encourage them to attend to the faces on the vehicles and learn about emotional expressions.

The *Transporters* programme includes interactive quizzes to help children learn about emotions. It also includes a detailed guide to provide supplementary information to parents. The supplementary guide is designed to give advice to parents on how to approach discussion about the different episodes, including the causes and consequences of emotions. The guide suggests that parents encourage children to look at the characters' faces and to watch episodes repeatedly (Golan et al., 2010).

As per previous research (Golan et al., 2010; Young & Posselt, 2012), participants in the intervention group were required to watch the *Transporters* DVD at home for 15 minutes each day for four weeks. Parents were encouraged to watch the DVD with their child and to help them complete the interactive quizzes. The number of minutes of DVD viewing time was recorded daily by parents on a diary sheet.

Thomas the Tanks Engine   The *Thomas the Tank Engine* television program (Gullane (Thomas) Limited, 1998) is a popular programme amongst children with autism (National Autistic Society, 2002). For the purpose of this study *Thomas and Friends season five* was used to control for time spent watching children's DVDs. This series consists of 26 five-minute episodes and was chosen because of its similarities with the *Transporters* programme, including the fact that it is a narrated and animated series, the characters are mechanical vehicles with faces, and the series contains multiple short episodes. The difference between *Thomas the Tank Engine* and the *Transporters* is that *Thomas the Tank Engine* does not specifically focus on emotions.

Participants were required to watch the DVD at home for 15 minutes a day over four weeks. Participants chose which episodes they watched. The number of minutes of DVD viewing time was recorded daily by parents on a diary sheet.

3.2.2 Assessment Measures

Autism Diagnostic Observation Schedule (ADOS) The ADOS (Lord et al., 2000) is a standardised measure of autism symptomatology, used in the assessment of individuals who may have Autistic Disorder or another Pervasive Developmental Disorder (PDD). The ADOS uses planned social occurrences, or "presses", to create situations in which a range of social responses and initiations are likely to occur (Lord et al., 2000). The goal is to provide a standardised context in which spontaneous behaviours and communication are elicited. During these activities the presence or absence of specific behaviours are recorded, with higher scores indicating greater autism symptomatology.

The ADOS comprises four modules which apply to individuals of different developmental and language levels. Module 1 is for individuals who are non-verbal or who have single words, Module 2 for individuals with meaningful phrase speech of three or more words, Module 3 for children or adolescents who are verbally fluent, and Module 4 for verbally fluent adults. The use of these different modules was intended to reduce the bias of language skills on ADOS performance (Lord et al., 2000).

The current study used revised algorithms in the calculation of ADOS scores. These revised algorithms provide clinical cut-offs for autism and Autism Spectrum Disorders (Gotham, Risi, Pickles, & Lord, 2007). The current study also used ADOS severity scores (also known as *comparison* scores) to allow for the comparison of ADOS

scores across different modules and time points (Gotham, Pickles, & Lord, 2009). It should be noted that whilst ADOS severity scores measure degree of autism symptomatology they do not measure the child's level of functional impairment, which is a separate construct.

The ADOS has been shown to have high inter-rater reliability across all modules (.82 to .93), and reasonable test-retest reliability (.59 to .82) (Gotham et al., 2007; Gotham et al., 2008). The ADOS revised algorithms have been found to have high sensitivity (82% and 98%) and specificity (80% and 100%) (Gotham et al., 2007; Gotham et al., 2008).

For the current study the ADOS was administered to all participants during pre-intervention assessment to confirm their diagnosis of autism. Module 1, 2 or 3 was administered according to the child's language ability.

Wechsler Preschool and Primary Scale of Intelligence, third edition The WPPSI-III (Wechsler 2002b) is a standardized assessment of cognitive ability for children aged 2 years 6 months to 7 years 3 months. The WPPSI-III gives an overall estimate of cognitive ability as a Full-Scale Intelligence Quotient (FSIQ) and composite scores for Verbal and Performance IQ (VIQ and PIQ). It also gives a Processing Speed Quotient (PSQ) for children aged 4 years 0 months and over. Scores have a mean of 100 and a standard deviation of 15. The WPPSI-III has 14 subtests classed as either core, supplemental or optional. All subtests have a mean of 10 and standard deviation of 3 points. The WPPSI-III test battery for children aged 4 years 0 months to 7 years and 3 months has seven core subtests that are administered to calculate the FSIQ, VIQ and PIQ scores.

The WPPSI-III has been shown to have good test-retest reliability, with average subscale coefficients ranging from .86 to .95 (Madle, 2005; Wechsler, 2004) and high inter-rater reliability, ranging from 0.98 to 0.99 (Wechsler, 2002c). The WPPSI-III also has good convergent validity, with WPPSI-III VIQ, PIQ and FSIQ scores correlating highly with the WPPSI-R (Wechsler, 2002c) (.70 to .86), with WISC-III (Wechsler, 2004) FSIQ scores (.89), and with the Bayley Scales of Infant Development (BSID-II, Bayley 1993) (.80) (Madle, 2005).

In the present study the WPPSI-III was used to measure cognitive ability in terms of FSIQ, VIQ and PIQ. The WPPSI-III was administered to children who had not previously completed a WPPSI-III within the last 12 months. WPPSI-III scores were used in the analyses to control for differences in cognitive ability between children.

Vineland Adaptive Behaviour Scales, second edition – survey forms   The Vineland Adaptive Behaviour Scales (VABS, Sparrow & Cicchetti, 1985) were designed to provide a general assessment of adaptive behaviour, which the authors define as an individual's ability to transform cognitive potential into everyday skills. The second edition of the Vineland includes the Vineland-II survey forms, which include a parent/carer completed checklist and updated norms (Sparrow et al., 2005). The Vineland-II can be used from birth through to 90 years of age. It consists of four domains (and 11 sub domains); (1) Communication (receptive, expressive and written communication skills), (2) Daily Living (personal, domestic and community skills), (3) Socialization (interpersonal relationships, play and leisure time, and coping skills) and (4) Motor Ability (gross and fine motor skills). An overall composite score, the

Adaptive Behaviour Composite (ABC), is calculated based on these domain and sub domain scores.

For children aged 0 to 7 years, internal consistency of the Vineland-II domain scores and ABC scores have been shown to be high (.79 to .95) (Sparrow et al., 2005). The test-retest reliability of the Vineland-II survey forms is also high, with mean correlations ranging from .85 to .90 (for a period of 13 to 34 days between assessments) (Sparrow et al., 2005). Inter-rater reliability coefficients for the Vineland-II ABC are moderately strong (.70 to .80) (Stein, 2010). The Vineland-II has good concurrent validity with the Adaptive Behaviour Assessment System (ABAS, Harrison & Oakland, 2003) (69 to .78) and good discriminate validity evidenced through weak correlations with the Child Behavior Checklist (CBCL; Achenbach, 2001) and the Developmental Behavior Checklist (DBC; Einfeld & Tonge, 1995) (De Bildt, Kraijer, Sytema & Minderaa, 2005a; Sparrow et al., 2005).

For the current study parents completed the Vineland-II parent survey form at three time points (pre-intervention, post-intervention and at three-month follow-up). Vineland-II ABC scores were used as a measure of Adaptive Functioning, and Socialization Domain scores used as a measure of Social Skills.

3.2.3 Outcome Measures

Measures of Basic Emotion Recognition Ability

The basic (non-social) emotions have been defined as six universally recognised expressions of facial affect (happiness, sadness, anger, fear, disgust and surprise) (Ekman & Friesen, 1976). The basic emotions are considered to be non-social because they can be recognised outside of their social context and have an innate biological

basis (Williams & Happe, 2010). Typically developing children appear able to identify and label basic emotions around three years of age (Widen & Russel, 2003). For the current study three measures of basic emotion recognition were used; an Emotion Identification task, an Emotion Matching task, and the NEPSY-II Facial Affect Recognition task.

Emotion Identification and Matching Tasks   A series of tasks were developed to assess the ability of each child to identify and match facial expressions of emotion. The photos used for the Emotion Identification and Emotion Matching tasks were chosen from the *Pictures of Facial Affect* (Ekman & Friesen, 1976), which is a collection of 110 black and white photographs of adult models displaying six basic facial expressions (happiness, sadness, anger, fear, surprise, and disgust). The *Pictures of Facial Affect* have been widely used in cross-cultural studies of emotion recognition, and more recently in neuropsychological research. They are reported as being the most widely used and validated set of stimuli for research into facial expression recognition (Young, Perret, Calder, Sprengelmeyer, & Ekman, 2002).

For the **Emotion Identification – four expressions task**, four emotional expressions (happiness, sadness, anger and fear) were used from 10 models (six male and four female) from the *Pictures of Facial Affect* stimuli. Each picture had four different emotional expressions from four different models and the participant was required to point to a specific emotion for each picture (e.g., *"who is happy?"* or *"who is sad"*). An example from this task is shown in Appendix A.

For the **Emotion Identification – six expressions task**, six emotional expressions (happiness, sadness, anger, fear, surprise and disgust) were used from 10 models (six

male and four female) from the *Pictures of Facial Affect* stimuli. The first four emotions were the target emotions, with surprise and disgust acting as distracters. Each picture had six different emotional expressions from six different models and the participant was required to point to a specific emotion for each picture (e.g., "*who is happy/sad/angry or scared?*"). The six expressions task was developed during pilot testing when it was discovered that the four expressions task may be too easy for some children. An example from this task is shown in Appendix B.

For the **Emotion Matching** task four emotional expressions (happiness, sadness, anger and fear) were used from eight models from the *Pictures of Facial Affect* stimuli. A plain brown box was made for each emotion, with four different examples of the emotion attached to the front of each box. The other photos were made into cards for posting into the boxes. Different faces were used on the boxes and the cards to ensure that children were matching emotions not identities. During the assessment the four boxes were placed in front of the child in a random order. The child was shown each box and told what each emotion was. The child was then shown one card at a time and was required to post the card into the box with the matching emotion. Appendix C contains a pictorial representation of the Emotion Matching task.

For the purpose of the current study the *Emotion Identification* and *Emotion Matching* tasks were administered to participants at three time points (pre-intervention, post-intervention and at three-month follow-up) to measure change in basic emotion recognition skills following intervention.

NEPSY, second edition - Affect Recognition Subtest   The NEPSY-II (Korkman et al., 2007a) is a series of neuropsychological tests used to assess neuropsychological development in children aged from 3 years and 0 months to 16 years and 11 months of age.   The Social Perception domain of the NEPSY-II measures cognitive processes thought to facilitate social interaction, including facial affect recognition (the ability to recognise and identify emotions displayed on faces).   The NEPSY-II Affect Recognition task assesses a child's ability to recognise different emotions from photos of children's faces. Throughout the Affect Recognition task participants are required to determine whether two photos display the same emotion or different emotions, choose two photos that display the same emotion from a selection of three or four photos, and choose a photo from a selection of four faces that displays the same emotion as a target face at the top of the page.   The Affect Recognition tasks do not rely on contextual information.

The NEPSY-II Affect Recognition subtest has been shown to have moderate test-retest reliability (.46 to .58) and good construct validity (it had low correlations with other NEPSY-II subtests) (Korkman, Kirk, & Kemp, 2007b).   Concurrent validity was ascertained through correlations between the NEPSY-II subtests and other validated assessment measures.   The Affect Recognition task was shown to have low correlations with the WISC-IV (Wechsler, 2003), the Wechsler Nonverbal Scale of Ability (Wechsler & Naglieri, 2006), the Wechsler Individual Achievement Test (Wechsler, 2002a), and the Adaptive Behaviour Assessment System (ABAS, Harrison & Oakland, 2003) (Korkman et al., 2007b).   There is no current convergent validity data comparing the NEPSY-II Affect Recognition subtest with other measures of affect recognition.

For the current study the NESPY-II Affect Recognition subtest was administered to participants at three time points (pre-intervention, post-intervention and at three-month follow-up) to measure change in basic emotion recognition skills.

Measures of Mentalizing Ability and Theory of Mind Skills

Mind-Reading Tasks   Mind-reading tasks from *Teaching Children with Autism to Mind-Read* (Howlin et al., 1999) were used to measure children's ability to recognise emotions in contextual situations. The *Teaching Children with Autism to Mind-Read* programme was developed as a tool for teaching mentalizing skills to children aged 4 to 13 years with autism, across five levels of emotional understanding (1) recognition of facial affect from photographs (happy/sad/angry/afraid), (2) recognition of facial affect from schematic drawings (happy/sad/angry/afraid), (3) identification of situation-based emotions (happy/sad/angry/afraid), (4) identification of desire-based emotions (happy/sad) and (5) identification of belief-based emotions (happy/sad). The programme was designed to teach the principles or 'rules' underlying each of these concepts of emotional understanding and mind-reading.

Each of the mind-reading tasks (situation-based, desire-based and belief-based emotion tasks) from *Teaching Children with Autism to Mind-Read* consists of a black and white cartoon depicting a character in a situation. Each cartoon is accompanied by a few sentences about the situation, and in some cases information about the character's desires or beliefs.   For each cartoon the character has a blank expression and the child is required to select a face depicting how the character would feel in the situation (happy, sad, angry or afraid). In the training programme, teaching occurs through discussion of each situation with the child. For the situation-based

emotion tasks the child is taught that when certain things happen people feel specific

emotions (e.g., if something scary happens people feel afraid). For the desire-based

emotion tasks the child is taught that when someone gets something they want then

they feel happy, but if they do not get something they want then they feel sad.   For

the belief-based emotion tasks the child is taught that people feel happy if they think

they have got what they wanted, even if they aren't going to get it, and conversely

people will feel sad if they think they have not got what they wanted, even if they are

going to get it.

Six examples of situation-based emotion cartoons and six examples of desire-

based emotion cartoons were chosen from *Teaching Children with Autism to Mind-*

Read. Appendix D provides an example of a situation-based question and Appendix E

provides an example of a desire-based question. The cartoons were used to measure

mentalizing ability and no teaching occurred for any tasks.

In the current study six situation-based emotion questions and six desire-

based emotion questions from *Teaching Children to Mind-Read* were administered to

participants at three time points (pre-intervention, post-intervention and at three-

month follow-up) to assess change in mentalizing ability following intervention.

NEPSY, second edition - Theory of Mind Tasks   **T**he NEPSY-II (Korkman et al.,

2007a) is a series of neuropsychological tests used to assess neuropsychological

development in children aged from 3 years and 0 months to 16 years and 11 months of

age. The NEPSY-II *Theory of Mind* subtest contains a Contextual TOM task and a Verbal

TOM task. For the current study the Contextual TOM task was used as a measure of

mentalizing ability. During the Contextual task participants are shown a picture of a

social context containing a character with no visible expression. The participant is required to choose one of four faces that depict the emotion felt by the character in the story. The individual psychometric properties of the Contextual TOM task are not available because they were calculated in combination with the Verbal TOM task.

The NEPSY-II Verbal TOM task is designed to assess understanding of mental functions and of other people's thoughts and feelings. The task requires participants to listen to stories, look at pictures and answer questions including comprehension of abstract phrases (Kemp & Korman, 2010).

The psychometric properties of the NEPSY-II TOM subtest were evaluated by combining both the Verbal and Contextual tasks (Korkman et al., 2007b). The TOM subtests have shown good test-retest reliability for children aged three to seven years (.76 to .84), and good construct validity through low correlations with most other NEPSY-II subtest scores (though the TOM subtest did have small to moderate correlations with some tests of verbal skills, including expressive and receptive language, and comprehension) (Kemp & Korkman, 2010). Convergent validity was examined through inter-correlations with the Wechsler Individual Achievement Test (WIAT, Wechsler 2002a). For the TOM subtest, inter-correlations ranged from .25 to .37, with a moderate correlation of .76 with the oral language composite of the WIAT (Kemp & Korkman, 2010). There is no current convergent validity data comparing the NEPSY-II Theory of Mind subtest with other measures of TOM.

In the current study, the NEPSY-II Contextual and Verbal TOM tasks were administered to participants at three time points (pre-intervention, post-intervention

and at three-month follow-up) to measure change in mentalizing ability and theory of mind skills following intervention.

3.2.4 Behavioural Assessment Measures

Vineland Adaptive Behaviour Scales For the purpose of the current study the Vineland-II (Sparrow & Cicchetti, 1985) parent survey form was completed by parents at three time points (pre-intervention, post-intervention and at three-month follow-up) to measure change in children's adaptive functioning skills following intervention. For the purpose of this study Vineland-II Socialization domain scores were used as a measure of social skills.

Social Responsiveness Scale (parent version) The SRS (Constantino & Gruber, 2005) is a 65-item carer-completed questionnaire for use with children aged 4 years to 18 years of age. It was designed to be used in the identification of ASD, and measures a child's ability to engage in emotionally appropriate reciprocal social interactions (Constantino et al., 2003). Each SRS item requires the observer to rate the child's behaviour from "1" (never true) to "4" (almost always true). The SRS gives a single scale score as an index of the severity of social deficits, whereby higher scores indicate a greater severity in social impairment. The SRS also gives domain scores for Social Awareness, Social Cognition, Social Communication, Social Motivation and Autistic Mannerism.

The SRS has been shown to have good internal consistency, with split-half reliabilities of .93 to .97, and good test-retest reliability, with correlations of .77 to .85 (Constantino & Gruber, 2005). Inter-rater reliabilities were also moderate to strong; .91 for mother verses father ratings (Constantino & Gruber, 2005). The SRS has also

shown moderate concurrent validity with the ADI-R (Lord, Rutter, & Le Couteur, 1994) (.60 to .79) (Constantino et al., 2003). For the differentiation of ASD from TD controls, the SRS has shown sensitivities of .74 to .80, and specificity of 1.0 for ASD (Bölte, Westerwald, Holtmann, Freitag, & Poustka, 2011). For the differentiation of ASD from non-ASD diagnoses, the SRS has shown sensitivities of .74 to .80, and specificities of .69 to .79 (Bölte et al., 2011).

In the current study the SRS was completed by parents at three time points (pre-intervention, post-intervention and at three-month follow-up) to measure autism symptom severity.

Developmental Behaviour Checklist (parent version) The DBC is a carer-completed measure of behavioural and emotional problems in children with intellectual disability (ID) aged 4 to 18 years (Einfeld & Tonge, 1995). The DBC was designed to allow for discrimination between behaviours that are attributable to developmental delay and those that are evidence of an emotional or behavioural disorder (Einfeld & Tonge, 1995). The DBC-P (primary carer version) is a 96-item questionnaire. Each item is rated from 0 ("not true as far as you know") to 2 ("very true or often true"). A total behaviour problem score (TBPS) is calculated, along with five subscales; Disruptive/Antisocial, Self-Absorbed, Communication Disturbance, Anxiety and Social Relating.

The DBC-P TBPS has shown high inter-rater reliability (.80), and test-retest reliability (.83 to .86) (Dekker, Nunn, & Koot, 2002; Einfeld & Tonge, 2002). The DBC-P also has high internal consistency (.94) (Gray & Tonge, 2005). The DBC-P TBPS scale has been shown to correlate highly with the Vineland Adaptive Behavior Scale (.86),

the American Association of Mental Deficiency Adaptive Behaviour Scales School Edition (ABS, Lambert & Windmiller, 1981) (.86), and the Problem Behaviour Section of the Scales of Independent Behaviours (SIB, Bruininks, Woodcock, Weatherman, & Hill, 1984). (.72) (Einfeld & Tonge, 2002).

For the current study the DBC was completed by parents at three time points (pre-intervention, post-intervention and at three-month follow-up) to measure change in behavioural and emotional problems following intervention.

3.3 Procedure

3.3.1 Ethics

Ethics approval was obtained from the Monash University Standing Committee for Ethics in Research Involving Humans (SCERH), and the Department of Education and Early Childhood Development (Victoria, Australia). Copies of Approval Documents are presented in Appendix F. Informed consent was obtained from parents of all participants. A copy of the participant information statement and consent form is presented in Appendix G.

3.3.2 Recruitment and Selection

Project recruitment was from October 2009 to January 2011, with post-treatment assessments completed by April 2011. Participants were recruited through the Monash University Centre for Developmental Psychiatry and Psychology (CDPP) autism research and assessment programmes, and through advertisement in early intervention services, paediatrician offices, and autism-related support groups including *Autism Victoria*. These organisations displayed recruitment posters and distributed study information packs to relevant families. Posters provided details of

how parents could obtain research information packs from the researchers (see Appendix H). Researchers contacted all consenting parents by telephone to collect background information and to conduct a screening interview to determine eligibility for the study.

3.3.3 Eligibility and Exclusion Criteria

Participants were deemed eligible for inclusion in the study if they met the following eligibility criteria.

Diagnosis All participants included in the study met DSM-IV-TR (APA, 2000) criteria for a diagnosis of Autistic Disorder (not Asperger's Disorder or PDD-NOS). Diagnoses were based upon baseline assessments including the ADOS (Lord et al., 2000) and individual case reviews by supervisor (KG) experienced in the diagnosis of autism. Three children did not meet ADOS criteria for ASD but did meet DSM-IV-TR criteria for Autistic Disorder through independent diagnostic review based on all available information, as well as meeting the cut-off on the SRS (Constantino & Gruber, 2005).

Age Participants were aged from 4 to 7 years (48-84 months) at baseline. During the initial telephone screening interview some potential participants were deemed ineligible for the study because they were outside of this age range.

Cognitive Ability Given the cognitive demands of the outcome measures, participants were required to be functioning at a minimum cognitive level of 30 months of age. This was determined by participant's ability to complete at baseline, or have completed in the past 12 months, a WPPSI-III cognitive assessment. Four children were unable to complete a cognitive assessment at baseline. These children did not

enter the intervention phase of the study but were given a copy of the *Transporters* DVD to keep.

Intervention DVD   Participants were excluded from the study if they had previously watched the *Transporters* DVD. These ineligible participants were identified during the initial telephone screening interview.

3.3.4 Group Allocation

The consultant statistician used a computer programme to generate the randomized sequence of conditions in blocks of twenty participants (ten for each condition at a time). Each DVD was packaged in an unmarked envelope which was then sequentially marked and distributed to the family at entry into the study. The clinician conducting the assessments remained blind to group allocations until the end of the study and parents were asked not to discuss their DVD with the clinician conducting the assessments.

Figure 1. outlines the flow of participants through the study. Initially 64 children were recruited in to the study. However four children were excluded because they were unable to complete a WPPSI-III cognitive assessment at baseline. Sixty children subsequently went in to the intervention phase. During the intervention phase five families withdrew their children from the study because of behavioural problems that prevented their child from watching the DVD. As a result fifty-five children completed the intervention phase and a one-month post-intervention follow-up assessment. Eighty-four percent ($n = 46$) children completed a three-month follow-up assessment.
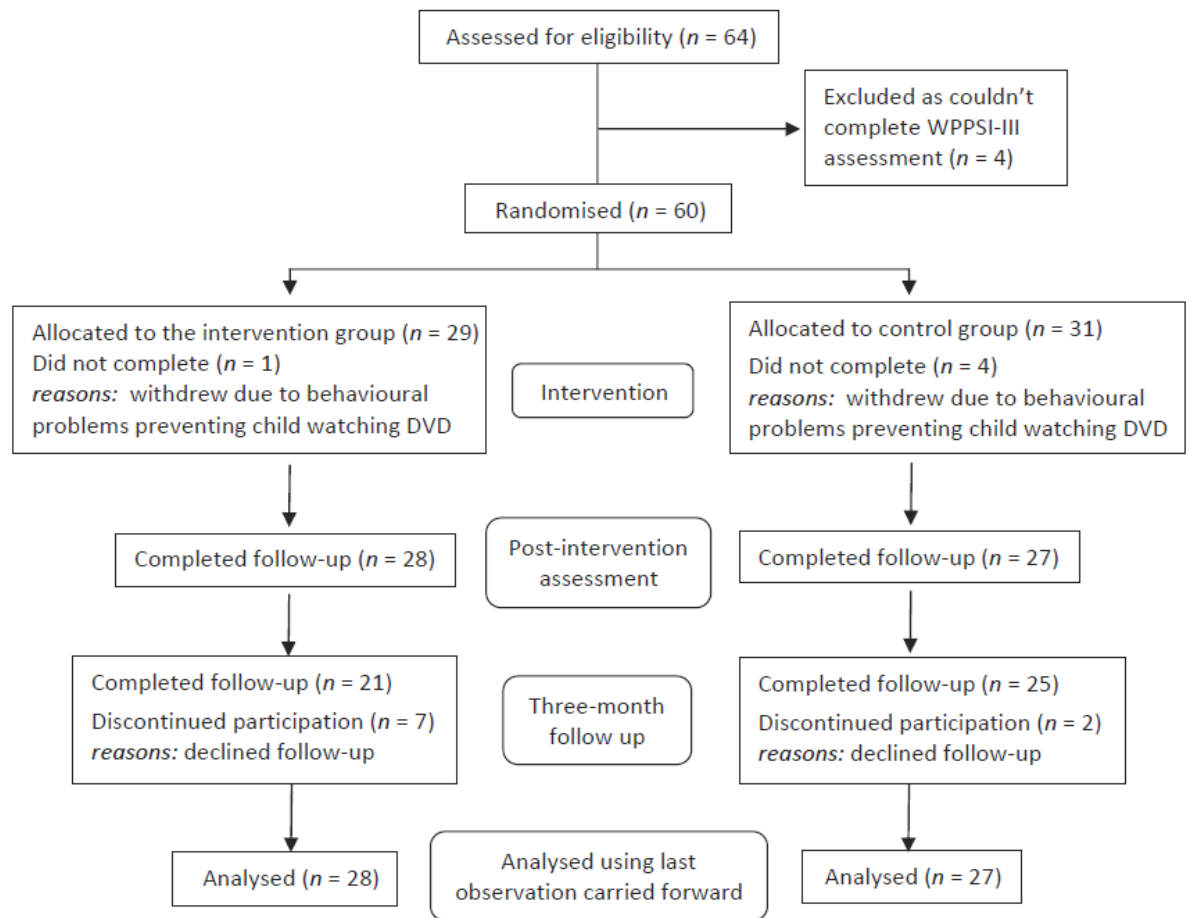
Figure 1. Flow of Participants through the Study

3.3.5 Baseline Assessment

The majority of the baseline assessments were conducted at the CDPP, with some being conducted at the participants' early intervention centres or kindergartens. All participants attended an assessment session with a parent who was seated at the back of the room behind the child. Children completed an ADOS assessment at the start of the session. They then completed the emotion tasks in a random order. Finally children completed a cognitive assessment (WPPSI-III) if they had not completed one in the past twelve months. Some children did not complete the cognitive assessment

during the initial assessment session because of time constraints and these families were invited to attend a second assessment session the following week in order to complete the cognitive assessment before taking part in the intervention. Parents completed the Vineland-II survey form, the SRS parent form and the DBC parent form during the baseline assessment.

3.3.6 Intervention

Participants watched their DVD at home for 15 minutes a day over four weeks. Parents kept a diary sheet to record the number of hours their child watched the DVD. To encourage adherence parents received a weekly SMS reminder to watch the DVD with their child. To reinforce learning, parents of children in the intervention group were encouraged to complete the additional DVD quizzes with their child.

3.3.7 Post-intervention Assessments

The majority of the post-intervention assessments were conducted at the CDPP, with some being conducted at the participants' early intervention centres or kindergartens. Children attended a post-intervention assessment within one week of completing the intervention phase of the study and again three months later. During the assessment children completed the emotion tasks in a random order whilst parents completed the Vineland-II survey form, the SRS parent form and the DBC parent form.

At the end of the three-month follow-up assessment those children who received the *Thomas the Tank Engine* DVD during intervention were given a copy of the *Transporters* DVD to keep.

3.4 Data Analysis

The efficacy of the *Transporters* intervention programme (change over time) was examined using mixed design regression analysis, including group (intervention versus control) as an independent variable and the emotion recognition tasks as dependent variables, whilst controlling for the effects of chronological age, gender, VIQ, and DVD hours on results. Partial correlations were conducted to explore the relationship between demographic variables (chronological age, VIQ and ADOS severity scores) and emotion recognition performance for individuals in the intervention group, controlling for individual differences in emotion recognition ability at baseline.

Baseline data was used to investigate the relationship between autism symptom severity and emotion recognition ability (Paper 2), and emotion recognition ability and social skills (Paper 3). For Paper 2, regression analyses were used to evaluate the relationship between ADOS severity scores, SRS scores and emotion recognition ability, controlling for chronological age and VIQ scores. For Paper 3, regression analyses were used to investigate to association between emotion recognition scores and Vineland-II Socialization domain scores, controlling for the influence of chronological age, VIQ and autism symptom severity (Paper 3).

Chapter 4. | **Research Paper 1**

Teaching emotion recognition skills to young

children with autism: A randomised controlled trial

of an emotion recognition training programme

4.1 Declarations

4.1.1 Declaration by candidate:

For Chapter 4 the extent of my contribution was 70%. The nature of my contribution was: data collection, data analysis, interpretation of findings, and drafting and submission of the research paper.

The following co-authors contributed to this work.

Name	Nature of contribution
Dr Kylie Gray	Conception of research design and assistance with the interpretation of findings. Provided direction on the paper and advice regarding where to publish. Reviewed, revised, and provided feedback and edits on the paper.
Prof Bruce Tonge	Reviewed, revised, and provided feedback and edits on the paper.

Candidate's signature:		Date:
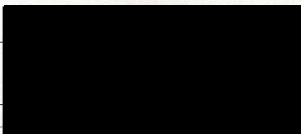
4.1.2 Declaration by co-authors for paper 1:

Declaration by co-authors for Paper 1:

The undersigned hereby certify that:

(1) The above declaration correctly reflects the nature and extent of the candidate's

contribution to this work, and the nature and contribution of each of the co-authors;

(2) They meet the criteria for authorship in that they have participated in the conception,

execution, or interpretation, of at least part of the publication in their field of expertise;

(3) They take public responsibility for their part of the publication, except for the

responsible author who accepts overall responsibility for the publication;

(4) There are no other authors of this publication according to these criteria;

(5) Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or

publisher of publications, and (c) the head of the responsible academic unit; and

(6) The original data are stored at the following location and will be held for at least five

years from the date indicated below:

Location: The Monash University Centre for Developmental Psychiatry and Psychology

| Dr. Kylie Gray | ██████████ | Date: 31·8·12 |
| Prof. Bruce Tonge | ██████████ | Date: 31·8·12 |

4.2 Paper Commentary and Paper 1

Chapter 4 presents a paper that has been accepted for publication in the *Journal of Child Psychology and Psychiatry*. This paper has been formatted to the specific requirements of the journal. The following is a copy of the manuscript that is in press. Page numbers have been re-numbered to provide consistency throughout the thesis.

Paper 1 is a randomised controlled trial evaluating the efficacy of an emotion recognition training programme (the *Transporters*) for use with a group of 55 young children with autism, aged four to seven years. This study extends previous research by investigating the use of the *Transporters* emotion training programme with a sample of young children with autism, with a lower mean age and a lower range of cognitive ability.

Teaching emotion recognition skills to young children with autism: a randomised controlled trial of an emotion training programme

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Background: Children with autism have difficulties in emotion recognition and a number of interventions have been designed to target these problems. However, few emotion training interventions have been trialled with young children with autism and co-morbid ID. This study aimed to evaluate the efficacy of an emotion training programme for a group of young children with autism with a range of intellectual ability. **Methods:** Participants were 55 children with autistic disorder, aged 4–7 years (FSIQ 42–107). Children were randomly assigned to an intervention ($n = 28$) or control group ($n = 27$). Participants in the intervention group watched a DVD designed to teach emotion recognition skills to children with autism (the *Transporters*), whereas the control group watched a DVD of *Thomas the Tank Engine*. Participants were assessed on their ability to complete basic emotion recognition tasks, mindreading and theory of mind (TOM) tasks before and after the 4-week intervention period, and at 3-month follow-up. **Results:** Analyses controlled for the effect of chronological age, verbal intelligence, gender and DVD viewing time on outcomes. Children in the intervention group showed improved performance in the recognition of anger compared with the control group, with few improvements maintained at 3-month follow-up. There was no generalisation of skills to TOM or social skills. **Conclusions:** The *Transporters* programme showed limited efficacy in teaching basic emotion recognition skills to young children with autism with a lower range of cognitive ability. Improvements were limited to the recognition of expressions of anger, with poor maintenance of these skills at follow-up. These findings provide limited support for the efficacy of the *Transporters* programme for young children with autism of a lower cognitive range. **Keywords:** Autism, emotion recognition, intervention, training.

Introduction

Social deficits are a core feature of autism (American Psychiatric Association, 2000) and it has been suggested that difficulties in recognising and responding to emotions may underlie these difficulties (Baron-Cohen, Golan, & Ashwin, 2009). Evidence suggests that individuals with autism have difficulty recognising facial expressions of emotion (Harms, Martin, & Wallace, 2010; Schultz, 2005) and atypical responses to facial expressions have also been reported in the relatives of individuals with autism, suggesting that difficulties in emotion recognition skills may underlie the broader autism phenotype (Spencer et al., 2011).

There are six universally recognised basic expressions of facial affect; happiness, sadness, anger, fear, surprise and disgust (Ekman & Friesen, 1976), which typically developing children can accurately identify and label by age 3 (Widen & Russell, 2003). Children with autism have been shown to be less accurate than typically developing children in their ability to identify these basic facial expressions of emotion from photographs, cartoons and video clips. These findings have been reported for both children with high-functioning autism spectrum disorders (ASD) (Bal et al., 2010; Wright et al., 2008) and children with autism with a lower range of cognitive ability (Celani, Battacchi, & Arcidiacono, 1999; Gross, 2004; Tardif, Lainé, Rodriguez, & Gepner, 2007).

Emotion recognition skills are thought to be a key component in the development of more complex social perception skills including mentalising ability and Theory of Mind (TOM) (Ashwin, Chapman, Colle, & Baron-Cohen, 2006). TOM is defined as the ability to attribute mental states (such as beliefs, desires and intentions) to others and to oneself, whilst the process of identifying these mental states has been referred to as 'mentalising' or 'mindreading' (Baron-Cohen, 2000). Typically developing children understand desires and intentions around 2 years of age, and knowledge and belief around 3–4 years (Sodian & Thoermer, 2008). Children with autism have difficulties understanding TOM relative to typically developing children (Baron-Cohen et al., 2000; Paynter & Peterson, 2010).

The *Transporters* DVD programme (Changing Media Development, 2006) was developed to teach emotion recognition skills to young children with autism aged 3–8 years. It features vehicles with human faces designed to engage children with

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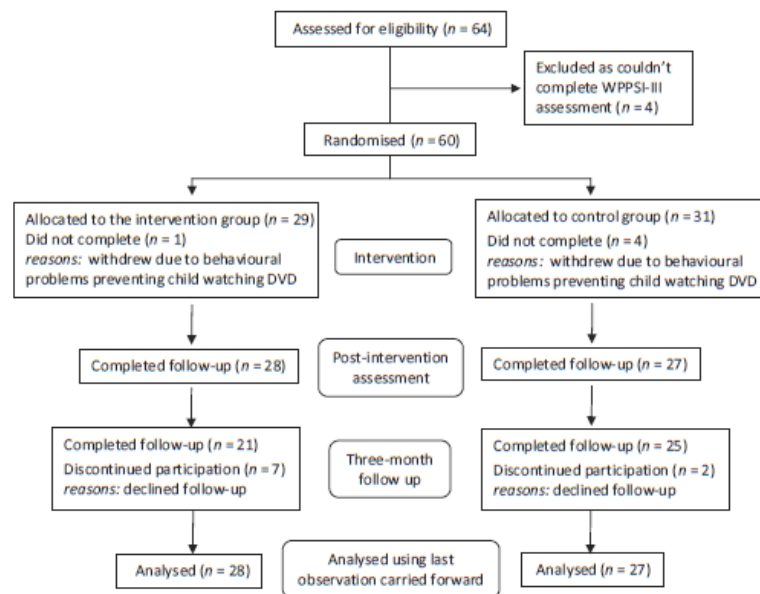Conflict of interest statement: No conflicts declared.

Figure 1 Flow of participants through the study

autism in learning about emotions. Two studies to date have evaluated the efficacy of the *Transporters* programme for children with autism. Golan et al. (2010) evaluated the use of the *Transporters* with a group of high-functioning children aged 4–7 years with an ASD. Twenty children with an ASD were compared with two control groups matched for age, sex and verbal ability; a group of 18 children with an ASD and a group of 18 typically developing children. Participants in the intervention group watched the *Transporters* DVD at home for 15 minutes a day over 4 weeks, whereas those in the control groups did not. All children were assessed before and after the intervention on their ability to (a) define emotional words, (b) match familiar situations and facial expressions taught in the *Transporters* DVD, (c) match novel situations and expressions similar to those in the *Transporters* DVD and to (d) match novel situations and expressions from a different emotion training programme. Analyses showed that participants in the intervention group improved significantly on all outcome measures compared with both control groups. Performance in the recognition of each individual emotion was not reported.

(Young and Posselt, 2012) evaluated the efficacy of the *Transporters* programme in comparison with a control DVD for a group of high-functioning children with ASD, aged 4–8 years. Participants were randomly allocated to an intervention group ($n = 13$) who watched the *Transporters* DVD for 15 minutes per day over 3 weeks, or with a control group ($n = 12$) who watched *Thomas the Tank Engine* for the same period of time per week. All participants were assessed pre and post intervention on their ability to recognise emotional expressions from pictures of basic and complex facial expressions and from the

NEPSY-II Affect Recognition Task (Korkman, Kirk, & Kemp, 2007). Children in the intervention group improved significantly on both emotion recognition tasks, although performance in the recognition of each individual emotion was not reported.

To date, there has been no research evaluating the efficacy of the *Transporters* with young children with a specific diagnosis of autistic disorder including those with co-morbid intellectual disability (ID).In addition, research is needed to determine whether improvements in emotion recognition skills generalise to improvements in other social perception skills including TOM. The current study aimed to evaluate the efficacy of the *Transporters* programme with a young sample of children with autistic disorder with a range of intellectual ability. It aimed to compare the *Transporters* DVD with a control DVD programme (*Thomas the Tank Engine*), as well as to determine whether improvements in emotion recognition skills generalised to improvements in TOM and social skills outcomes, and whether skills were maintained at 3-month follow-up. It was hypothesised that whilst the *Transporters* DVD would show some efficacy in teaching basic emotion recognition skills to children with autism, there would be limited generalisation to TOM and social skills.

Method
Participants

The sample included 55 children with a DSM-IV (American Psychiatric Association, 2000) diagnosis of autistic disorder. Participant demographic information is presented in Table 1. Participants met the following inclusion criteria: (a) met criteria for a diagnosis of autistic disorder, with diagnoses based on current

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Table 1 Participant demographics and initial assessment scores

	Intervention Group (n = 28)		Control Group (n = 27)		t (df)	p
	M (SD)	Range	M (SD)	Range		
Male (%)	89.3%		85.2%			
Age (months)	62.83 (11.17)	48.20–84.24	61.93 (9.91)	48.10–83.09	.32 (53)	.75
WPPSI FSIQ	77.93 (13.96)	54–107	74.56 (13.58)	42–96	.91 (53)	.37
WPPSI VIQ	73.61 (14.26)	48–93	74.33 (14.59)	46–107	−.19 (53)	.85
WPPSI PIQ	87.89 (16.24)	59–122	82.22 (15.57)	47–112	1.32 (53)	.19
DVD hours	11.76 (9.16)	3.33–47.12	7.41 (3.21)	1.58–14.67	2.25 (49)	.03
ADOS Severity Scores	6.79 (1.50)		7.56 (2.29)		−1.48 (53)	.15
FSIQ <69	25.0%		33.3%			
FSIQ 70–79	32.1%		33.3%			
FSIQ >79	42.9%		33.3%		Chi-square (df) =.66(2)	.72

WPPSI, WPPSI-III IQ, Full-Scale (FS IQ), Verbal (V IQ) and Performance (P IQ); ADOS, Autism Diagnostic Observation Schedule.

assessments, including the ADOS (Lord et al., 2000) and case reviews by the author (KG); (b) were aged from 4 to 7 years at baseline; (c) were able to complete a WPPSI-III cognitive assessment at baseline or had completed one in the past 12 months (i.e. were functioning cognitively at or above 30 months of age); and (d) had not previously watched the *Transporters*.

Project recruitment was from October 2009 to January 2011. Participants were recruited through the Monash University Centre for Developmental Psychiatry and Psychology, and through advertisements in early intervention programmes and autism support groups. Informed consent was obtained from parents of all participants. Ethics approval was obtained from Monash University and the Department of Education and Early Childhood Development (Victoria, Australia).

Measures

Intervention materials. The *Transporters* (Changing Media Development, 2006) is an animated and narrated children's television series designed to provide training in emotion recognition skills to children with ASDs aged 3–8 years (Golan et al., 2010). The programme consists of 15 five-minute episodes portraying 15 key emotions, including the six basic emotions and nine more complex emotions and mental states (e.g. excited, unfriendly, proud and jealous). The *Transporters* programme includes interactive quizzes to reinforce emotional learning and a Parent User Guide. Parents were encouraged to use the guide and help their child complete the quizzes.

For the purpose of the current study, *Thomas the Tank Engine* series five (Gullane (Thomas) Limited (1998)) was used to control for time spent watching children's DVDs. It was chosen due to similarities with the *Transporters* programme, namely the fact that it is a narrated and animated children's series, the characters are mechanical vehicles with faces, and the series contains multiple short episodes, but does not teach understanding of emotions.

Measures. The WPPSI-III (Wechsler, 2002) was used to measure cognitive functioning in terms of Full-Scale, Verbal and Performance IQ. The Socialization Domain of the Vineland-II survey form (Sparrow, Cicchetti, &

Balla, 2005) was used as a measure of social skills. The Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2000), a standardised measure of autism symptomatology, was used to assess degree of autism symptomatology. Standardised ADOS severity scores (Gotham, Pickles, & Lord, 2009) allowed for the comparison of symptomatology across different age groups and modules, with higher scores indicating greater severity of symptomatology.

Emotion identification and emotion matching tasks. A series of tasks were developed to assess the ability of each child to identify and match basic facial expressions of emotion. The photos used for these tasks were chosen from the *Pictures of Facial Affect* (Ekman & Friesen, 1976); a collection of 110 black and white photographs of adult models displaying six basic facial expressions (happiness, sadness, anger, fear, surprise and disgust). For the *emotion identification* (pointing) task, all six emotional expressions were used from 10 models from the *Pictures of Facial Affect* stimuli. Each picture had six different emotional expressions from six different models and the participant was required to point to a specific emotion for each picture (e.g. '*who is happy?*', '*who is sad*'). The target emotions were happiness, sadness, anger and fear. Surprise and disgust acted as distracters.

For the *emotion matching* task, four emotional expressions (happiness, sadness, anger and fear) were used from eight models from the *Pictures of Facial Affect* stimuli. A plain brown box was made for each emotion, with four different examples of the emotion attached to the front of each box. The other photos were made into cards for posting into the boxes. Different faces were used on the boxes and the cards to ensure that children were matching emotions not identities. During the assessment, the four boxes were placed in front of the child in a random order. The child was shown each box and told what each emotion was. The child was then shown one card at a time and was required to post the card into the box with the matching emotion.

NEPSY-II affect recognition and NEPSY-II TOM tasks. The *NEPSY-II Affect Recognition Task* (Korkman et al., 2007) was used as a measure of emotion recognition. The NEPSY-II Affect Recognition task was

designed to assess children's ability to recognise emotions from photos of children's faces. It has been normed with typically developing children aged 3–16 years. During the task, participants are required to match faces that display the same emotional expressions.

The *NEPSY-II Theory of Mind* subtests (Korkman et al., 2007) are comprised of a Contextual TOM task and a Verbal TOM task; both normed with typically developing children aged 3–16 years. The *NEPSY-II TOM Contextual task* was used to assess recognition of emotions in contextual situations. During the task, participants are required to choose a face depicting the emotion felt by the character in the situation. The *NEPSY-II TOM Verbal task* was used to assess understanding of other people's mental functions, thoughts and feelings, requiring participants to listen to stories, look at pictures and answer questions.

Situational and desire-based mindreading tasks. A series of *mindreading tasks* (Howlin, Baron-Cohen, & Hadwin, 1999) were used to measure ability to recognise emotions in contextual situations. For the purpose of the current study, six examples of situational emotions and six examples of desire-based emotions were selected. For the *situational emotions*, children were presented with a cartoon of a character with a blank face in a specific situation and were asked how the character was feeling. Participants responded by pointing to a happy, sad, angry, or scared face. For the *desire-based emotions*, participants were presented with a cartoon of a character with a blank face and were explained the situation and the character's desires. Participants were asked how the character was feeling, and they responded by pointing to a happy or sad face.

Procedure

A consultant statistician randomised the allocation to groups. Each DVD was packaged in an unmarked envelope, which was sequentially marked and distributed to the family at entry into the study. The clinician conducting the assessments remained blind to group allocations. During the intervention, five families withdrew from the study because of behavioural problems preventing the children from watching the DVD. Fifty-five children completed the intervention phase and a 1-month post intervention assessment. Eighty-four percent (*n* = 46) of the children completed a 3-month follow-up assessment.

All participants attended a baseline assessment session with a parent who completed a Vineland-II questionnaire during the session. Children completed an ADOS assessment at the start of the session and then completed the emotion tasks in a random order. Participants completed a cognitive assessment (WPPSI-III) if they had not completed one in the past 12 months. All participants completed the emotion-matching task. Some participants were unable to complete the other emotion and TOM tasks due to the cognitive demands of these tasks (Tables 2 and 3).

Participants watched their DVD at home for 15 minutes a day over 4 weeks. Parents completed a daily diary, recording the number of hours their child watched the DVD. To encourage adherence, parents received a weekly reminder via text message. Participants attended a post intervention assessment within 1 week of completing the intervention phase of the study, and again 3 months later. During the assessment, participants completed the emotion tasks in a random order and parents completed a Vineland-II questionnaire. At the end of the study, those children who received the *Thomas the Tank Engine* DVD received a copy of the *Transporters* DVD to keep.

Results

Mean scores on all outcome measures are presented in Tables 2 and 3. Last observation carried forward analysis was conducted on the nine children who withdrew between the post intervention and 3-month follow-up assessments. Pretreatment group differences were assessed using independent sample *t*-tests. There were no statistically significant group differences in demographic variables or outcome measures at baseline. Analysis of the distribution of FSIQ scores for the total sample indicated that 29% of children had FSIQ scores in the ID range, 33% had FSIQ scores in the Borderline range (70–79), and 38% had FSIQ scores above 79. Chi-squared analysis showed no significant difference in the distribution of FSIQ scores between groups (Table 1.).

Independent sample *t*-test analysis indicated that children in the intervention group watched more DVD hours than those in the control group (Table 1.). As a result, the number of DVD hours was included as a covariate in analyses. Mixed-design regression analysis was used to investigate differences between the intervention and the control groups on outcome measures from Time 1 to Time 2 (intervention phase) and from Time 2 to Time 3 (maintenance phase). Regression analysis controlled for the effects of chronological age, WPPSI VIQ, gender and DVD hours. In general, chronological age and WPPSI-III VIQ scores were found to be significant predictors of performance on the outcome measures, whilst gender and DVD hours were not.

Intervention phase (Time 1 to Time 2)

For the emotion identification task regression analysis showed a significant effect of intervention by time for the identification of expressions of anger [$B = .73$ (.26), $p = .01$]. For the emotion-matching task, regression analysis showed a significant effect of intervention by time for the matching of all four expressions of emotion (total score) [$B = 1.68$ (.59), $p = .00$] and specifically for the matching of expressions of anger [$B = .81$ (.37), $p = .03$]. In summary, those in the intervention group showed significant improvements from Time 1 to Time 2 in the identification of expressions of anger, in the matching of all expressions of emotion (total score), and specifically in matching anger compared with the control group.

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Table 2 Means and SDs for the emotion identification and emotion-matching tasks for the intervention and control groups over time

Identification of emotions

	Total emotions[a] (max score = 12)		Happiness[b] (max score = 3)		Sadness (max score = 3)		Anger[a,b] (max score = 3)		Fear (max score = 3)	
	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)
	n = 25	n = 22	n = 25	n = 22	n = 25	n = 22	n = 25	n = 22	n = 25	n = 22
Time 1	8.12 (2.62)	7.00 (2.32)	2.68 (0.56)	2.42 (0.83)	1.64 (1.08)	1.17 (0.82)	1.88 (1.09)	1.58 (1.14)	1.92 (1.15)	1.79 (1.06)
Time 2	8.62 (2.71)	7.24 (2.59)	2.73 (0.67)	2.48 (0.96)	1.46 (1.07)	1.40 (0.87)	2.19 (.90)	1.68 (0.99)	2.23 (.99)	1.68 (0.85)
Time 3	9.00 (2.29)	7.36 (3.25)	2.88 (.33)	2.52 (.96)	1.80 (1.08)	1.40 (1.19)	2.12 (1.05)	1.84 (1.07)	2.20 (.87)	1.64 (1.11)

Matching of emotions

	Total emotions[a] (max score = 16)		Happiness (max score = 4)		Sadness (max score = 4)		Anger[a] (max score = 4)		Fear (max score = 4)	
	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)
	n = 28	n = 27	n = 28	n = 27	n = 28	n = 27	n = 28	n = 27	n = 28	n = 27
Time 1	10.64 (4.08)	10.63 (3.77)	3.21 (1.17)	3.04 (1.22)	2.68 (1.31)	2.41 (1.39)	2.00 (1.54)	2.41 (1.34)	2.75 (1.30)	2.74 (1.26)
Time 2	11.39 (4.34)	9.81 (3.63)	3.39 (1.13)	3.33 (1.07)	2.68 (1.42)	2.30 (1.51)	2.61 (1.32)	2.11 (1.01)	2.71 (1.33)	2.07 (1.39)
Time 3	11.82 (3.66)	10.26 (4.11)	3.61 (0.79)	3.30 (1.10)	2.79 (1.34)	2.48 (1.37)	2.54 (1.23)	2.00 (1.44)	2.89 (1.17)	2.48 (1.25)

Time 1 = baseline, Time 2 = post intervention, Time 3 = 3-month follow-up.
[a]Significant intervention by time effect ($p < .05$) from T1 to T2, controlling for age, VIQ, gender and DVD hours.
[b]Significant intervention by time effect ($p < .05$) from T2 to T3, controlling for age, VIQ, gender and DVD hours.

Table 3 Means and SDs for the NEPSY-II, mindreading and Vineland-II socialization domain scores for the intervention and control groups over time

	NEPSY-II					
	NEPSY-II affect recognition (max score = 25)		NEPSY-II TOM verbal (max score = 15)		NEPSY-II TOM contextual[b] (max score = 6)	
	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)
	n = 21	n = 18	n = 15	n = 18	n = 20	n = 20
Time 1	12.33 (4.20)	12.72 (3.53)	7.60 (3.68)	6.28 (3.10)	3.63 (1.67)	2.83 (1.10)
Time 2	14.53 (4.30)	13.22 (3.26)	7.93 (3.47)	6.22 (2.88)	4.24 (1.60)	3.26 (1.24)
Time 3	16.00 (4.66)	13.17 (3.43)	9.67 (3.27)	6.94 (3.40)	3.70 (1.49)	3.80 (1.40)

	Mindreading and social skills					
	Mindreading situational[b] (max score = 6)		Mindreading desire-based (max score = 6)		Vineland-II socialization domain	
	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)	Intervention M (SD)	Control M (SD)
	n = 23	n = 21	n = 23	n = 20	n = 27	n = 27
Time 1	4.35 (1.50)	4.55 (1.91)	4.22 (1.59)	4.00 (1.29)	74.22 (13.66)	71.93 (9.94)
Time 2	4.55 (1.65)	5.00 (1.00)	4.18 (1.37)	3.95 (1.10)	76.05 (13.06)	72.26 (11.10)
Time 3	5.05 (0.91)	4.50 (1.61)	4.32 (1.46)	4.42 (1.54)	76.35 (13.11)	73.52 (9.80)

Time 1 = baseline, Time 2 = post intervention, Time 3 = 3-month follow-up.
[a]Significant intervention by time effect ($p < .05$) from T1 to T2, controlling for age, VIQ, gender, DVD hours.
[b]Significant intervention by time effect ($p < .05$) from T2 to T3, controlling for age, VIQ, gender, DVD hours.

There were no significant intervention by time effects for the NEPSY-II affect recognition task, the mindreading, or TOM tasks. There was no significant intervention by time effects for the Vineland-II Socialization scores.

Maintenance phase (Time 2 to Time 3)

Children in the intervention group showed improvement on two measures during the maintenance phase. This was represented by significant intervention by time effects for the identification of expressions of happiness [B = .60 (.26), p = .02] and for performance on the mindreading situational task [B = 1.10 (.51), p = .03]. These results suggest that the ability to identify happiness and performance on the mindreading situational task showed improvement from Time 2 to Time 3 for those in the intervention group compared with those in the control group.

Two measures showed a significant decrease in scores during the maintenance phase for those in the intervention group compared with the control group. This was represented by significant intervention by time effects for the identification of expressions of anger [B = −.68 (.29), p = .02] and results on the NEPSY-II TOM Contextual task [B = −.99 (.38), p = .01]. This suggests that some improvements in the recognition of expressions of anger from Time 1 to Time 2 were not maintained over time.

Predictors of successful outcomes for participants in the intervention group

Further analysis was conducted to examine the influence of demographic variables (chronological age, VIQ and ADOS severity scores) on improvements on outcome measures (emotion recognition and TOM tasks) for participants in the intervention group. Improvements in emotion recognition, mindreading and TOM scores were calculated for Time 1 to Time 2 (short-term improvements) and Time 1 to Time 3 (long-term improvements) for each participant. Partial correlations were calculated for demographic variables (chronological age, VIQ and ADOS severity scores) against improvements in outcome measures (Time 1 to Time 2, and Time 1 to Time 3), controlling for differences in outcome measure scores at baseline. Analysis indicated that higher chronological age and VIQ scores were associated with greater short-term and long-term improvements in the recognition of fear, whereas higher chronological age was specifically associated with short-term and long-term improvements on the NEPSY-II Affect Recognition and mindreading desire-based task. Higher VIQ scores were significantly associated with short-term and long-term improvements on the mind-reading situational task (Table 4). Higher ADOS severity scores were associated with greater long-term improvements in the identification of happiness and matching of emotions (specifically for sadness) only.

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Table 4 Partial correlations for demographic variables against improvements in outcome measures for the intervention group, controlling for differences in baseline outcome measure scores

	Time 1 to Time 2			Time 1 to Time 3		
	Age	VIQ	ADOS	Age	VIQ	ADOS
Emotion identification (Total)	.29	.29	.13	.50*	.26	.18
Happiness	−.03	.43*	−.31	.12	.29	.45*
Sadness	−.12	.19	−.20	.26	.20	−.18
Anger	.37	.13	.37	.40	.20	.03
Fear	.44*	.48*	−.03	.53*	.40	−.06
Emotion matching (Total)	−.24	.25	.14	.14	.17	.47*
Happiness	−.15	.42*	−.33	.07	.20	−.05
Sadness	.11	.39	.08	.41*	.15	.41*
Anger	−.07	.28	−.30	−.05	.26	.14
Fear	.28	.51*	.19	.28	.45*	.17
NEPSY-II affect recognition	.59*	.19	.41	.56*	.45	.14
NEPSY-II TOM (total)	−.16	.19	−.27	.13	.59*	−.13
Mind reading situational	.29	.72**	−.03	.32	.58*	−.46
Mind reading desire-based	.63**	.31	.06	.68**	.31	.09

$*p < .05$; $**p < .01$.
Person correlations: Age/VIQ ($r = .16$); Age/ADOS ($r = −.12$); VIQ/ADOS ($r = .01$);Time 1 to Time 2 = short-term improvements; Time 1 to Time 3 = long-term improvements.

Discussion

These results provide limited support for the efficacy of the *Transporters* programme in teaching basic emotion recognition skills to young children with autism. Following the intervention phase, children in the intervention group showed improvements in their ability to identify and match expressions of anger only, compared with children in the control group. Only improvements in matching (but not in identifying) expressions of anger were maintained at 3-month follow-up. There was some improvement in the identification of happiness and situational mindreading skills for participants in the intervention group during the maintenance phase. Overall, improvements in emotion recognition skills did not generalise to improvements in desire-based mindreading, TOM or social skills.

The reason for the specific improvements in the recognition of anger, but not in the recognition of happiness, sadness or fear, remains unclear. It was not due to a disproportionately higher focus on anger in the intervention, as only three *Transporters* episodes referred to anger, whereas 13 referred to feelings of happiness, 9 to sadness and one to fear. Instead, it may have been that children found the episodes containing anger to be more interesting. Further, improvements in the current study may have been due to anger being the most difficult of the four emotions for children with autism to recognise at baseline. Examination of the mean scores at baseline suggested that anger was the least accurately matched of the four basic emotions, and the second least accurately identified emotion (following sadness). Previous research has reported specific emotion recognition difficulties in the recognition of anger, but not other basic emotions for children with high-functioning ASDs (Bal et al., 2010; Wright et al., 2008). However, it is unlikely that baseline differences in emotion recognition accuracy can fully explain the specific findings in relation to anger.

The current results provide less compelling support for the efficacy of the *Transporters* intervention than previous findings reported in the literature. Golan et al. (2010) and (Young and Posselt, 2012) investigated the efficacy of the *Transporters* programme for children with high-functioning ASDs and both studies reported improved performance across basic and complex emotions for children in the intervention groups. In contrast, the current study measured individual basic emotions, with results limited to improvements in the identification and matching of only one emotional expression (anger) following the intervention, with improvements in identifying anger not maintained at follow-up. There are some variations in participant demographic variables between these studies, including the fact that in the current study, participants had a lower range of cognitive ability, much lower verbal IQ scores and a specific diagnosis of autistic disorder as opposed to ASD. The current study failed to replicate support for the efficacy of the *Transporters* programme for use in this lower-functioning group of young children with autism.

The current study included measures of mind-reading and TOM ability. Our results indicated that there were long-term improvements in situational mindreading skills, but no improvements in desire-based mindreading or TOM skills. The situational mindreading task required participants to infer how a character was feeling in a specific situation, whereas the desire-based mindreading task required further understanding of mental states based on the characters specific desires (similar to TOM skills). The absence of improvements in desire-based mindreading and TOM skills following intervention was unlikely to have been due to the low cognitive ability of participants in our study because the TOM

tasks were developed for typically developing children aged 36 months and our participants had a minimum cognitive ability of 30 months with the lowest functioning children ($n = 12$) not completing any of the TOM tasks. It may be that improvements in a wider range of emotions, or direct training in TOM skills, are required for improvements in TOM skills to be observed.

Analysis of the predictors of successful outcomes for children in the intervention group indicated a pattern wherein higher chronological age and VIQ scores were significantly correlated with short-term and long-term improvements in the recognition of fear, performance on the NEPSY-II affect recognition task and the mindreading situational and desire-based tasks. Higher ADOS severity scores were only significantly correlated with greater long-term improvements in the identification of happiness and matching of sadness. These results suggest that the *Transporters* programme may be most efficacious for older children with higher verbal skills, and that severity of autism symptoms had minimal influence on successful outcomes for this intervention. Our results are contrary to (Young and Posselt, 2012)\ who reported no significant correlation between VIQ and improvements in emotion recognition skills for participants in the intervention group. This may be due to the current study including children with a lower range of IQ and verbal ability, and having controlled for differences in outcome measure scores at baseline.

There were some limitations to the current study. Some children were unable to complete more than the basic emotion-matching task, and emotion tasks were limited to the identification and matching of four basic expressions of emotion due to the young developmental age of participants. The current study did not measure recognition of the complex emotions targeted in the intervention, as we were unable to access well-validated tasks to reliably measure this construct in this group of children. Thus, it remains unknown whether children improved in their recognition of these more complex emotions. Furthermore, the current study did not collect data for how many parents used the *Transporters* Parent Users Guide and how many children completed the *Transporters* quizzes. It would be interesting to know whether using these materials increased child learning.

In conclusion, the results of the current study showed the *Transporters* programme to have limited efficacy in teaching basic emotion recognition skills to lower-functioning young children with autism, with improvements limited to the recognition of expressions of anger. Only improvements in matching anger were maintained over time, with some improvement in the identification of happiness and situational mindreading skills identified at long-term follow-up. Improvements did not generalise to TOM or broader social skills. These findings, along with the relatively weak evidence of maintenance and the lack of generalisation, provide limited support for the efficacy of the *Transporters* programme for young children with autism of a lower cognitive range. Taken together with previous research, the results of this study suggest that the *Transporters* programme may be more efficacious for older, higher-functioning children with autism.

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Key points

- The *Transporters* programme showed limited efficacy in teaching basic emotion recognition skills to young children with autism of a lower cognitive range.
- Improvements were limited to the recognition of expressions of anger, with poor maintenance of these skills at follow-up.
- Taken together with previous research, the results of this study suggest that the *Transporters* programme may be more efficacious for older, higher-functioning children with autism.

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Chapter 5. | **Research Paper 2**

Are Emotion Recognition Skills Related to Autism

Symptom Severity in Children with Autism?

5.1 Declarations

5.1.1 Declaration by candidate:

For Chapter 5 the extent of my contribution was 70%. The nature of my contribution

was: data collection, data analysis, interpretation of findings, and drafting and

submission of the research paper.

The following co-author contributed to this work.

Name	Nature of contribution
Dr Kylie Gray	Conception of research design and assistance with the interpretation of findings. Provided direction on the paper and advice regarding where to publish. Reviewed, revised, and provided feedback and edits on the paper.

Candidate's signature:		Date:

5.1.2 Declaration by co-authors for paper 2:

Declaration by co-author for Paper 2:

The undersigned hereby certify that:

(1) The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature and contribution of each of the co-authors;

(2) They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least part of the publication in their field of expertise;

(3) They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

(4) There are no other authors of this publication according to these criteria;

(5) Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of publications, and (c) the head of the responsible academic unit; and

(6) The original data are stored at the following location and will be held for at least five years from the date indicated below:

Location: The Monash University Centre for Developmental Psychiatry and Psychology

| Dr. Kylie Gray | ████████████ | Date: 31·8·12 |

5.2 Paper Commentary and Paper 2

Chapter 5 presents a paper that has been submitted to the *International Journal of Developmental Disabilities.* This paper has been formatted to the specific requirements of the journal. Page numbers have been re-numbered to provide consistency throughout the thesis.

Paper 2 assessed the relationship between autism symptom severity and emotion recognition ability for 55 young children with autism. This paper used measures completed during the baseline phase of the intervention study (paper 1). Only two previous studies had been published on this topic, with findings suggesting that increased autism symptom severity may be related to reduced emotion recognition accuracy in older children and adolescents with ASD. More research was needed to investigate the relationship between autism symptom severity and emotion recognition skills in young children with autism, including those of a lower range of cognitive ability.

Title: Are emotion recognition skills related to autism symptom severity in children with autism?

Objectives: This study aimed to assess the relationship between degree of autism symptom severity (as measured by the ADOS and the SRS) and emotion recognition ability in young children with autism.

Methods: The sample consisted of 55 children with Autistic Disorder aged four to seven years with a range of cognitive ability. Participants completed emotion identification and matching tasks for facial expressions of happiness, sadness, anger and fear, as well as situation-based and desire-based emotion tasks.

Results: Regression analyses controlled for the influence of age and IQ on results, demonstrating that higher autism severity scores were associated with reduced accuracy in the recognition of facial expressions of fear and anger, as well as decreased accuracy in the identification of desire-based but not situation-based emotions.

Discussion: Results suggest that autism symptomatology may be related to less accurate recognition of expressions of anger and fear.

Key words: Autism severity, emotion recognition, young children

Social deficits are a core feature of autism (American Psychiatric Association; APA, 2000), and it has been suggested that difficulties in recognising and responding to emotions may underlie these social problems (Baron-Cohen et al., 2009). Evidence suggests that individuals with autism have difficulty recognising facial expressions of emotion (Harms et al., 2010: Schultz, 2005) and atypical responses to facial expressions have also been reported in the relatives of individuals with autism, suggesting that difficulties in emotion recognition skills may underlie the broader autism phenotype (Spencer et al., 2011). However, some research has reported finding no difficulties in emotion recognition in autism (e.g. Castelli, 2005; Gepner et al., 2001) suggesting that the relationship between autism symptomatology and emotion recognition ability is not well understood.

The majority of research investigating emotion recognition difficulties in autism has focused on individuals with High-Functioning Autism (HFA). This is often because individuals with HFA are better able to follow instructions and complete the experimental tasks. Research with individuals with HFA also controls for the confounding influence of intellectual disability (ID) on emotion recognition performance. There is less research with children with autism who also have an ID despite the high rate of comorbid ID and developmental delay in autism (Cotugno, 2009).

Research with children with DSM-IV (APA, 2000) diagnosed Autistic Disorder and comorbid ID suggests that difficulties in emotion recognition may be specific to autism; beyond difficulties attributable to cognitive impairment. Children with autism

and ID have been shown to be less accurate than chronological age-matched typically developing children as well as verbal mental age (VMA)-matched typically developing children in their ability to identify and match basic expressions of emotion from photographs and videos of faces (Celani et al., 1999; Feldman et al., 1993; Tardif et al., 2007). They have also been shown to be less accurate than age-matched children with ID without a Pervasive Developmental Disorder (PDD) as well as VMA-matched children with Down Syndrome in their ability to label and match photos of basic facial expressions (Celani et al., 1999; Tantam et al, 1989).

Additionally the comparison of children with autism and comorbid ID to multiple clinical comparison groups (children with developmental language disorders without ID, children with ID without a PDD, and children with a clinical diagnosis that is not a PDD or language disorder) has shown children with autism and comorbid ID to be less accurate than children in the non-autism control groups in their ability to recognise photos of faces displaying sadness, anger and surprise across three species of emotional expression (human, orang-utan and canine) (Gross, 2004), and less accurate than children in these non-autism control groups in their ability to match photos displaying human emotional expressions and canine emotional expressions of happiness, sadness and anger (Gross, 2005).

There is however some research suggesting that children with autism and comorbid ID do not differ significantly from typically developing children in the recognition of facial expressions of emotion. For example, children with autism and ID were found not to differ significantly from developmentally age-matched typically developing children as well as VMA-matched typically developing children in their

ability to match and label basic expressions of emotion from videos and photographs of faces (Gepner et al., 2001; Lacroix et al., 2009; Ozonoff et al., 1990). They have also been found not to differ from typically developing children matched for sex, chronological age and VMA in their ability to match photos of basic facial expressions of emotion with affective sounds, gestures, and contextual pictures (Prior et al., 1990).

Differences between studies may be due to varying participant characteristics including age, IQ, diagnosis (autism, Asperger's Disorder or PDD-NOS), differences in control group characteristics (whether they were matched for chronological age, developmental age, verbal mental age or IQ), and differences in task demands such as the type of emotions targeted (basic or complex emotions) and the format of the tasks (matching, identifying or labelling of emotions) from different stimuli (photographs, cartoons or video clips). The ability of children with autism to match facial expressions has been shown to correlate positively with verbal ability (Buitelaar et al., 1999; Happe, 1994) and be associated with age (Gepner et al., 2001).

One approach to investigating emotion recognition difficulties in autism is to examine the relationship between degree or severity of autism symptomatology and emotion recognition ability. The existence of a relationship between severity of autism symptoms and emotion recognition difficulties would provide support for the body of research suggesting that emotion recognition difficulties are a feature of autism and would suggest that those individuals with more severe autism symptomatology may have greater emotion recognition difficulties. Several standardised measures allow for the assessment of the amount of autism-specific symptoms in children with autism, enabling the comparison of the relative severity of symptoms between children. These

include the Childhood Autism Rating Scale (CARS; Schopler et al., 1980), the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) and the Autism Diagnostic Observation Schedule (ADOS) standardised severity scores (Gotham et al., 2009). Whilst these measures allow for the calculation of the severity of autism symptomatology they do not measure the child's level of functional impairment which is a separate construct.

Only two studies have investigated the relationship between severity of autism symptomatology and emotion recognition ability. One study compared symptoms of autism as measured by the CARS with emotion recognition performance, for twelve children and adolescents with DSM-IV diagnosed autism and comorbid ID aged 7 to 14 years (Tardif et al., 2007). Participants were required to identify expressions of joy, surprise, sadness and disgust from video clips of an actor portraying facial expressions. A significant correlation was found between emotion recognition accuracy and degree of autism symptomatology as measured by the CARS. This finding suggests that increased autism symptom severity may be associated with greater emotion recognition difficulty, however the possible confounding effects of age and IQ were not considered in the analysis. Further, researchers did not include measures of happiness, anger and fear recognition.

Another study examined the relationship between autism symptomatology and emotion recognition ability in a sample of 35 children and adolescents with an Autism Spectrum Disorder (ASD; HFA n = 6, Asperger's Disorder n = 29) and 35 typically developing children and adolescents, aged 7 to 16 years (Wright et al., 2008). Participants were matched for sex, age and IQ. Researchers analysed the relationship

between scores on the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2006) and children's ability to recognise photos of faces displaying happiness, sadness, anger, fear, surprise and disgust. A diagnosis of an ASD and more symptoms of autism (i.e. higher AQ scores) were both significantly associated with reduced accuracy in the identification of happiness and anger only.

This study aimed to extend the current body of knowledge on the relationship between severity of autism symptomatology and emotion recognition ability, specifically in young children with Autistic Disorder with a range of intellectual ability including those with an ID. Based on previous research it was hypothesised that a more severe degree of autism symptomatology would be associated with reduced accuracy in emotion recognition ability, above and beyond the influence of chronological age, cognitive ability and communication skills.

Methods

Participants

A total of 55 children participated in this study. Participant demographic information is presented in Table 1. Study inclusion criteria included having a diagnosis of Autistic Disorder (DSM-IV-TR criteria, APA, 2000)) and being aged 4 to 7 years of age (48 to 84 months). For the purpose of this study diagnosis was confirmed based on an independent diagnostic review by author KG experienced in the assessment of autism in children as well as information obtained from the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). Three children did not meet ADOS criteria for Autism Spectrum Disorder but did meet DSM-IV-TR criteria for Autistic Disorder

through independent diagnostic review based on all available information. In addition, all three children met the cut-off on the Social Responsiveness Scale. Due to the cognitive demands of the emotion recognition tasks, participants were excluded from the study if they could not complete a WPPSI-III assessment (i.e., they were functioning cognitively below 30 months of age).

Participants were recruited through the Monash University Centre for Developmental Psychiatry and Psychology autism assessment program, and through advertisement in early intervention schools, paediatrician offices, and autism-related support groups including *Autism Victoria*. Informed consent was obtained from parents of all participants.

< insert Table 1 about here>

Measures

Autism symptomatology

The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) and the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) were used to assess the severity of autism symptomatology. The ADOS is a standardised measure of autism symptomatology which uses planned social occurrences, or "presses", to create situations in which a range of social responses and initiations are likely to occur. During an assessment the presence or absence of specific behaviours are recorded, with higher scores indicating greater abnormality. Recently ADOS scores were standardised to allow for the calculation of an autism severity score (Gotham et al., 2009). This research was based on a dataset of 1,415 individuals with ASD and non-ASD diagnoses

aged 2-16 years. The resulting severity scores range from 1 to 10, with scores of 4 to 5 corresponding with ASD (i.e., Asperger's Disorder or PDD-NOS) and scores of 6 to 10 corresponding with Autistic Disorder. These severity scores allow for the comparison of ADOS scores across different ages, modules and time points, with higher scores indicating greater degree of autism symptomatology or severity of symptoms.

The Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) was also used as a measure of severity of autism symptomatology. The SRS is a 65-item carer-completed questionnaire which measures a child's ability to engage in emotionally appropriate reciprocal social interactions. Higher scores on the SRS indicate greater severity in social impairment. The SRS has shown high levels of sensitivity and specificity in the differentiation of children with ASD from typically developing children and those with non-ASD diagnoses (Bölte et al., 2011). It has also shown good concurrent validity with the Autism Diagnostic Interview-Revised (ADI-R; Lord et al., 1994) and high independence from IQ scores (Constantino et al., 2003).

Cognitive Assessment, Adaptive Functioning and Behavioural Assessment

The WPPSI-III (Wechsler, 2002) was used to measure cognitive functioning. The WPPSI-III is a standardised assessment of cognitive ability for children aged 2 years 6 months to 7 years 3 months. The WPPSI-III gives an overall estimate of cognitive ability as a Full-Scale Intelligence Quotient (FSIQ) and composite scores for Verbal and Performance IQ (VIQ and PIQ).

The Vineland-II survey form (Sparrow et al., 2005) is a carer-completed questionnaire used to assess a child's current level of adaptive behaviour in terms of

four domains; Communication ability, Daily living skills, Socialization, and Motor ability. The Vineland-II gives a total score for adaptive behaviour (the Adaptive Behaviour Composite or Vineland-II ABC) as well as the four domain scores.

The Developmental Behaviour Checklist (DBC; Einfeld & Tonge, 1995) is a carer-completed measure of behavioural and emotional problems in children with intellectual disability (ID) aged 4 to 18 years. It includes five subscales; Disruptive/Antisocial, Self-Absorbed, Communication Disturbance, Anxiety and Social Relating.

Emotion Recognition Tasks

A series of tasks were developed to assess the ability of each child to identify and match facial expressions of emotion. The photos used for the emotion identification and matching tasks were chosen from the *Pictures of Facial Affect* (Ekman & Friesen, 1976) which is a collection of 110 black and white photographs of adult models displaying six basic facial expressions of happiness, sadness, anger, fear, surprise, and disgust.

Emotion Identification Task   For the emotion identification (pointing) task six emotional expressions (happiness, sadness, anger, fear, surprise and disgust) were used from 10 adult models from the *Pictures of Facial Affect* stimuli. Each of the 10 pictures had six different emotional expressions from six different models and the participant was required to point to a specific emotion for each picture (e.g., "*who is happy?*" or "*who is sad*"). Four emotions acted as the target emotions (happiness, sadness, anger and fear), and surprise and disgust acted as distracters.

Emotion Matching Task For the emotion matching task four emotional expressions (happiness, sadness, anger and fear) were used from eight adult models from the *Pictures of Facial Affect* stimuli. A plain brown box was made for each emotion, with four different examples of the emotion attached to the front of each box. The other photos were made into cards for posting into the boxes. Different faces were used on the boxes and the cards to ensure that children were matching emotions not identities. During the assessment the four boxes were placed in front of the child in a random order. The child was shown each box and told what the emotion was (e.g., "*these people feel happy*"). The child was then shown one card at a time and was required to post the card into the box with the matching emotion (e.g., "*who feels the same as this person*?"). Four examples of each emotion were presented to the participant for matching.

Contextual Emotion Recognition Task (situation-based and desire-based emotions) The mind-reading tasks from *Teaching Children with Autism to Mind-Read* (Howlin et al., 1999) were used to measure participants ability to recognise emotions in contextual situations. For the purpose of the current study six examples of situation-based emotions and six examples of desire-based emotions were selected. For the situation-based emotions, children were presented with a cartoon of a character with a blank face in a specific situation and were asked how the character was feeling. For example, participants were shown a picture of a boy being chased by a dog and were asked how the boy was feeling. Participants responded by pointing to a happy, sad, angry, or scared face. For the desire-based emotions, participants were presented with a cartoon of a character with a blank face and told about the situation and the

character's desires. For example "Adrian wants a book about trains. His mummy buys him a car book. How does Adrian feel?" Participants were asked how the character was feeling and they responded by pointing to a happy or sad face.

Procedure

All participants attended an assessment session with a parent who was seated at the back of the room behind the child. Participants completed an ADOS assessment at the start of the session. They then completed the emotion tasks in a random order. Finally participants completed a cognitive assessment (WPPSI-III) if they had not had one conducted in the past twelve months. Parents completed the Vineland-II survey form, DBC parent form and the SRS parent form during the session. All participants completed the emotion matching task but some were unable to complete the identification, situation-based and desire-based tasks because of the cognitive demands of the task. The number of participants who completed each task is presented in Table 1. Additionally some children did not complete the cognitive assessment during the initial assessment session because of time constraints and these families were invited to attend a second assessment session the following week in order to complete the cognitive assessment.

Results

Analysis of the distribution of FSIQ scores indicated that 29% of children had FSIQ scores in the ID range, 33% had FSIQ scores in the Borderline IQ range (70-79) and 38% had FSIQ scores above 79 (as shown in Table 1.). Chronological age was distributed uniformly among these three FSIQ groups. Mean scores on the DBC anxiety subscale were compared with a normative sample of children of a similar age with ID (Einfeld &

Tonge, 1996a,b), with results indicating that children in the current study had higher anxiety scores ($t(143) = 2.20$, $p<.05$). However there were no significant correlations between DBC anxiety scores and performance on the emotion recognition tasks, suggesting that level of anxiety did not appear to have influenced emotion recognition performance.

Correlations between measures are outlined in Table 2. Autism symptom severity, as measured by the ADOS, was not significantly correlated with chronological age, WPPSI VIQ or PIQ scores, or Vineland-II Communication or ABC scores. However, symptom severity as measured by the SRS was significantly correlated with chronological age and Vineland-II ABC scores, whilst correlations with the WPPSI VIQ and the Vineland-II Communication domain approached significance. These results suggest that the ADOS severity scores may be a more reliable measure of autism symptomotology, as unlike the SRS, the ADOS scores appeared independent of chronological age, IQ, communication skills and adaptive functioning.

The ADOS severity scores had significant negative correlations with the emotion identification task and the desire-based emotion task, suggesting that higher ADOS severity scores were associated with reduced emotion recognition accuracy on these tasks. SRS scores had significant negative correlations with the emotion matching task and the desire-based emotion task, suggesting that higher scores on the SRS (higher autism severity) were associated with reduced emotion recognition accuracy. There were also significant positive correlations for performance on the emotion tasks with chronological age, WPPSI IQ (VIQ and PIQ) scores, and Vineland-II Communication and Adaptive Behaviour Composite scores.

Regression analyses were performed to investigate the association between ADOS severity scores and emotion recognition ability, and SRS scores and emotion recognition ability, controlling for the confounding influence of chronological age and VIQ on performance. VIQ was chosen to control for the influence of cognitive ability and communication skills given its strong positive correlations with FSIQ ($r = .84$) and PIQ ($r = .59$) scores, and with Vineland-II Communication domain scores ($r = .65$). As shown in Tables 3 and 4, the regression analyses indicated a pattern whereby age and VIQ were related to accuracy in identifying and matching expressions of happiness and sadness (but not anger and fear), as well as in the identification of situational and desire-based emotions.

< insert Table 2 about here >

Linear regression analyses were conducted to examine the relationship between ADOS severity scores and emotion recognition performance, controlling for the influence of chronological age and WPPSI VIQ scores. As shown in Table 3, increased ADOS severity scores were significantly associated with reduced accuracy in identifying facial expressions of emotion, as shown by the total score for the identification of all emotions (total for happiness, sadness, anger and fear). Further regression analyses for each specific emotion indicated that higher ADOS severity scores were significantly associated with reduced accuracy in the identification of expressions of fear. Additionally, higher ADOS severity scores were associated with reduced accuracy in the identification of desire-based but not situation-based emotions.

< insert Table 3 about here >

As shown in Table 4, increased ADOS severity scores were associated with reduced accuracy in matching all emotions (total for happiness, sadness, anger and fear) and specifically for matching expressions of anger, but these results did not reach significance.

Linear regression analyses were conducted to examine the relationship between SRS scaled scores and emotion recognition measures, controlling for the influence of chronological age and WPPSI VIQ scores. SRS scores were not significantly associated with ability to identify the four basic expressions of emotion or ability to identify the situation-based or desire-based emotions (as shown in Table 3). For the emotion matching task, higher SRS scaled scores were significantly associated with reduced accuracy in matching expressions of anger only (as shown in Table 4).

< insert Table 4 about here >

Discussion

The results of the regression analyses indicated that higher ADOS severity scores were associated with reduced accuracy in the identification of expressions of fear and desire-based emotions, with a trend towards reduced accuracy in the matching of expressions of anger. Further, higher SRS scores were associated with reduced accuracy in the matching of facial expressions of anger only. Collectively these results suggest that increased severity of autism symptomatology was related to reduced accuracy in emotion recognition ability, specifically in relation to the recognition of expressions of fear, anger, and desire-based emotions, above and beyond the influence of age and cognitive ability.

These results support previous findings of a relationship between autism symptomatology and emotion recognition accuracy (Tardif et al., 20007; Wright et al., 2008), extending these findings to young children with autism. Consistent with Tardif et al. the current study found an association between increased autism symptom severity and reduced accuracy in the recognition of basic expressions of emotion. However Tardif et.al. (2007) did not measure accuracy in the recognition of specific emotions of fear and anger, did not report results for each individual emotion, and did not control for the influence of age and IQ on results. The current study controlled for the influence of age and VIQ on emotion recognition ability, finding an association between increased autism symptom severity and reduced accuracy in the identification of the specific emotions of anger and fear. This finding for anger is consistent with Wright et al. (2008). However unlike Wright et al., the current study did not find an association between increased autism symptom severity and reduced accuracy in the recognition of happiness, but instead found an association for the recognition of fear.

This difference may be due to the current study having controlled for the influence of age and VIQ on results. As previously discussed, age and IQ have been shown to impact on emotion recognition ability but previous research did not control for the influence of these covariates when investigating the relationship between autism symptom severity and emotion recognition ability. In the current study regression analyses showed that age and VIQ were consistently related to accuracy in identifying and matching expressions of happiness and sadness, and in the identification of situational and desire-based emotions. When these covariates were

included in the analysis, autism symptom severity was related to recognition of anger and fear, and desire-based emotions only.

The current study also differed from previous research in that it included younger children with a specific diagnosis of Autistic Disorder and with a range of intellectual ability (29% with FSIQ scores in the ID range) and it used two measures of autism symptom severity (the ADOS and SRS) not used in prior research. The current study also extended past research by incorporating measures of contextual emotions (situation and desire-based emotions). The characters in the contextual emotion recognition cartoons did not have facial expressions and participants were required to infer how the character was feeling from the situation. The current study found a significant association between increased autism symptomatology (ADOS severity scores) and reduced accuracy in the identification of desire-based but not situation-based emotions. These findings suggest that children with more severe autism symptomatology may have difficulty understanding the mental states of others (as required in the desire-based task) rather than in their ability to infer contextual emotions e.g., how the characters felt in specific situations (e.g., when being chased by a dog).

Recognition of desire-based emotions involves understanding the mental state of others and the idea that other people have beliefs, desires, thoughts, and intentions that may be different from our own (Baron-Cohen, 1995). This concept, known as Theory of Mind, has also been shown to be impaired in individuals with autism (Begeer et al., 2010). The current finding of an association between autism symptom severity and the recognition of desire-based emotions suggests that children with

more severe autism symptomatology may have more impaired Theory of Mind ability, however further research is needed to explore this relationship.

The amygdala theory of autism posits that the amygdala, often referred to as part of the 'social brain', is abnormal in individuals with autism (Baron-Cohen et al., 2000; Schultz, 2005). Research has shown that individuals with autism have abnormalities in the size and the activation of the amygdala and related regions (Pierce et al., 2001; South et al., 2008). Amygdala abnormalities have been shown to be associated with reduced recognition of specific emotions related to danger and threat, including the recognition of fear (Adolphs, 1999; Howard et al., 2000; Pierce et al., 2001) and anger (Krysko & Rutherford, 2009; Pelphrey et al., 2007). The current finding of an association between autism symptom severity and reduced accuracy in the specific recognition of fear and anger, but not happiness or sadness, provides further support for the amygdala theory of autism.

Difficulties in recognising expressions of fear and anger have social implications for children with autism. The accurate identification of fear is necessary for interpreting the presence of a threat in the environment as observed by another person and the interpretation of anger is an important warning signal that another person may pose a threat to oneself. If the recognition of fear and anger is impaired, one's ability to detect threats in social interactions may also be impacted.

The current study had several limitations. The research material was limited to the use of four basic facial expressions due to the young developmental age of the participants and the cognitive demands of the emotion recognition tasks. Further

research is needed to determine whether the relationship between autism symptomatology and emotion recognition ability extends to the other basic emotions of surprise and disgust, and to the recognition of other complex emotions and mental states. Further, whilst all participants completed the emotion matching tasks it cannot be determined whether failure to respond accurately was due to emotion recognition difficulties or rather due to communication impairments. The current study attempted to control for the impact of communication difficulties on performance by excluding children who were functioning cognitively below 30 months of age and by designing the emotion recognition tasks to allow for non-verbal responses.

The absence of a typically developing control group meant that the relative degree of emotion recognition difficulty of participants could not be analysed. Future research would benefit from inclusion of a typically developing group to determine the level of autism symptom severity that is associated with a distinct level of emotion recognition impairment. This could also be achieved through the use of standardised measures of emotion recognition though there is a notable absence of standardised measures that can be completed by children of this young developmental level.

A possible theoretical limitation of investigating the relationship between autism symptom severity and emotion recognition ability is the potential for measures of autism symptomatology to include items related to emotion recognition skills. Of the measures used in the current study the ADOS was the most independent of emotion recognition ability in that no items in the scoring algorithm were related to the child's ability to recognise other people's emotions. Further of the 65 SRS items

only four measured understanding or recognition of others' emotions. Thus it seems unlikely that this had a significant impact on the results of the current study.

It is also possible that performance on the contextual emotion recognition tasks (the mindreading situation and desire-based tasks) may have been influenced by anxiety given the high rate of anxiety disorders reported for children with ASDs. Statistical analysis indicated that children in the current study had significantly higher levels of anxiety in comparison to a normative sample of children of a similar age with ID. However there were no significant correlations between level of anxiety (DBC anxiety subscale scores) and performance on the emotion recognition tasks, suggesting that level of anxiety did not influence emotion recognition performance. However the potential influence of emotional states on emotion recognition accuracy in ASD warrants further investigation.

The present study investigated the relationship between autism symptom severity and emotion recognition ability in young children with Autistic Disorder with a range of intellectual ability. The current findings suggest that increased autism symptomatology was specifically associated with reduced accuracy in the recognition of expressions of fear and anger as well as desire-based but not situation-based emotions, above and beyond the influence of age and cognitive ability. These findings support the body of research suggesting that individuals with autism have difficulties in basic emotion recognition, with the current findings suggesting that children with more severe autism symptomatology may have greater difficulties in the recognition of anger and fear specifically. Further research is needed to determine whether the association between autism symptomotology and emotion recognition accuracy

extends to other specific emotions including complex emotions as well as Theory of Mind skills.

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Table 1

Sample Demographics, Means and SDs for the Emotion Recognition Tasks

N = 55	Mean	(SD)	Range	Task Completion Rate	
				FSIQ < 70	FSIQ ≥ 70
Male (%)	87%				
Age (months)	62.39	(10.48)	48.10 - 84.24		
Vineland ABC	73.44	(11.05)	49 - 100		
DBC (anxiety)	6.15	(3.29)	0 - 12		
WPPSI FSIQ	76.27	(13.76)	42 - 107		
WPPSI VIQ	73.96	(14.29)	46 - 107		
WPPSI PIQ	85.11	(16.02)	47 - 122		
FSIQ < 70	29.1%				
FSIQ 70 - 79	32.7%				
FSIQ > 79	38.2%				
Emotion Recognition Tasks					
Matching (n = 55)	10.69	(3.91)	3 - 16	100%	100%
Happiness	3.11	(1.19)	0 - 4		
Sadness	2.57	(1.34)	0 - 4		
Anger	2.24	(1.43)	0 - 4		
Fear	2.74	(1.28)	0 - 4		
Identification (n = 43)	5.91	(1.86)	2 - 10	44%	92.5%
Happiness	2.42	(0.76)	0 - 3		
Sadness	1.30	(0.89)	0 - 3		
Anger	1.16	(0.75)	0 - 3		
Fear	1.02	(0.83)	0 - 3		
Situation-based (n = 43)	4.44	(1.35)	1 - 6	38%	94.5%
Desire-based (n = 42)	4.12	(1.45)	1 - 6	31%	94.5%

Table 2

Correlations Between Demographic Variables, ADOS Severity Scores, SRS Scores and Emotion Recognition Tasks

	1	2	3	4	5	6	7
1. Chronological Age	-						
2. ADOS severity	-.08	-					
3. SRS scaled score	-.35**	.11	-				
4. WPPSI VIQ	.05	-.03	-.23	-			
5. WPPSI PIQ	-.08	-.05	-.05	.59**	-		
6. Vineland Communication	-.02	.07	-.26	.65**	.41**	-	
7. Vineland ABC	.07	.11	-.35**	.65**	.38**	.90**	-
8. Emotion Matching	.41**	-.23	-.37**	.48**	.38**	.34*	.39**
9. Emotion Identification	.23	-.44**	-.28	.32*	.37**	.36*	.33*
10. Situation-Based Emotions	.30*	-.09	-.18	.48**	.28	.28	.37*
11. Desire-Based Emotions	.37*	-.33*	-.32*	.51**	.46**	.23	.30

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

Table 3

Regression Results for the Identification of Expressions of Emotion

	Total for identifying all emotions		Identification of happiness		Identification of sadness		Identification of anger		Identification of fear		Situational emotions		Desire- based emotions	
	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p
Age	.03 (.02)	.27	-.01 (.01)	.53	.04 (.01)	*.00*	.00 (.01)	.98	-.00 (.01)	.78	.04 (.02)	*.04*	.05 (.02)	*.01*
VIQ	.03 (.02)	.12	.03 (.01)	*.00*	.00 (.01)	.68	.00 (.01)	.95	.00 (.01)	.98	.05 (.02)	*.00*	.06 (.01)	*.00*
ADOS	- .40 (.15)	*.01*	-.02 (.06)	.80	-.13 (.07)	.07	-.08 (.07)	.24	-.17 (.07)	*.02*	.01 (.10)	.96	-.22 (.10)	*.04*
Constant	4.41 (2.57)	.09	.74 (1.09)	.50	-.49 (1.20)	.69	1.72 (1.20)	.16	2.44 (1.25)	.06	-1.94 (1.87)	.31	-1.91 (1.78)	.29
Age	.02 (.03)	.47	-.01 (.01)	.42	.03 (.01)	*.01*	-.01 (.01)	.69	.00 (.01)	.93	.04 (.02)	*.03*	.05 (.02)	*.02*
VIQ	.04 (.02)	.11	.03 (.01)	*.01*	.01 (.01)	.66	.00 (.01)	.97	.01 (.01)	.56	.05 (.02)	*.00*	.06 (.02)	*.00*
SRS	-.01 (.01)	.33	-.00 (.01)	.55	-.01 (.01)	.30	-.01 (.01)	.26	.00 (.01)	.67	.00 (.01)	.61	-.01 (.01)	.56
Constant	2.88 (3.39)	.40	1.18 (1.34)	.38	-.60 (1.51)	.69	2.14 (1.47)	.15	.17 (1.64)	.92	-2.69 (2.29)	.25	-2.91 (2.35)	.22

B = unstandardized coefficients, *SE* = standard error

Table 4

Regression Results for the Matching of Expressions of Emotion

	Total for matching all emotions		Matching happiness		Matching sadness		Matching anger		Matching fear	
	B (SE)	*p*	*B (SE)*	*p*	*B (SE)*	*p*	*B (SE)*	*p*	*B (SE)*	*p*
Age	.14 (.04)	*.00*	.04 (.01)	*.00*	.04 (.02)	*.01*	.04 (.02)	*.02*	.02 (.02)	.22
VIQ	.12 (.03)	*.00*	.04 (.01)	*.00*	.04 (.01)	*.00*	.03 (.01)	*.04*	.02 (.01)	.08
ADOS	-.38 (.22)	.09	-.03 (.07)	.64	-.11 (.08)	.17	-.17 (.09)	.08	-.09 (.09)	.34
Constant	-4.34 (3.72)	.25	-1.75 (1.21)	.16	-2.00 (1.37)	.15	-1.08 (1.55)	.49	.53 (1.50)	.73
Age	.12 (.04)	*.01*	.04 (.01)	*.01*	.04 (.02)	*.01*	.03 (.02)	.10	.02 (.02)	.31
VIQ	.12 (.03)	*.00*	.04 (.01)	*.00*	.04 (.01)	*.00*	.02 (.01)	.07	.02 (.01)	.09
SRS	-.05 (.04)	.24	-.01 (.01)	.37	.01 (.01)	.68	-.03 (.02)	***.04***	-.01 (.02)	.64
Constant	-2.10 (5.67)	.71	-.76 (1.78)	.67	-3.59 (2.08)	.09	1.41 (2.29)	.54	.66 (2.27)	.77

B = unstandardized coefficients, *SE* = standard error

Chapter 6. | **Research Paper 3**

Short report: The relationship between

emotion recognition ability and social skills in

young children with autism

6.1 Declarations

6.1.1 Declaration by candidate:

For Chapter 6 the extent of my contribution was 70%. The nature of my contribution

was: data collection, data analysis, interpretation of findings, and drafting and

submission of the research paper.

The following co-authors contributed to this work.

Name	Nature of contribution
Dr Kylie Gray	Conception of research design and assistance with the interpretation of findings. Provided direction on the paper and advice regarding where to publish. Reviewed, revised, and provided feedback and edits on the paper.

Candidate's signature:		Date:

6.1.2 Declaration by co-authors for Paper 3:

Declaration by co-author for Paper 3:

The undersigned hereby certify that:

(1) The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature and contribution of each of the co-authors;

(2) They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least part of the publication in their field of expertise;

(3) They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

(4) There are no other authors of this publication according to these criteria;

(5) Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of publications, and (c) the head of the responsible academic unit; and

(6) The original data are stored at the following location and will be held for at least five years from the date indicated below:

Location: The Monash University Centre for Developmental Psychiatry and Psychology

| Dr. Kylie Gray | | Date: 31·8·12 |

6.2 Paper Commentary and Paper 3

Chapter 6 presents a paper that has been accepted for publication in the journal *Autism*. This paper has been formatted to the specific requirements of the journal. The following is a copy of the manuscript that is in press. Page numbers have been re-numbered to provide consistency throughout the thesis.

Paper 3 investigated the relationship between emotion recognition ability and social skills for a group of 42 young children with autism. Participants were a subset of the total sample of participants from the intervention study; those that were able to complete both the Emotion Identification and the Emotion Matching tasks. This paper used measures completed during the baseline phase of the intervention study. Three previous studies had been published on this topic but further research was needed focusing on the association between accuracy in the recognition of specific emotions (happiness, sadness, anger and fear) and social skills in young children with autism of a lower range of cognitive ability.

Title: Short report: The relationship between emotion recognition ability and social skills in young children with autism

Abstract

This study assessed the relationship between emotion recognition ability and social skills in 42 young children with Autistic Disorder aged 4-7 years. Analyses revealed that accuracy in recognition of sadness, but not happiness, anger or fear, was associated with higher ratings on the Vineland-II Socialization domain, above and beyond the influence of chronological age, cognitive ability and autism symptom severity. These findings extend previous research with adolescents and adults with ASDs, suggesting that sadness recognition is also related to social skills in children with autism.

Keywords

Autism, emotion recognition, social skills, young children

For individuals with autism, social interaction is generally of low frequency and poor quality, and more likely to involve ritualistic behaviours and poor social skills (Bauminger, 2002).   Evidence suggests that individuals with autism have difficulty recognising facial expressions of emotion (for review, see Harms, Martin and Wallace, 2010) and it has been suggested that these difficulties in recognising and responding to emotions may underlie the social problems that are a core feature of autism (Baron-Cohen, Golan and Ashwin, 2009).   There is however limited research into the functional impact of emotion recognition difficulties in autism, including the association between emotion recognition ability and social skills.

Wallace and colleagues investigated the association between facial emotion recognition skills and both the Social Responsiveness Scale (SRS; Constantino and Gruber, 2005) and the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) social and communication skills for a group of 42 adolescents with high functioning Autism Spectrum Disorder (ASD) (Wallace, Case, Harms et al., 2011). Researchers measured sensitivity in identifying individual expressions of emotion (happiness, sadness, anger, fear, surprise, disgust) and accuracy in identifying all emotions (total score). Analyses controlled for age and IQ, indicating a significant correlation between diminished sensitivity in identifying sad faces and social-communication deficits (as measured by the SRS and the ADOS) and lower adaptive behaviour skills as measured by the ABAS-II (Adaptive Behavior Assessment System; Harrison and Oakland, 2003). Whilst researchers reported correlations between social communication scores and accuracy in identifying all emotions (total score) and *sensitivity* in identifying each individual emotion, more research is needed to

investigate the relationship between social communication scores and *accuracy* in identifying these individual expressions of emotion.

Further research has investigated the relationship between basic emotion recognition accuracy and ADOS reciprocal social interaction (RSI) subscale scores for a group of 11 adult males aged 19-60 years with high-functioning ASD (Boraston, Blakemore, Chilvers et al., 2007). Participants were assessed on their ability to label basic expressions of emotion (happiness, sadness, anger and fear) from photos of faces and from the movement of animated shapes. Analyses indicated that social skills ability was significantly correlated with accuracy in sadness recognition for the shape animation task. No significant correlations were found between ADOS RSI scores and facial emotion recognition accuracy. However analyses were limited by a small sample size and failure to control for the effects of age and IQ.

A final study investigated the relationship between emotion recognition ability and Vineland-II Socialization scores (Sparrow, Cicchetti and Balla, 2005) for a group of 19 adults with ASD and comorbid intellectual disability (ID) (Garcia-Villamisar, Rojahn, Zaja et al., 2010). Participants were required to label and match photos according to facial expressions (happy, sad or neutral (not happy or sad)), as well as according to age and identity (non-emotional tasks). Regression analyses showed no significant association between increased Vineland-II Socialization domain scores and increased emotion recognition accuracy (total for all emotions), above and beyond the influence of cognitive ability and non-emotional task performance. However the results for each individual emotion (happiness and sadness) were not reported, and analyses did not control for the influence of age on results.

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The current study aimed to extend this body of knowledge by investigating the relationship between facial emotion recognition accuracy for specific emotions (happiness, sadness, anger and fear) and social skills for a group of young children with ASD with a range of cognitive ability, controlling for the influence of age, cognitive ability and autism symptom severity. Autism symptom severity was included as a covariate in the analysis given that increased severity has been shown to be related to reduced emotion recognition performance in children with autism (Wright et al., 2008). Based on previous research it was hypothesised that there would be an association between sadness recognition ability and higher social skills.

Method

Participants

Forty-two children participated in this study. Participant demographic information is presented in Table 1. Study inclusion criteria included having a diagnosis of Autistic Disorder (American Psychiatric Association, 2000) and being aged 48-84 months. Diagnoses were confirmed based on case review by the author (KG) and information from the ADOS. Two children did not meet ADOS criteria for ASD but did meet DSM-IV-TR criteria for Autistic Disorder. Due to the cognitive demands of the emotion recognition tasks, participants were excluded from the study if they could not complete a WPPSI-III assessment (i.e., they were functioning cognitively below 30 months of age). Informed consent was obtained from parents, and ethics approval from Monash University and the Department of Education and Early Childhood Development (Victoria, Australia).

< insert Table 1 >

Measures

  Autism Symptomatology. The ADOS (Lord et al., 2000) was used to assess the degree of autism symptom severity. The ADOS is a standardised measure of autism symptomatology, using planned social occurrences, or "presses", to create situations in which a range of social responses and initiations are likely to occur. Standardised ADOS severity scores (Gotham, Pickles, & Lord, 2009) were used in the analyses as a measure of autism symptom severity.

  Cognitive Assessment. The WPPSI-III (Wechsler, 2002) was used to measure cognitive functioning. The WPPSI-III is a standardized assessment of cognitive ability for children aged 30-87 months. The WPPSI-III gives an overall estimate of cognitive ability as a Full-Scale IQ (FSIQ) and composite scores for Verbal and Performance IQ (VIQ and PIQ).

  Social Skills. The Vineland-II survey form (Sparrow et al., 2005) is a carer-completed questionnaire used to assess a child's level of adaptive behaviour. The Socialization domain was used to measure social skills, including three areas of social functioning: interpersonal relationships, use of play and leisure time, and coping skills.

  Emotion Recognition Task. Two emotion recognition tasks were developed using photos from the *Pictures of Facial Affect* (Ekman & Friesen, 1976); a collection of 110 black and white photographs of adult models displaying six basic facial expressions (happiness, sadness, anger, fear, surprise, and disgust). For the *Emotion Identification (Pointing) Task*, six emotional expressions were used from 10 models from the *Pictures of Facial Affect* stimuli. Each picture had six different emotional expressions from six different models and participants were required to point to a specific emotion for each

picture (e.g., *"who is happy?"* or *"who is sad"*). The target emotions were happiness, sadness, anger, fear, with surprise and disgust as distracters.

For the *Emotion Matching Task* four emotional expressions (happiness, sadness, anger, fear) were used from eight models from the *Pictures of Facial Affect* stimuli. A plain brown box was made for each emotion, with four different examples of the emotion attached to the front of each box. The other photos were made into cards for posting into the boxes. Different faces were used on the boxes and the cards to ensure children were matching emotions not identities. During the assessment the four boxes were placed in front of the child in a random order. The child was shown each box and told what each emotion was. The child was then shown one card at a time and was required to post the card into the box with the matching emotion.

Procedure

All participants attended an assessment session with their parent. Participants completed an ADOS assessment and the emotion tasks. Finally participants completed a cognitive assessment (WPPSI-III) if they had not completed one in the past twelve months. Parents completed the Vineland-II survey form during the session.

Results

The analysis of the distribution of FSIQ scores are presented in Table 1. The mean FSIQ score was 79.76 (11.89). Scores on the Identification and Matching tasks were combined to create total scores for each emotion. Analysis of the emotion recognition scores indicated that happiness was the most easily recognised emotion, whilst anger was the most difficult (see Table 1.).

Linear regression analyses were performed to investigate the association between emotion recognition and Vineland-II Socialization domain scores, controlling for the influence of chronological age, VIQ and ADOS severity scores on performance (see Table 2). VIQ was chosen to control for the influence of IQ and verbal skills given its strong positive correlations with FSIQ (r = .84) and the Vineland-II Communication domain (r = .65).

Sadness was the only emotion found to be associated with Vineland social skills scores. Recognition of sadness was estimated to increase by .06 per unit of the Vineland social skills score (p=.02) and by .07 units per year of the child's age (p<.01), and to decrease by .35 per unit of the ADOS symptom severity score (p=.01), but there was no evidence that it was related to verbal IQ. Recognition of fear was estimated to decline by .17 per unit of ADOS symptom severity score, but was not found to be associated with the Vineland social skills score, age or verbal IQ. Recognition of happiness increased by .07 per point of verbal IQ score but was not associated with the other variables in the model. Recognition of anger was not found to be associated with any of the variables in the regression model.

<insert Table 2 >

Discussion

Results demonstrated that increased accuracy in the recognition of sadness, but not happiness, anger or fear, was associated with better social skills, above and beyond the influence of chronological age, cognitive ability and autism symptom severity. The current findings in children are consistent with past research reporting a specific relationship between increased sadness recognition and higher social skills for adults

with high-functioning ASD (Boraston et al., 2007) and reduced sensitivity in the recognition of sadness and deficits in social-communication skills for adolescents with high-functioning ASD (Wallace et al., 2011). The current study extends previous research by investigating the relationship between basic emotion recognition ability and social skills for young children with Autistic Disorder with a lower-range of cognitive ability, whilst controlling for the influence of age, IQ and autism symptom severity.

The reason for the specific association between social skills and recognition of sadness, but not happiness, anger or fear, remains unclear. Interestingly, previous research has reported the same specific association for sadness and social skills in both adolescents and adults with high-functioning ASD, using different measures of emotion recognition and social skills (Boraston et al., 2007; Wallace et al., 2011). In the current study the specific finding for sadness was not due to it being the most difficult emotion to recognise, as mean scores indicated that anger was the least accurately recognised emotion. It may be that other factors mediated the relationship between sadness recognition and social skills. For example, research has found that specific deficits in sadness recognition are related to poor emotional empathy (callous/unemotional traits) in boys with Autistic Disorder (Rogers, Viding, Blair et al., 2006). Whilst we did not specifically measure emotional empathy, the Vineland-II Socialization domain includes some items related to empathy. More research is needed to elucidate the nature of the relationship between sadness recognition, empathy and social skills for individuals with ASD, as this may be useful in the development of social skills interventions.

A possible theoretical limitation of investigating the relationship between emotion recognition ability and social skills is the potential for social skills measures to include items related to emotion recognition. Inspection of the Vineland-II Socialization domain indicated that whilst some items were related to empathy and ability to express emotions, no questions directly measured emotion recognition ability. Further, the items measuring empathy only made up a small component of the total Socialization domain score.

One limitation of the current study was that only a parent measure (Vineland-II parent ratings) was used to assess social skills. Future research could incorporate other measures of social skills including teacher reports. Additionally the current research material was limited to the use of four basic emotions due to the young developmental age of the participants. Future research could include measures of complex emotion recognition for older children, and compare results with typically developing children.

The current study investigated the relationship between facial emotion recognition ability and social skills for a group of young children with Autistic Disorder with a range of cognitive ability. Results showed that recognition of sadness, but not happiness, anger or fear, was significantly associated with greater social skills, above and beyond the influence of age, cognitive ability and autism symptom severity. These findings build upon research with adolescents and adults with ASD, suggesting that sadness recognition is also related to social skills in young children with ASD.

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Table 1.

Sample Demographics and Descriptive Statistics for the Emotion Tasks

N = 42	Mean	(SD)	Range
Male (%)	90%		
Age (months)	63.44	(10.70)	48.10 - 84.24
WPPSI FSIQ	79.76	(11.89)	56 - 107
WPPSI VIQ	77.00	(12.38)	48 - 107
Vineland ABC	75.38	(10.48)	55 - 100
Vineland Socialisation	74.57	(11.88)	53 - 100
FSIQ < 70	17%		
FSIQ 70 – 79	40%		
FSIQ > 79	43%		
Emotion Recognition			
Total (all emotions)*	17.52	(5.09)	5 - 25
Happiness	5.79	(1.41)	1 - 7
Sadness	4.05	(1.81)	0 - 7
Anger	3.62	(1.79)	0 - 7
Fear	4.05	(1.62)	0 - 6

*maximum possible score = 28

Table 2.

Regression Results for the Recognition of Expressions of Emotion

	Sadness		Fear		Happiness		Anger	
	B (SE)	*p*	*B (SE)*	*p*	*B (SE)*	*p*	*B (SE)*	*p*
Age	.07 (.02)	*.00*	-.00 (.02)	.84	.02 (.02)	.18	.02 (.03)	.49
VIQ	.01 (.02)	.68	-.01 (.03)	.61	.07 (.02)	*.00*	.02 (.03)	.54
Autism Symptomatology (ADOS)	-.35 (.12)	*.01*	-.17 (.14)	*.01*	-.05 (.10)	.63	-.24 (.15)	.12
Social Skills (VABS Social Domain)	.06 (.02)	*.02*	.05 (.03)	.08	-.01 (.02)	.69	.04 (.03)	.21
Constant	-2.51 (2.01)	.22	4.42 (2.35)	.07	-.36 (1.78)	.84	.12 (2.66)	.97

B: unstandardized coefficients; *SE*: standard error; VABS Social: Vineland-II Socialization Domain

Chapter 7. Integrated Discussion and Conclusions

7.1 Summary of Research and Key Findings

This research study aimed to evaluate the efficacy of an emotion training programme (the *Transporters*) for a group of young children with autism of a lower cognitive range than previously tested. It aimed to compare the efficacy of the *Transporters* programme with a control DVD, to determine whether improvements in emotion recognition skills were maintained at three month follow up, and to determine whether improvements generalised to TOM ability and social skills. It also aimed to investigate the predictors of successful outcomes for those children who completed the intervention. Additional aims were to investigate whether emotion recognition skills were related to autism symptom severity and social skills for the same group of young children with autism.

Results for the intervention study (presented in Chapter 4) indicated that, following treatment, children in the intervention group showed improvements in the recognition of anger (not happiness, sadness or fear), with few improvements maintained at three month follow-up. These results did not support our hypotheses as we hypothesised that there would be general improvements in emotion recognition skills (i.e., improvements across more than one emotion). We also hypothesised that improvements would be maintained at three month follow-up, but results indicated that only improvements in matching (but not identifying) anger were maintained at three month follow up.

The current results provide less compelling support for the efficacy of the *Transporters* intervention than previous findings reported in the literature. Golan et.al. (2010) and Young & Posselt (2012) investigated the efficacy of the *Transporters*

programme for children with high-functioning ASD. Both studies reported improved performance across basic and complex emotions for children in the intervention groups compared with those in the control groups. In contrast the current results were limited to improvements in the identification and matching of only one emotional expression (anger) following the intervention, with improvements in matching (but not identifying) anger maintained at follow-up. There are some variations in participant demographic variables between these studies, including the fact that in the current study participants had a lower range of cognitive ability, much lower verbal IQ scores, and a specific diagnosis of Autistic Disorder as opposed to ASD.

Results of the intervention study also showed that improvements in emotion recognition skills did not generalise to improvements in TOM or social skills. These results supported our hypotheses of limited generalisation of improvements in emotion recognition skills to TOM ability or social skills. The absence of improvements in TOM skills following intervention was unlikely to have been due to the low cognitive ability of participants in our study because the TOM tasks were developed for typically-developing children aged 36 months and our participants had a minimum cognitive ability of 30 months, with the lowest functioning children not completing any of the TOM tasks. It may be that improvements in a wider range of emotions (not only anger), or direct training in TOM skills, are required for improvements in TOM to be observed. Further, the current findings indicated that improvements in the recognition of anger did not correspond with improvements in social skills. It may be that emotion recognition accuracy (or specifically recognition of anger) is not directly related to social skills in children with autism. For example, research Paper 3 reported

on a specific association between social skills and accuracy in the recognition of expressions of sadness (not anger, happiness or fear).

As hypothesised, analysis of the predictors of successful outcomes for children in the intervention group indicated a pattern whereby higher chronological age and VIQ scores were associated with short-term and long-term improvements across multiple measures of emotion recognition skills following intervention. However autism symptom severity showed minimal association with improvements in emotion recognition skills for children in the intervention group. The lack of an association between autism symptom severity and improvements in emotion recognition skills following intervention did not support our hypotheses, as we predicted that children with a more severe degree of autism symptomatology would show less improvement in emotion recognition skills following treatment. This may be related to the fact that the autism symptom severity scores are not a measure of functional impairment and therefore may not be related to ability to learn from the *Transporters* programme. This finding suggests the *Transporters* programme may be equally efficacious for children of varying levels of autism symptomatology.

Another aim of this research study was to investigate the relationship between autism symptom severity and emotion recognition skills. Research paper 2 (chapter 5) examined this through analysis of the relationship between scores on the ADOS and SRS (autism symptom severity) and emotion recognition ability. This paper used measures completed during the baseline phase of the intervention study. It was hypothesised that higher autism symptom severity scores would be related to reduced performance on the emotion recognition tasks, above and beyond the influence of

chronological age and cognitive ability. As hypothesised, a higher level of autism symptom severity was related to reduced accuracy on the emotion recognition tasks, but this was specific to the recognition of expressions of fear and anger only. These results support previous findings of a relationship between increased autism symptom severity and reduced emotion recognition ability in individuals with autism (Tardif et al., 2007; Wright et al., 2008). Findings build upon previous research by demonstrating that this relationship extends to younger children with autism, of a lower ranger of cognitive ability.

Chapter 1 reviewed the large body of research into the emotion recognition skills of children with autism. Review of the literature suggested that individuals with autism may have difficulties recognising facial expressions of emotion relative to TD participants. However there remains some research finding no specific emotion recognition deficits in autism, particularly for children with HFA. The current finding of a relationship between increased autism symptom severity and reduced emotion recognition accuracy provides support for the body of research suggesting that emotion recognition difficulties are a feature of autism. It also suggests that emotion recognition difficulties may be more pronounced for children with higher levels of autism symptomatology.

The amygdala theory of autism posits that the amygdala, often referred to as part of the 'social brain', is abnormal in individuals with autism (Baron-Cohen et al., 2000; Schultz, 2005). Research has shown that individuals with autism have abnormalities in the size and the activation of the amygdala and related regions relative to TD control individuals (Pierce, Muller, Ambrose, Allen, & Courchesne, 2001;

South et al., 2008). Further, amygdala abnormalities have been shown to be associated with reduced recognition of specific emotions related to danger and threat, including the recognition of fear (Adolphs, 1999; Howard et al., 2000; Pierce, et al., 2001) and anger (Krysko & Rutherford, 2009; Pelphrey et al., 2007). Our specific findings for the relationship between increased autism symptom severity and reduced accuracy in the recognition of expressions of fear and anger, but not happiness and sadness, provides support for the amygdala theory of autism (as discussed in Chapter 1).

The final aim of this study was to investigate the functional impact of emotion recognition skills, through examination of the relationship between emotion recognition ability and social skills for young children with autism. Research paper 3 (chapter 6) examined this through analysis of the relationship between emotion recognition ability and Vineland-II scores (social skills). This paper used measures completed during the baseline phase of the intervention study. It was hypothesised that higher emotion recognition scores would be related to increased social skills, above and beyond the influence of chronological age, cognitive ability and autism symptom severity. Results demonstrated that increased accuracy in the recognition of expressions of sadness (not happiness, anger or fear) was related to better social skills.

The current findings are consistent with past research reporting a specific relationship between increased sadness recognition/sensitivity and higher social skills for adolescents and adults with high-functioning ASD (Boraston et al., 2007; Wallace et al., 2011). The current study extended previous research by investigating the relationship between basic emotion recognition ability and social skills for young children with autism with a lower-range of cognitive ability, whilst controlling for the

influence of age, VIQ and autism symptom severity. The reason for the specific association between social skills and recognition of sadness, but not happiness, anger or fear, remains unclear. Previous research has reported the same specific association for recognition of sadness and social skills in both adolescents and adults with high-functioning ASD, using different measures of emotion recognition and social skills (Boraston et al., 2007; Wallace et al., 2011). It may be that other factors mediate the relationship between sadness recognition and social skills. For example, research has found that specific deficits in sadness recognition are related to poor emotional empathy (callous/unemotional traits) in boys with Autistic Disorder (Rogers et al., 2006). More research is needed to investigate the nature of the relationship between sadness recognition and social skills for individuals with ASD.

7.2 Implications for Clinical Practice

Difficulties in recognising expressions of emotion have social implications for children with autism. For example, the accurate identification of fear is necessary for interpreting the presence of a threat in the environment as observed by another person, and the interpretation of anger is an important warning signal that another person may pose a threat to oneself. If the recognition of fear and anger is impaired, one's ability to detect threats in social interactions may also be impacted. There is a need to target these emotion recognition difficulties through early intervention programmes for children with autism, especially programmes designed for children of a young developmental age. Early intervention has the advantage that it may alter developmental trajectories in a positive direction, whilst improvements in emotion recognition skills may impact social outcomes for young children with autism.

Analyses from the baseline data indicated that greater autism symptom severity was associated with reduced emotion recognition accuracy (Paper 2). These findings have implications for the treatment of emotion recognition difficulties in young children with autism. The current findings suggest that children with more severe autism symptomatology may have greater emotion recognition difficulties, and therefore may require more training in emotion recognition skills.

In the current study the *Transporters* emotion training programme showed limited efficacy in helping young children with autism learn about emotions. Improvements were limited to recognition of expressions of anger. In the current study there was minimal maintenance of these skills at three month follow-up. Previous evaluation studies of the *Transporters* programme by Golan et al., (2010) and Young & Posselt (2012) did not include follow-up assessments to determine whether improvements in emotion recognition skills were maintained over time. Therefore it is unknown whether the *Transporters* has any long-term impact on the emotion recognition skills, and subsequent social skills, of children with autism. Our findings indicated that few improvements in emotion recognition skills were maintained at short term follow up, potentially limiting the long-term impact of this emotion training programme for young children with autism.

In the current study there was limited generalisation of emotion recognition skills to other areas of social perception (e.g., TOM and mentalizing ability). Previous studies evaluating the efficacy of the *Transporters* (Golan et al., 2010; Young & Posselt, 2012), as well as the other emotion recognition training programmes reviewed in Chapter 2 (with the exception of Hadwin et al., 1996), did not include measures of

distant generalisation to determine whether improvements in emotion recognition skills generalised to areas of social perception. Our findings indicated that the *Transporters* programme did not help to teach mentalizing ability and TOM skills to young children with autism. Similarly, Hadwin et al. (1996) also found that, following training in emotion recognition skills, improvements in emotion recognition ability did not generalise to improvements in perspective taking (distant generalisation). Thus it may be that specific training in TOM and mentalizing ability is required for young children with autism to develop these additional social perception skills. Clinically, it may be beneficial for social skills training programmes to provide training in a range of social perception skills.

Further results of the intervention study suggested that, whilst the *Transporters* emotion recognition training programme can be used with young children with autism and comorbid ID, it may be more efficacious for older, higher functioning, children with autism. There is a need for further research to develop emotion training programmes for use with young children with autism, including those with comorbid ID. This is of clinical importance because the majority of children with autism have a comorbid ID (Cotugno, 2009).

7.3 Limitations of Current Research

The main limitation of the current research was that it was limited to the use of four basic facial expressions of emotion due to the young developmental age of the participants and the cognitive demands of the emotion tasks. Thus it is unknown whether children improved in their recognition of the more complex emotions that

were targeted in the *Transporters* programme. The investigation of emotion recognition ability of children with autism of a young developmental age is hindered by difficulty accessing well validated tasks that reliably measure this construct for this group of children. As previously discussed, TD children appear to understand pride and embarrassment around the ages of three to four years (Russell & Paris, 1994) and other complex emotions around the ages of four to five years (Haan & Nelson, 1998), and it has been posited that children's developing emotional vocabularies allow them to identify and label more subtle expressions of emotion with age (McClure, 2000). Thus young children with autism, especially those of a young developmental age, may not have the emotional vocabulary or cognitive skills to complete measures of complex emotion recognition making it difficult to fully evaluate the efficacy of the *Transporters* DVD for this group of children.

Further, whilst all participants completed the emotion matching tasks it cannot be determined whether failure to respond accurately was due to emotion recognition difficulties or rather due to communication impairments. The current study attempted to control for the impact of communication difficulties on performance by excluding children who were functioning cognitively below 30 months of age and by designing the emotion recognition tasks to allow for non-verbal responses.

It is also possible that performance on the contextual emotion recognition tasks (the mindreading situation and desire-based tasks) may have been influenced by anxiety given the high rate of anxiety disorders reported for children with ASD. Statistical analysis indicated that children in the current study had significantly higher levels of anxiety in comparison to a normative sample of children of a similar age with

ID. However there were no significant correlations between level of anxiety (DBC anxiety subscale scores) and performance on the emotion recognition tasks, suggesting that level of anxiety did not influence emotion recognition performance. However the potential influence of emotional states on emotion recognition accuracy in ASD warrants further investigation.

Additional limitations of the current research are related to the methodology of Papers 2 and 3. The absence of a TD control group in Papers 2 and 3 meant that the relative degree of emotion recognition difficulty of participants could not be analysed. Future research into the relationship between autism symptom severity and emotion recognition ability would benefit from inclusion of a TD control group to determine the level of autism symptom severity that is associated with a distinct level of emotion recognition impairment. This could also be achieved through the use of standardised measures of emotion recognition, though there is a notable absence of standardised measures that can be completed by children of this young developmental level.

A possible theoretical limitation of investigating the relationship between autism symptom severity, social skills, and emotion recognition ability is the potential for measures of autism symptomatology and social skills to include items related to emotion recognition skills. For Paper 2, the ADOS appeared to be independent of emotion recognition ability in that no items in the scoring algorithm were related to the child's ability to recognise other people's emotions. Further, for of the 65 SRS items, only four measured understanding or recognition of others' emotions. For Paper 3, inspection of the Vineland-II Socialization domain indicated that whilst some items were related to empathy and ability to express emotions, no questions directly

measured emotion recognition ability. Thus it seems unlikely that this methodological issue had a significant impact on the results for Papers 2 and 3.

7.4 Future Research Directions

More research is needed to develop and evaluate emotion training programmes for use with young children with autism including those with comorbid ID. The results of the current study suggested that the *Transporters* emotion training programme, whilst developed for use with young children with autism, showed limited efficacy for use with children with autism of a lower range of cognitive ability. Before developing a new intervention for this young group of children, it might be useful to evaluate current emotion training programmes that have potential for use with this population of children. For example, the literature review presented in Chapter 2 indicated that level 1 of the *Mind Reading* programme (Baron-Cohen et al., 2004) has the potential to be used with young children with autism and comorbid ID. However no research to date has evaluated the efficacy of the *Mind Reading* programme for use with children with autism functioning at a young developmental level. Future research is needed to fully evaluate this programme.

When evaluating the efficacy of an intervention programme it is important to include follow-up assessments to determine whether improvements are maintained over time. Skills maintenance is an important criterion in the evaluation of intervention studies, as there is more value in an intervention that impacts long term outcomes. Unfortunately few emotion training intervention studies for children with autism have included follow-up assessments. Future evaluation studies would benefit

from the inclusion of follow-up assessments to measure the long-term impact of training programmes on emotion recognition skills.

Further research is needed to investigate the relationship between autism symptom severity and emotion recognition ability in young children with autism, to determine the level of autism symptom severity that is associated with a distinct level of emotion recognition impairment. This could be achieved through the inclusion of a TD control group for comparison of emotion recognition skills, or the use of standardised measures of emotion recognition. Unfortunately the investigation of emotion recognition ability of young children with autism is hindered by difficulty accessing well validated tasks that reliably measure this construct for this group of children. Future research is needed to develop and evaluate emotion recognition stimuli for use with young children with autism of a young developmental level. These materials would be useful in the evaluation of emotion training programmes for use with this population of children.

Finally, more research is needed to elucidate the nature of the relationship between sadness recognition and social skills for children with ASD, as this may be useful in the development of social skills interventions. It would be useful to ascertain whether specific training in recognition of sadness is related to improvements in social skills, or whether there is another factor mediating this relationship (e.g., emotional empathy). If there is a factor mediating this relationship, it might be useful to understand how and why this is related to emotion recognition ability and social skills, and whether it can be targeted through social skills training interventions.

7.5 Conclusions

Difficulties in recognising expressions of emotion have social implications for children with autism, and may underlie the social difficulties that are a core diagnostic feature of autism. One of the findings from the current study was that children with more severe autism symptomatology may have greater emotion recognition difficulties. There is a need to target these emotion recognition difficulties through early intervention programmes for children with autism, especially programmes designed for children of a young developmental age and those with more severe levels of autism symptomatology. Early intervention has the advantage that it may alter developmental trajectories in a positive direction. Unfortunately there are few emotion recognition training programmes designed for use with children with autism of a younger developmental age.

The current study aimed to evaluate the efficacy of the *Transporters* emotion training programme for use with a group of young children with autism of a lower cognitive range. Results of the current study indicated that the *Transporters* showed limited efficacy in teaching emotion recognition skills to young children with autism of a lower range of cognitive ability, and that it may instead be more efficacious for older, higher functioning, children with autism. These findings suggest that there is a need to identify more effective interventions that will improve emotion recognition skills of children with autism of a young developmental age, including those with ID and those with more severe autism symptom severity.

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APPENDICES

Appendix A

Sample Emotion Identification Task Question – Four Expressions

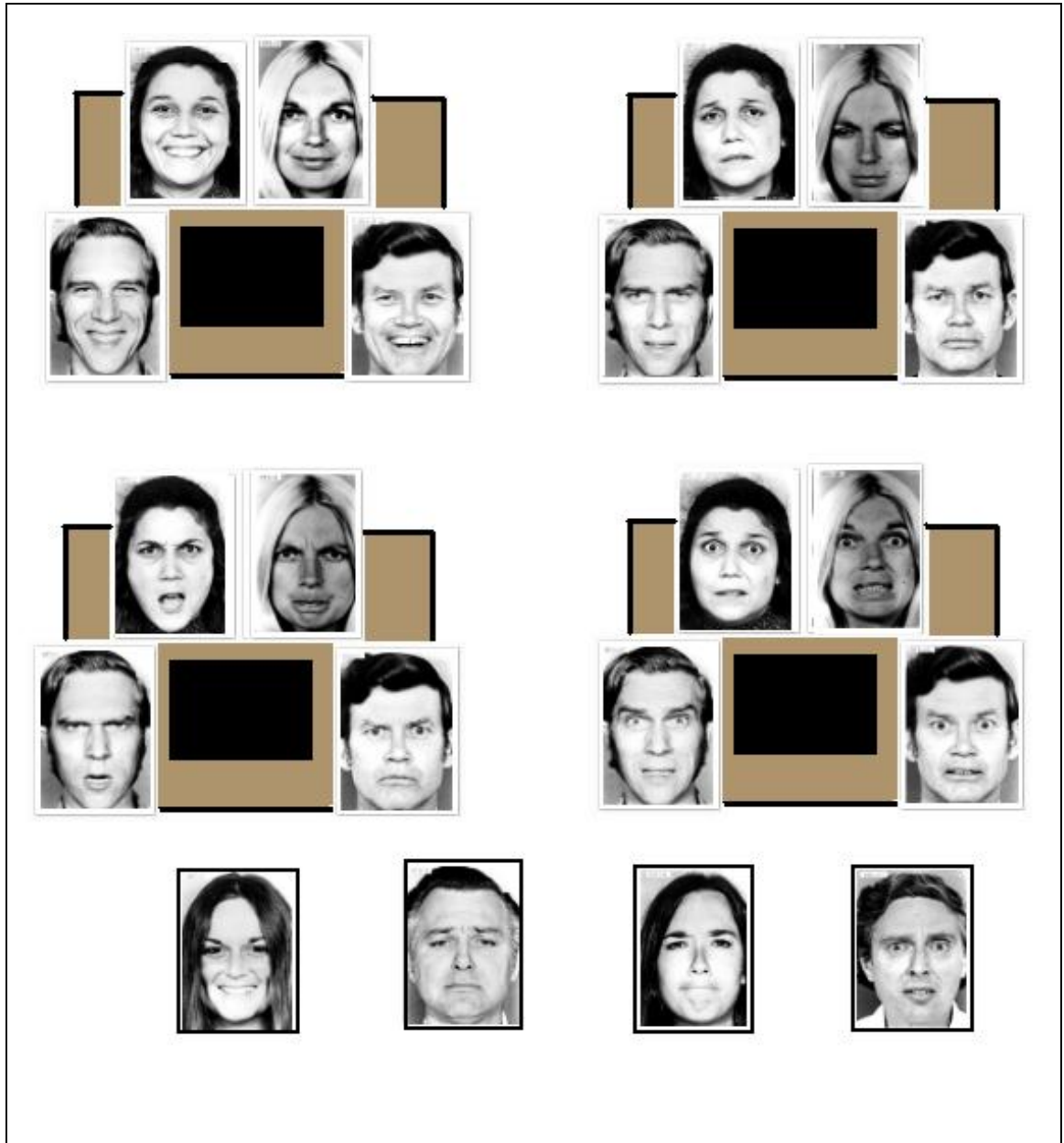e.g., Participants were asked "Who feels angry?" "Point to angry".

Appendix B

Sample Emotion Identification Task Question – Six Expressions
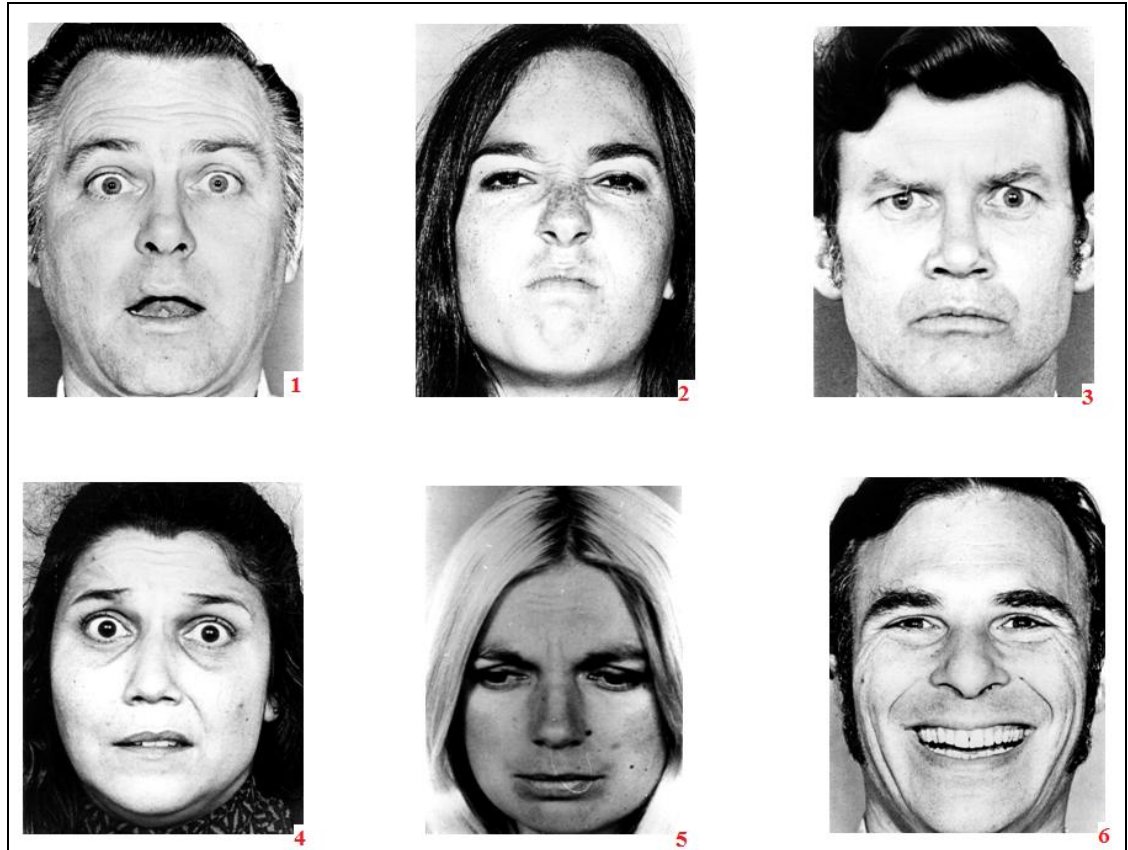
e.g., Participants were asked "Who feels angry?" "Point to angry".

Appendix C

Sample Emotion Matching Task Question


A plain brown box was made for each emotion (happy, sad, angry, scared), with four different examples of the emotion attached to the front of each box. The other photos were made into cards for posting in to the boxes. During the assessment, the four boxes were placed in front of the child in a random order. The child was shown each box and told what each emotion was. The child was then shown one card at a time and was required to post the card into the box with the matching emotion.

Appendix D

Sample Mindreading Situation-based Question

Copyright 1999, John Wiley & Sons Ltd.
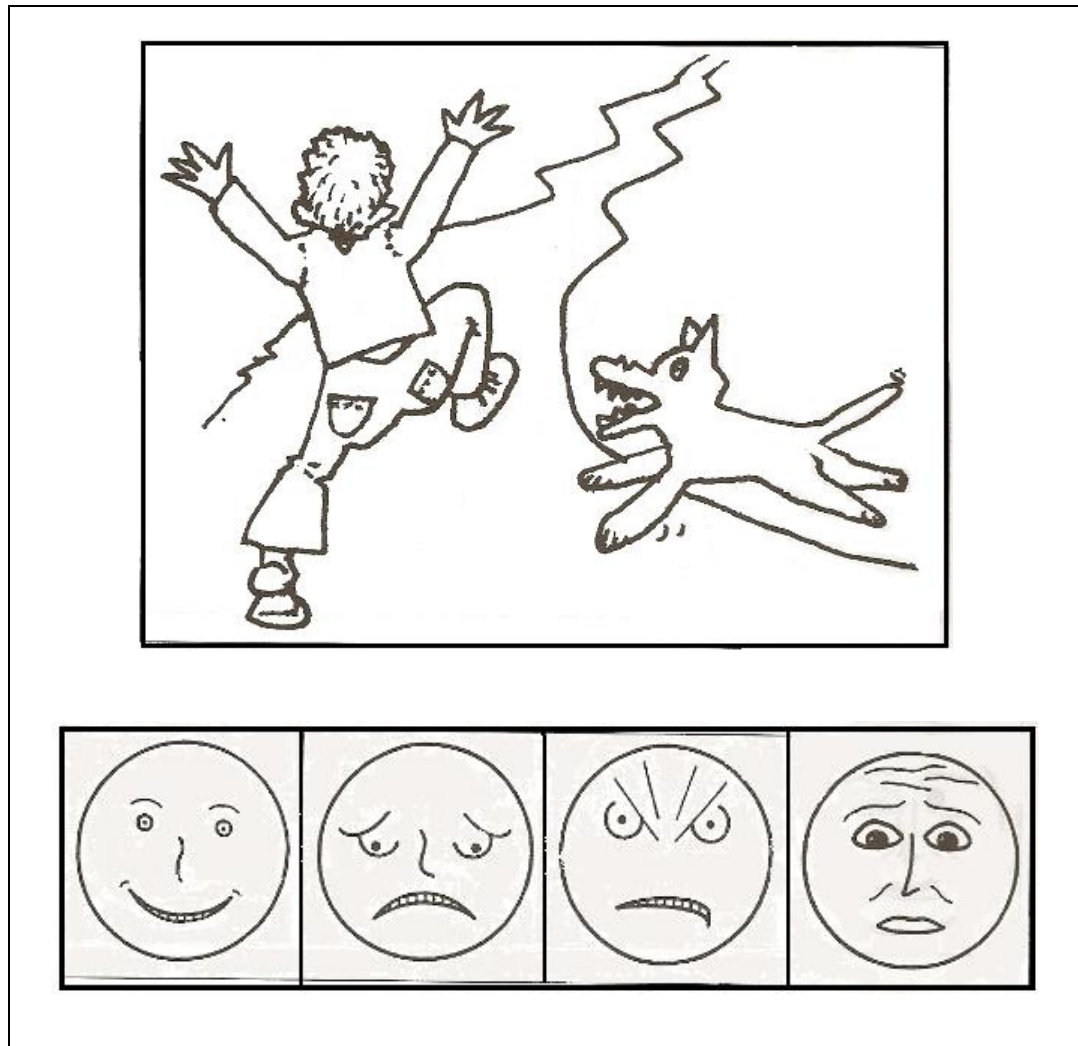
Participants were read a story.

e.g. "The big dog is chasing Dan down the road.

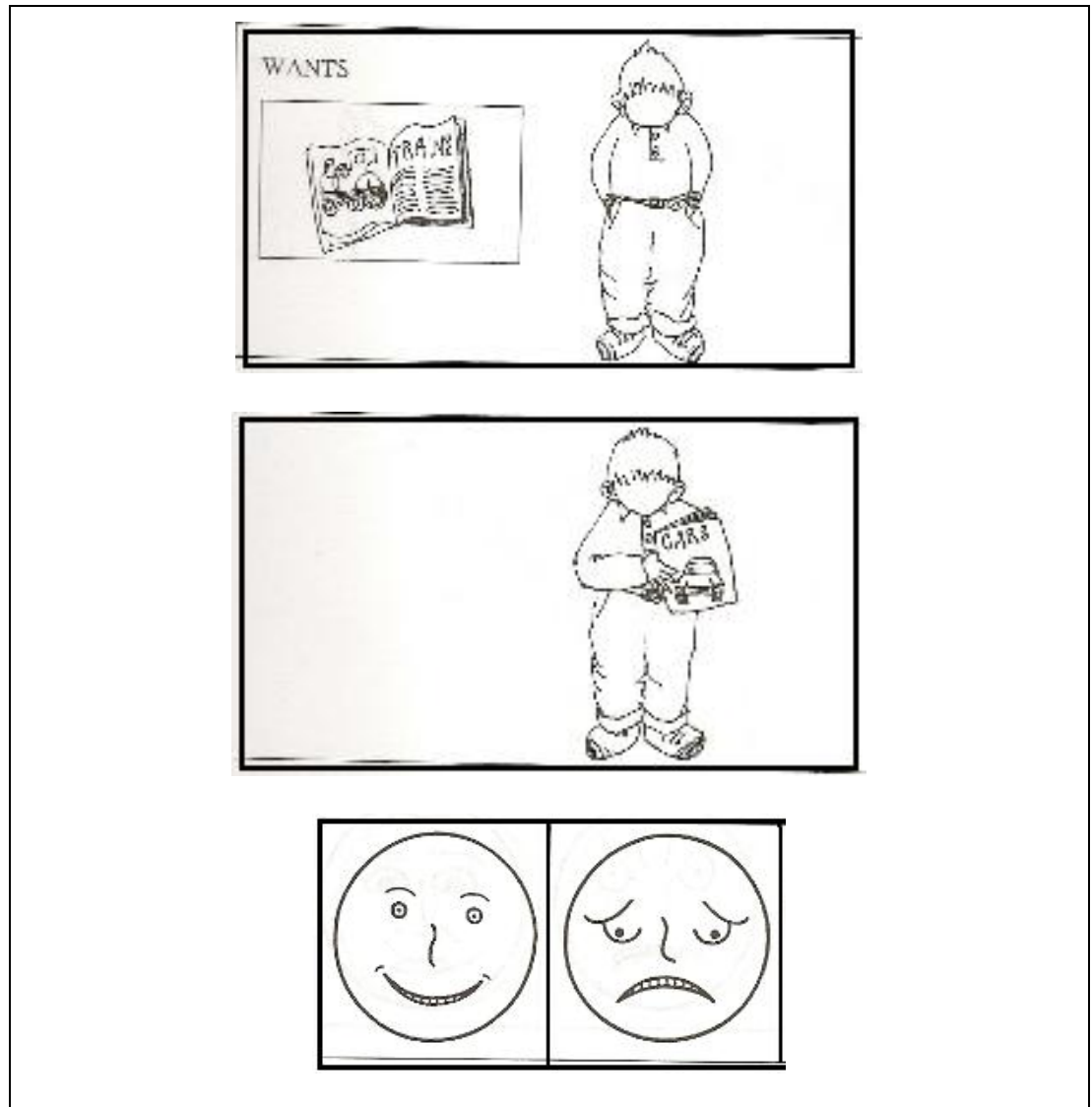How does Dan feel when the big dog is chasing him?"

Participants responded by pointing to a happy, sad, angry or scared face.

From: Howlin, P., Baron-Cohen, S., & Hadwin, J. (Eds.). (1999). *Teaching children with autism to mind-read*. Chichester, UK: John Wiley and Sons.

Appendix E

Sample Mindreading Desire-based Question

Copyright 1999, John Wiley & Sons Ltd.

Participants were read a story.

e.g. "Adrian wants a train book. Adrian's mummy has bought him a car book.
How does Adrian feel when his mummy buys him a car book?"

Participants responded by pointing to a happy or sad face.

From: Howlin, P., Baron-Cohen, S., & Hadwin, J. (Eds.). (1999). *Teaching children with autism to mind-read*. Chichester, UK: John Wiley and Sons.

Appendix F

Ethics Approval Documentation

MONASH University

Standing Committee on Ethics in Research Involving Humans (SCERH)
Research Office

Human Ethics Certificate of Approval

Date:	**10 February 2009**
Project Number:	**CF08/3272 - 2008001609**
Project Title:	**Emotion recognition and autism**
Chief Investigator:	**Dr Kylie Gray**
Approved:	**From: 10 February 2009 to 10 February 2014**

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained and a copy forwarded to SCERH before any data collection can occur at the specified organisation. **Failure to provide permission letters to SCERH before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by SCERH.
4. You should notify SCERH immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to SCERH and must not begin without written approval from SCERH. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. SCERH should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by SCERH at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Professor Ben Canny
Chair, SCERH

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Department of Education and Early Childhood Development

Department of Education
and Early Childhood
Development
GPO Box 4637
Melbourne
Victoria 3001

14 May 2009

MS Beth Williams
Department of Psychological Medicine
Monash University
Clayton 3168

Dear Ms Williams,

RE: Application to undertake research involving the Department of Education and Early Childhood Development

I write to you concerning your application to the Early Childhood Research Committee (ECRC) to undertake research entitled "*Teaching emotion recognition skills to children with autism and intellectual disability: Evaluation of an emotion recognition training program*"

I am pleased to inform you that the Department of Education and Early Childhood Development ECRC will support the research subject to the following conditions:

- The research is conducted in accordance with the documentation you provided to the ECRC;
- The provision of a final report to the ECRC at the completion of the research;
- The provision of a one page summary of the outcomes of the research and how this relates to the Department of Education and Early Childhood Development;
- That you provide the ECRC with the opportunity to review and provide comment on any materials generated from the research prior to formal publication. It is expected that if there any differences of opinion between the ECRC and yourself related to the research outcomes, that these differences would be acknowledged in any publications, presentations and public forums;
- That you acknowledge the support of the Department of Education and Early Childhood Development in any publications arising from the research; and
- The project is commenced within 12 months of this approval letter, after this time the approval lapses and extensions will need to be considered by the ECRC.

If you have any further enquiries, please don't hesitate to contact the ECRC Secretariat on 03 9947 1849 or via email ████████████████████████ The ECRC wishes you the best in your research and we look forward to seeing the results in due course.

Yours sincerely

████████████
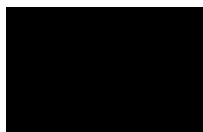
Joyce Cleary Chair, Early Childhood Research Committee

Appendix G

Explanatory Statement and Consent Form

MONASH University

Centre for Developmental Psychiatry & Psychology
Explanatory Statement

Emotion recognition and autism

This information sheet is for you to keep.

You are invited to participate in a research project. This project is being conducted by Dr Kylie Gray, Professor Bruce Tonge, and Beth Williams (Doctor of Clinical Psychology student) of the Monash University Centre for Developmental Psychiatry & Psychology and Professor Stewart Einfeld of the Brain and Mind Research Institute, University of Sydney.

We are inviting the parents of children who have autism to assist us with a project looking at emotion recognition.

Possible benefits
Individuals with autism often have difficulties in expressing and understanding emotion. Recent research has suggested that certain DVDs might help to teach important emotion recognition skills to children with autism. However, more research is needed to evaluate their effectiveness. This study will assist in investigating the effectiveness of two different children's DVDs in teaching emotions to children with autism. This study will also investigate if these DVDs also improve social skills and behavioural problems in these children.

What does the research involve? How much time will the research take?
The study requires you to complete some questionnaires about your child and his/her behaviour. The study also requires your child to participate in a developmental assessment and some emotion recognition tasks, at a location that is convenient to you. This will take approximately 3 hours.

Each family will be randomly given one of two DVDs (The Transporters or Thomas the Tank Engine). You will be asked to participate in watching the episodes on this DVD with your child at home, for 15 minutes a day, for four weeks. You will be asked to record the number of hours your child spends watching the DVD.

After this four week period, we will then reassess your child, which will take approximately 2 hours. We will then follow up your child's progress again at 3 months and 12 months. Again, these assessments will take approximately 1 hour and will be conducted at a location that is convenient to you.

You will be provided with a report on the results of the assessments. These results may be of use to professionals involved in the care of your child. Copies of reports for other professionals will only be provided with your consent.

At the completion of the study your child will be allowed to keep the DVD that he/she has been given. Children in the control group (those who received the Thomas the Tank Engine DVD) will receive a copy of the Transporters at the end of the study.

If any specific difficulties or problems are identified, a referral to appropriate services will be arranged. If you express any concerns or need any help, this will also be arranged.

If you would like to be a part of this project, please complete the attached consent form. A member of our research team will then contact you about the project. You can return the form to us in the reply paid envelope which is attached to the form. No stamp is necessary.

Inconvenience/discomfort
There is no risk of physical or psychological harm in the study. The length of the assessments session will be tailored to each individual child's needs and can be split up into smaller time-frames if necessary. If any specific difficulties or problems are identified, a referral to appropriate services will be arranged. If you have any concerns, questions, or need any help feel free to contact Dr Kylie Gray (contact details below).

Voluntary participation
Please note that participation in this project is voluntary and you can withdraw from the study at any time. Whether you take part or not, it will not make any difference to the medical care or other professional services which your child or your family receive.

Confidentiality
Data on computers is securely stored and deidentified (names are not used). There will be nothing in any reports of the study that could identify individual children or families. Reports on the study will be submitted for publication, but individual participants will not be identifiable in such reports. Participation in this project is voluntary. You are free to withdraw from the project at any stage.

Storage of data
Storage of the data collected will adhere to the University regulations and kept on University premises in a locked filing cabinet for 5 years. The research staff directly involved with the study are the only people who have access to these files. You may access the file containing information collected about your child by contacting Dr Kylie Gray.

Ethical guidelines
This project will be carried out according to the National Statement on Ethical Conduct in Research Involving Humans (1999) produced by the National Health and Medical Research Council of Australia. In the state of Victoria, medical practitioners are mandated by law to report cases of suspected child abuse. This research project has been approved by the Standing Committee on Ethics in Research Involving Humans (SCERH) Monash University, Clayton.

Results
If you would like to be informed of the research findings, please contact Dr Kylie Gray (see below).

If you would like to contact the **researchers** about any aspect of this study, please contact the Chief Investigator:	If you have a **complaint** concerning the manner in which this research is being conducted, please contact:
Dr Kylie Gray Centre for Developmental Psychiatry & Psychology, Monash Medical Centre 246 Clayton Rd Clayton VIC 3168 Ph Fax	**Human Ethics Officer** Standing Committee on Ethics in Research Involving Humans (SCERH) Building 3d Research Office Monash University VIC 3800 Tel: +61 3 9905 2052 Fax: +61 3 9905 1420 Email: scerh@adm.monash.edu.au Project number CF08/3272 – 2008001609

Thank you for taking the time to assist with our research project.

Dr. Kylie Gray   Prof. Bruce Tonge   Prof. Stewart Einfeld

MONASH University

Centre for Developmental Psychiatry & Psychology

Emotion Recognition and Autism

Conducted by: by Dr Kylie Gray, Professor Bruce Tonge, and Ms Beth Williams (DPsych Clinical student)
of the Monash University Centre for Developmental Psychiatry & Psychology, Melbourne
and Professor Stewart Einfeld,
of the Brain and Mind Research Institute, Sydney.

PARENT / GUARDIAN CONSENT FORM

I

print name

of

Address

Contact number

have been asked to participate in the research project entitled 'Emotion recognition and autism' being conducted by Dr Kylie Gray, Professor Bruce Tonge, Professor Stewart Einfeld, and Ms Beth Williams, and involving myself and my child,

Name of child	Date of birth

I give voluntary consent for my son/daughter for whom I am the guardian to participate in the above Monash University project. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that the research study will be carried out in a manner conforming with the principles set out by the National Statement on Ethical Conduct in Research Involving Humans, and further that:

1. I understand the general purposes, methods, demands and benefits and possible risks, inconveniences and discomforts of the study as outlined in the 'Parent/Guardian Information Sheet' that has been given to me.
2. Although I understand that the purpose of this research project is to improve the quality of care, it has also been explained that my involvement may not be of any direct personal benefit to me or my son/daughter/person for whom I am the guardian.
3. My participation in the research study is voluntary, and I am free to withdraw at any time, and to continue receiving appropriate treatment for my son/daughter/person for whom I am the guardian, as will be the case if I do not volunteer to enter the study.
4. I have been given the opportunity to have a member of my family or a friend present while the project was explained.
5. I have been given the opportunity to ask questions in relation to the research study, and I have received all the information and explanations I have requested.
6. I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

Parent / guardian signature

Signature		Date	

October 2008

Appendix H

Recruitment Poster