



School of Psychology

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**Investigating Facial Emotion Recognition and
Theory of Mind in relation to Externalising
Behaviour in Children: A Systematic Review and
Empirical Study**

Thesis submitted in partial fulfilment of the requirement for the degree of
Doctorate of Clinical Psychology (DClinPsy)

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Declaration

This work has not been submitted in substance for any other degree or award at this or any other university or place of learning, nor is being submitted concurrently in candidature for any degree or other award.

Signed (candidate) Date: 29th May 2018

STATEMENT 1. This thesis is being submitted in partial fulfillment of the requirements for the degree of Doctorate in Clinical Psychology (DClinPsy)

Signed (candidate) Date: 29th May 2018

STATEMENT 2. This thesis is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by explicit references. The views expressed are my own.

Signed (candidate) Date: 29th May 2018

STATEMENT 3. I hereby give consent for my thesis, if accepted, to be available for photocopying and for inter-library loan, and for the title and summary to be made available to outside organisations.

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Thesis Summary

Facial emotion recognition (FER) difficulties are associated with both mental health and antisocial presentations in adolescents and adults (e.g., Dawel, O’Kearney, McKone, & Palermo, 2012). Externalising behaviours in children are one of the earliest signs of risk for the development of such difficulties. Therefore, understanding the relationship between social-emotional skills and externalising behaviours in children is crucial to understanding how best to intervene.

In the systematic review, the evidence for the possible relationship between FER and externalising problems in pre-adolescent children was synthesised and evaluated. The review suggested strongest evidence for FER problems in ADHD or Callous-Unemotional presentations, and in samples of children with higher levels of externalising problems rather than in community samples. There was no evidence for specific emotions being implicated as some others have previously theorised (e.g., Blair, Leibenluft, & Pine, 2014).

The empirical paper examined FER and Theory of mind (ToM) in sixty-eight children (age 4-7), oversampled for externalising behaviour problems. Older children (aged 6-7) evidenced stronger FER and ToM performance than younger children (aged 4-5). Emotion, intensity and their interaction affected FER accuracy. High intensity emotions and happiness were easier, and of negative emotions, sadness was easier to recognise than fear. Children with weaker ToM had lower verbal IQ and poorer FER performance even when controlling for IQ. Relatively high hyperactivity and/or conduct scores were related to greater difficulty recognising anger, and regression analyses indicated that hyperactivity accounted for more of this variance. Hyperactivity and/or conduct problems did not predict ToM performance.

The final paper is a critical reflection on the research conducted and the process as a whole. The paper includes discussion of the research not conducted, the decisions made and a critique of the methodologies. Clinical and theoretical implications, dissemination and directions for future research are discussed.

**Facial Emotion Recognition in Children who present with Externalising
Problems: A Systematic Review**

**Prepared in accordance with the author guidelines for
Child Neuropsychology (Appendix A)**

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Abstract

Difficulties in facial emotion recognition (FER) are associated with a range of mental health and antisocial presentations in adolescents and adults (e.g., Dawel et al., 2012). Externalising behaviours in children are often one of the earliest signs of risk for the development of such difficulties.

This paper systematically reviews the evidence (from both group and correlational studies) for whether there is a relationship between FER and externalising problems in pre-adolescent children (aged 12 and under), both across and within externalising behaviour domains (attention/hyperactivity, conduct problems, callous-unemotional traits, and aggression). Four electronic databases were searched producing 1296 articles. Articles were included if they used empirical and validated measures of FER and externalising behaviours. Sixteen papers met criteria for inclusion in the review.

Overall, the results suggested that the strongest evidence for significant findings regarding FER problems was in ADHD or callous-unemotional presentations, and in samples of children with higher levels of externalising problems rather than in community samples. There was no evidence for specific emotions being implicated as some others have previously theorised (e.g., Blair et al., 2014).

Limitations include significant variability in the country under study, a lack of girls in the samples and differing methods of measurement. The generalisability of the findings is therefore limited. Clinically, the findings suggest that aspects of FER are associated with externalising problems in some children, and hence could be a relevant target of intervention.

Keywords: Emotion Recognition, Facial, Child, Externalising Behaviour

Introduction

Appropriate social interaction and adjustment relies on the accurate identification of other's emotional expressions (Saarni, 1999). Difficulties with emotion recognition are well documented in both adolescents and adults presenting with a range of mental health and antisocial presentations (e.g., Dawel et al., 2012). One of the earliest signs of such social or emotional adjustment difficulties in childhood is the presence of 'externalising behaviours' which are problematic behaviours directed towards an individual's environment. Externalising behaviours are also known to be linked to adjustment difficulties later in life (e.g., Frick, 2012).

This systematic review will focus on the relationship between facial emotion recognition (FER) and externalising behaviours in pre-adolescent children. Greater insight into this relationship is needed to inform effective interventions for children during crucial stages in their development.

Emotion Recognition

Emotions can be recognised from various cues including facial expressions, body postures, gestures, and tone of voice. Emotion recognition (ER) has been conceptualised as comprising four skills: awareness that an emotion has been expressed, labelling prototypical emotions, labelling non-typical emotions, and using contextually relevant information in identifying and labelling emotions (Castro, Cheng, Halberstadt, & Gruhn, 2016). It is an important component of 'cognitive empathy' which is the ability to rationally understand and recognise the emotional state, and to take the perspective of others (Bons et al., 2013). ER represents the early use of social cues on which children's subsequent behavioural responses (Cicchetti, 2016) and relationships (Chronaki et al., 2015) depend. Thus, the degree to which emotional skills develop in childhood has significant implications for children's lifelong social competence (Denham et al., 2003; Izard et al., 2001).

Differences in children's understanding and recognition of emotions derive from both genetic and environmental factors (Hovey et al., 2018). Environmentally, children's emotional understanding is most likely to develop in families where; there are regular expressions of positive emotions, negative emotions are displayed less frequently but are discussed, and parents are sensitive and responsive to the child (Denham & Kochanoff, 2002; Laible, 2011; McElwain, Halberstadt, & Volling, 2007). Conversely, high levels of negative emotion expression in families have been linked with lower emotional understanding, including ER in young children (Dunn & Brown, 1994).

ER has been shown to develop gradually in terms of both speed and accuracy (Herba & Phillips, 2004) from early childhood through to adolescence (Herba, Landau, Russell, Ecker, & Phillips, 2006). The pre-school years are a crucial developmental period, children's experiences and skills at this age form the basis of their later social and emotional competence (Denham et al., 2003). Generally, girls perform better than boys on ER tasks, and this is thought to be due to differences in socialisation and maturation patterns (McClure, 2000).

Facial Emotion Recognition

Facial expressions are one of the most powerful ways to communicate emotions (Frith, 2009). By preschool, most children can label another's feelings by looking at their face (Parker, Mathis, & Kupersmidt, 2013). By the age of 4 or 5 most children can reliably identify the six basic emotions of happiness, sadness, anger, fear, surprise and disgust across a range of stimuli (Camras et al., 1988; MacDonald, Kirkpatrick, & Sullivan, 1996; Russell & Widen, 2002; Schultz, Izard, & Ackerman, 2000). Some studies suggest that near-adult levels of FER are achieved before adolescence (Rodger, Vizioli, Ouyang, & Caldara, 2015).

Externalising Behaviours

One way of grouping concerning behaviours in children is by categorising them as either “internalising” or “externalising”. Internalising behaviours are those which are inhibiting or controlled such as anxiety, fearfulness, and social withdrawal. Externalising behaviours by contrast are “under-controlled”; they are manifested outside of the individual and examples include impulsivity, hyperactivity, aggression or oppositional behaviour.

“Externalising Behaviours” include the constructs of Disruptive Behaviour Disorders (DBD), conduct problems (CP), aggressive behaviours and Callous-Unemotional (CU) traits, as well as the DSM-V (APA, 2013) diagnostic categories of Oppositional Defiant Disorder (ODD), Conduct Disorder (CD), and Attention-deficit/Hyperactivity Disorder (ADHD). Most children display a level of externalising behaviours during childhood (e.g., temper tantrums, hitting, etc.) and these are generally moderate in intensity and frequency and decrease with age (Bongers, Koot, van der Ende, & Verhulst, 2004). Of those who display behaviours at a high intensity and frequency, some will outgrow such difficulties during adolescence, but for some behaviours persist or increase (Bongers et al., 2004).

ADHD

Within the umbrella of externalising problems, the most widely studied diagnostic group is children who meet the criteria for ADHD, a diagnosis characterised by hyperactivity, impulsivity, and/or inattention (Leibson & Hall Long, 2003; Wilens & Spencer, 2010). ADHD usually begins in early childhood with excessive activity relative to age (Faraone, Sergeant, Gillberg, & Biederman, 2003). Rates are lower in girls than boys (4% in girls and 8% in boys in preschool, decreasing to 0.9-2% and 1-5.6% respectively in adolescence (Faraone et al., 2003). A large proportion of children with ADHD exhibit poor interpersonal skills and have difficulties developing healthy relationships (Melnick & Hinshaw, 2000). ADHD can be measured categorically through diagnostic interview (e.g., The Child and Adolescent

Psychiatric Interview; Angold & Costello, 2000), or on dimensional rating scales (e.g., the Strengths and Difficulties Questionnaire; Goodman & Goodman, 2009).

Conduct Problems

CP refers to angry, defiant, antisocial, aggressive and norm violating behaviours in children and adolescents which subsume ODD and CD (Lorber, 2004). ODD refers to a recurrent pattern of negative, defiant, disobedient and hostile behaviour towards others in authority, whereas CD describes more severe behaviour, where basic rights or norms are violated. ODD can be a precursor to CD which is in turn often a precursor to antisocial personality disorder in adulthood (de Wied, Gispen-de Wied, & van Boxtel, 2010). CP can be measured in the same way as ADHD (i.e., categorically through diagnostic interviews for ODD or CD; or on dimensional symptom rating scales).

Callous Unemotional Traits

CU traits are purported to measure the childhood version of the affective dimension of psychopathy as originally measured in adults through the Psychopathy Checklist-Revised (Hare, 1991). CU traits are characterised by callousness, a lack of empathy and guilt, and shallow emotions (Frick, Ray, Thornton, & Kahn, 2014); they are often measured using dimensional measures such as the Inventory of Callous Unemotional Traits (Essau, Sasagawa, & Frick, 2006).

Aggression

Aggressive behaviours in childhood are usually measured through teacher or parent report and traditionally focus on overt aggression involving harm to others. Aggression measures can also include 'relational' aggression which by definition involves harm to the victim through purposeful damage to their relationships with others (Crick, 1996). Evidence has shown that boys are more likely to display both physically and relationally-aggressive behaviours

(Wenxin, Linqin, Xiuli, Qian, 2003) whereas girls are more likely to display relational than physical aggression (Crick & Grotpeter, 1995).

Comorbidity

Whilst these externalising presentations are often studied separately, they are highly comorbid. Children with ODD and CD are thought to have much lower levels of empathy and increased rates of CU traits (de Wied et al., 2010). Comorbidity between ADHD and ODD is estimated to be 60% (APA, 2013) and comorbidity between ADHD and CD is 16-20% with higher rates of comorbidity in boys than girls (Biederman et al., 2002).

Prognosis

Externalising behaviour problems in childhood can predict a multitude of later difficulties. For example, CU traits in childhood predict later antisocial behaviour and psychopathy (Frick & Viding, 2009). Co-occurrence of clinical levels of CP and CU behaviours is associated with higher frequency, severity and persistence of antisocial and aggressive behaviours into adulthood (Frick & White, 2008). People who have had a diagnosis of CD are more likely to be arrested, imprisoned and experience physical and mental health difficulties (Frick, 2012; Odgers et al., 2007). The presence of CD has been costed at £100,000 (140,000 USD) per person between the ages of 10 and 28 in statutory service provision in the UK (Odgers et al., 2007). Mannuzza and Klein's (2000) longitudinal data have shown that children with a diagnosis of ADHD are more likely as adolescents to display academic difficulties, have lower self-esteem and exhibit difficulties in terms of social functioning. Furthermore, approximately a third of children with a diagnosis of ADHD were later diagnosed with an antisocial disorder and two thirds of those were arrested, a high proportion of whom had problems with substance abuse.

Facial Emotion Recognition and Externalising Behaviours

Research has found that ER deficits are present in adolescent antisocial populations including those who present with CD and psychopathic traits (Fairchild, Stobbe, Van Goozen, Calder, & Goodyer, 2010; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009) and young offenders (Bowen, Morgan, Moore, & van Goozen, 2014).

A number of relevant reviews have been conducted. Dawel et al. (2012) conducted a meta-analysis and found that psychopathy in adults and older children was associated with impairments in ER (vocal and facial) across positive and negative emotions. Their review suggested a generalised difficulty rather than one specific to particular emotions. It is noted that none of the studies included in the Dawel et al. review focused on children exclusively under 13. Nor were there any data presented regarding whether the presence of inattention/hyperactivity (likely to be high in such populations) explained the findings, despite hyperactivity having been linked to difficulties recognising negative and positive emotions (e.g., Sinzig, Morsch, & Lehmkuhl, 2008).

Bons et al (2013) conducted a review of empathy in CD and Autism, including a synthesis of findings regarding ER in both diagnostic groups. They found mixed results in the seven studies which examined individuals with CD, with four studies finding most pronounced difficulties with recognising negative emotions (fear, anger and disgust) and three studies reporting no difficulty. They also reported inconsistent results regarding a link between CU traits and the recognition of sad faces. Again, there was no analysis of whether attention/hyperactivity accounted for the findings, and the studies included mainly focused on older children and adolescents.

Collin, Bindra, Raju, Gillberg, & Minnis (2013) conducted a systematic review of FER studies across a wide range of psychiatric conditions throughout older childhood and

adolescence (schizophrenia/psychosis, mood disorders, anxiety disorders, eating disorders, ADHD and CD). They concluded that all disorders have some association with FER difficulties but the evidence was too preliminary to draw any strong conclusions contrasting disorders. However, due to ER being a potential focus for early intervention, there has been a number of studies in younger children since that time.

Overall, the above reviews of ER have yielded inconsistent findings and have considered studies that have used wide age-ranges. No review has been conducted that specifically focuses on pre-adolescent children when ER skills are at a more sensitive stage of development. Younger children's performance is also less likely to be affected by other factors such as substance abuse, and early identification provides greater opportunities for enhancing our understanding and informing early interventions. Therefore, a synthesis of relevant findings within pre-adolescent children specifically, across a range of externalising problems is required.

Theories of Emotion Recognition in relation to Externalising Problems

Various theories relating to externalising behaviour problems also propose a role for ER. Crick and Dodge (1994) proposed that individuals with aggression misinterpret ambiguous social cues as threatening and are therefore hypersensitive to emotions such as anger. Dadds, Jambrak, Pasalich, Hawes and Brennan (2011) have argued that deficits in FER in CP and CU populations may reflect general deficits in attention to social-emotional stimuli. Their argument follows previous findings that instructing children with high CU behaviours to look at the eye region reduces FER difficulties (Dadds, Masry, Wimalaweera, & Guastella, 2008).

Finally, reduced amygdala activation has been found during the processing of fearful facial expressions in DBD youth (Marsh et al., 2008) and boys with CU traits (Jones, Laurens, Herba, Barker, & Viding, 2009). This has been proposed to reduce the stress response systems

resulting in children being ‘under-reactive’ to fear-related stimuli (Blair et al., 2014), decreasing the likelihood of them being able to inhibit aggression in the face of distress cues. However, Dawel et al.'s (2012) meta-analysis revealed deficits for several emotions, not solely fear. In terms of attention/hyperactivity, ADHD is typically associated with a range of difficulties which may account for difficulties with ER such as reduced global cognitive ability (Frazier, Demaree, & Youngstrom, 2004), difficulties in executive functioning such as response inhibition and working memory (Willcutt, Sonuga-Barke, Nigg, & Sergeant, 2008) and attention difficulties, which would affect children’s ability to attend to and therefore learn about and notice facial emotions (Kats-Gold, Besser, & Priel, 2007).

Interventions

A previous systematic review has found a robust relationship between emotion knowledge and school success (Voltmer & von Salisch, 2017). This review emphasised the need for further research on the mechanisms underlying this relationship, such as specific ER difficulties, which could inform early intervention programmes and ultimately reduce the psychological and economic cost to society (van Goozen, 2015). Indeed, ER skills are already included in several interventions for children with behavioural difficulties, for example ‘Providing alternative thinking strategies’ (PATHS) (Greenberg, Kusche, Cook, & Quamma, 1995), the Incredible Years classroom social skills and problem solving curriculum (Webster-Stratton & Reid, 2004), Roots of Empathy (Gordon, 2001) and ELSA (“ELSA Network – Emotional Literacy Support Assistants”). In addition, it has been shown that ER training can reduce recidivism and crime severity in young offenders (Hubble, Bowen, Moore, & van Goozen, 2015).

Rationale

In summary, ER is a crucial skill which we begin to learn at a young age and has been linked to a number of abilities and difficulties throughout the lifespan. However, research on the link between ER and externalising problems has tended to focus on older children/adolescents and

specific domains of externalising problems, meaning that no clear conclusions have been drawn thus far. Looking at the findings across the various externalising categories (ADHD, CP, Aggression and CU traits) simultaneously in studies exclusively looking at pre-adolescent children will offer an important contribution to the literature; i.e., is there sufficient evidence about whether or not FER problems are shared or distinct across externalising domains in pre-adolescent children, and what further research is required? Understanding the links between FER and externalising behaviour early in development will inform preventive and early interventions aimed to increase emotional knowledge and reduce distress, mental health difficulties and antisocial behaviour later in development.

The Current Review

The aim of this review is therefore to systematically appraise the nature of the relationship between FER and externalising problems in young children, age 12 and under. It aims to ask, firstly, whether there is evidence for FER problems across externalising behaviour domains, and if so, are specific emotions implicated? Secondly, is there evidence for specific patterns of FER problems in the different domains of externalising behaviours (ADHD, CP, CU traits and aggression)? Consideration of these questions will lead to a discussion about the implications for emotion-based interventions and future research.

Methods

Search Strategy

A systematic search of Psychinfo, Medline, Scopus and Web of Science was conducted to cover a broad range of psychological and social science journals. The search was conducted in December 2017 and the search terms covered both English and American forms in the format: emotion recognition (emotion recog* or emotion recognition as a topic) AND Children (paediat*, preschool, infan*, kid, toddler, girl OR boy).

Figure 1 provides the search process based on Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). Studies were excluded for the following reasons:

- If the article was not published in a peer-reviewed journal
- If it was not written in English
- If exclusively non-human populations were examined
- If only adults or children over 12 years old were examined or if data for children age 12 and under was not reported separately.
- If all participants had a diagnosis of Autism, an Intellectual Disability, or had specific health conditions or sensory difficulties (e.g., hearing or vision)
- If an empirical measure of FER was not used (e.g., vocal and scenario-based ER or non-photographic stimuli). Self, teacher or parent reports were also excluded.
- If a validated measure of externalising behaviour was not used.

Where titles or abstracts did not contain this information, papers were included in the next stage of sifting. At the eligibility stage 21 papers were excluded due to the age of the participants, 7 due to the ER task not specifically assessing FER of photographic faces, 3 did not use a validated measure of externalising behaviour or were self-report, 2 were not in peer review journals, 2 did not report FER accuracy separately from other skills and one article could not be sourced. The remaining studies were read in full and the references were examined for further articles. Ultimately 16 papers were included in the review.

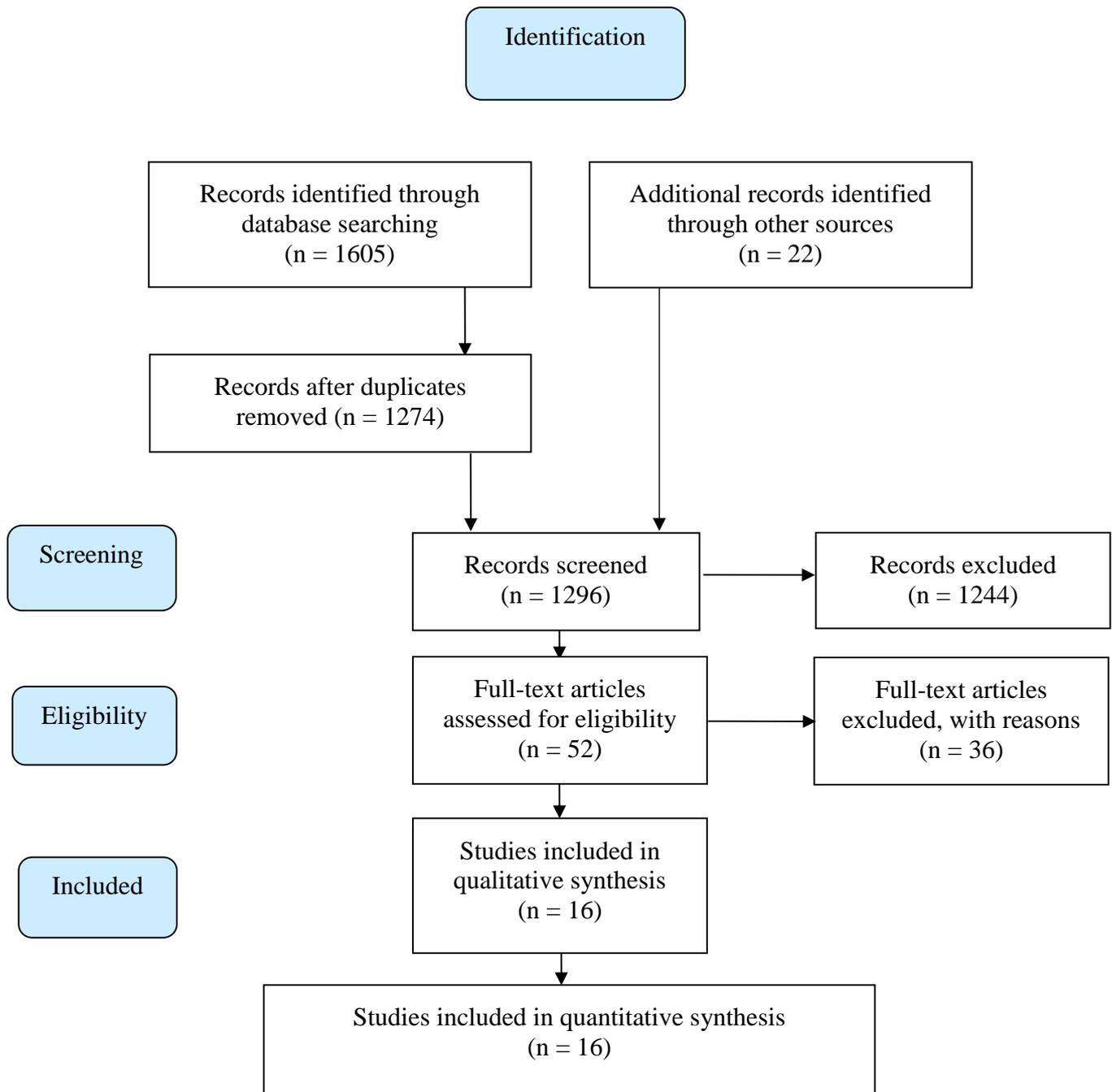


Figure 1 PRISMA Flow Diagram Demonstrating Systematic Review Procedure.

Quality Assessment

The Quality Assessment Tool for Studies with Diverse Designs (QATSDD; Sirriyeh, Lawton, Gardner, & Armitage, 2012) was used to assess study quality (see Appendix B). It comprises 14 items relating to quantitative studies which are rated on a 4-point scale from 'not at all' (0) to 'complete' (3). This tool has demonstrated good reliability and validity and was selected due to the diverse methodologies of the studies relevant for this review (group comparison, correlational, cross-sectional and longitudinal) and the clear descriptions for scoring which increases the objectivity of the rating. The author rated all studies and a 2nd rater independently rated 4 studies (25%) (NICE, 2012) to determine inter-rater reliability which was very good ($\kappa = 0.97$).

Results

Quality Ratings

Quality ratings ranged from 17 to 36 out of a possible 42, the results are presented in Table 1 as percentages which ranged from 40% to 86% with a mean of 63% (27).

Reasons for lower ratings included a lack of evidence that the sample size was considered in terms of analysis, limited rationale for choice of data collection tools, and minimal recruitment data (a crucial measure of attrition bias). Few studies gave adequate justification for the analytical method selected, there was limited assessment of the reliability and validity of measurement tools and there was often minimal discussion of study limitations. No studies evidenced user involvement in design. As this is the first systematic review of the relationship between FER and externalising behaviours in pre-adolescent children, all studies were retained to provide a comprehensive overview of the available research.

Table 1 Quality rating criteria and results for the studies included in this review

Study	QATSDD Criteria														Total %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Martin et al. (2014)	3	3	3	2	2	3	3	3	2	3	3	3	0	3	85.71%
Woodworth & Waschbusch (2008)	3	2	3	2	2	3	3	3	3	3	3	3	0	2	83.33%
Rehder et al. (2017)	3	3	3	2	2	3	3	3	3	3	3	2	0	2	83.33%
Sharp et al. (2015)	2	3	3	3	3	2	1	3	2	2	3	3	0	2	76.19%
Chronaki, et al. (2015)	3	3	2	0	3	3	2	2	2	3	3	0	0	2	66.67%
White et al. (2016)	3	3	2	3	1	2	0	2	2	2	3	3	0	2	66.67%
Parker et al. (2013)	3	3	2	0	2	2	2	2	2	2	3	1	0	2	61.90%
Rosenberg-Kima & Sadeh (2010)	3	3	2	0	1	3	3	0	2	2	3	2	0	2	61.90%
Boakes et al. (2008)	3	3	2	1	3	1	2	0	2	3	3	0	0	2	59.52%
Kats-Gold et al. (2007)	3	3	2	0	2	3	0	2	0	3	3	3	0	1	59.52%
Corbett & Glidde (2000)	3	3	2	0	2	2	0	1	3	2	3	2	0	2	59.52%
Liao et al. (2014)	3	3	1	0	3	2	2	0	2	2	2	1	0	2	54.76%
Bedford et al. (2017)	3	3	1	0	2	3	0	0	2	1	3	0	0	2	47.62%
Shapiro et al. (1993)	3	3	2	0	2	2	0	0	0	3	3	1	0	0	45.24%
Kimonis et al. (2016)	3	2	1	0	1	2	0	0	2	2	3	1	0	2	45.24%
Pelc et al. (2006)	3	1	1	0	2	1	2	0	2	2	3	0	0	0	40.48%

QATSDD Criteria: 1. Explicit theoretical framework; 2. Statement of aims / objectives in main body of report; 3. Clear description of research setting; 4. Evidence of sample size considered in terms of analysis; 5. Representative sample of target group of a reasonable size; 6. Description of procedure for data collection; 7. Rationale for choice of data collection tools; 8. Detailed recruitment data; 9. Statistical assessment of reliability and validity of measurement tools; 10. Fit between stated research question and method of data collection; 11. Fit between research question and method of analysis; 12. Good justification for analytical method selected; 13. Evidence of user involvement in design; 14. Strengths and limitations critically discussed.

Table 2 summarises the sample characteristics and findings of the selected studies. The

16 studies included 12611 children with sample sizes ranging from 48 to 9912. All the studies provided child age ranges, and most provided information about gender. Just over half provided some description of the socio-economic status of the sample, and half of the studies provided information about the ethnicity of the sample. The countries in which the studies had been conducted varied considerably; only 2 were conducted in the UK (Chronaki, et al., 2015; Martin, Hamshere, Stergiakouli, O'Donovan, & Thapar, 2014) and 6 were conducted in America (the most common; Bedford et al., 2017; Corbett & Glidden, 2000; Parker et al., 2013; Rehder, Mills-Koonce, Willoughby, Garrett-Peters & Wagner, 2017; Shapiro, Hughes, August & Bloomquist, 1993; White et al., 2016). Sixty-nine percent of studies were cross-sectional (Boakes, Chapman, Houghton & West., 2008; Corbett & Glidden, 2000; Kats-Gold et al., 2007; Kimonis et al., 2016; Liao, Li, & Su, 2014; Parker et al., 2013; Pelc, Kornreich, Foisy & Dan,

2006; Rosenberg-Kima & Sadeh, 2010; Shapiro et al.,1993; Sharp, Vanwoerden, Van Baardewijk, Tackett, & Stegge, 2015; Woodworth & Waschbusch, 2008), and 19% were longitudinal (Bedford et al., 2017; Martin et al., 2014; Rehder et al., 2017). Six included a control sample which ranged from 17 to 61 in size. Whilst all studies examined evidence for links between FER and externalising behaviours (through correlational or group-comparison designs), this was not the primary objective for 5 studies.

Table 2 Sample characteristics, measures, control variables and findings for the studies included in this review

Paper	Sample Characteristics	Sample Size, Age Range (Years) and % Female	Type of Externalising Problem and Measure	Measure of FER and Stimulus	Control variables	Findings and Emotions Tested (<u>underlined if significant impairment identified</u>)
Correlational studies:						
Rehder et al. (2017)	America: Birth cohort, over-sampling for poverty & ethnic minorities SES: Rural poverty Ethnicity: 59% European American; 41% African American	N = 761 Age: 7-8 Female: 51%	CP and CU traits Measure: DBDRS & ICU	Measure: ICE Stimulus: Adults – 2 ethnicities, 7 intensities	Gender, ethnicity, family income, caregiver’s education and children’s age. Also race of faces on ER task	<u>Happy</u> (CP & CU traits) Sad Surprise Anger Fear
Bedford et al. (2017)	America: Community sample SES: 53% on low income Ethnicity: 57% African American, 43% European American	N = 206 Age: 6 – 7 Female: not reported	CU traits Measure: ICU age 7	Measure: Facial expressions subscale of the ACES Stimulus: Child	Sex, race, poverty status, earlier CU behaviours.	<u>Grouped - Happy, Sad, Anger and Fear</u> (CU traits)
Chronaki, et al. (2015)	England: Nurseries and referrals for emotional or behavioural difficulties SES and Ethnicity not reported	N = 57 Age: 2-6 Female: 58%	Hyperactivity & CP Measure: SDQ	Measure: Ekman & Friesen’s faces Stimulus: Adult female, 2 intensities	Gender, age, voice/face modality.	<u>Happy</u> (Hyperactivity) Sad <u>Anger</u> (Hyperactivity) Neutral
White et al. (2016)	America: Pre-schoolers from paediatric clinic waiting rooms SES: 46% living in poverty Ethnicity: 45% African American, 22% European American, 31% Hispanic, 1% other	N = 337 Age: 3-7 Female: 55%	Low concern & punishment insensitivity Measure: MAP-DB	Measure: Emotional faces task, NimStim stimulus Stimulus: Adult – male & female, mixed ethnicity	Impulsivity, irritability, aggression & IQ	Happy Anger <u>Fear</u> Low concern (CU trait)
Sharp et al. (2015)	Netherlands: Children from 17 elementary schools SES: not reported Ethnicity: 75% Caucasian, 25% other	N = 417 Age: 10-12 Female: 46%	CU traits Measure: YPI-CV	Measure: CET Stimulus: Adult faces, eye region only	Verbal intelligence, gender, age	<u>Grouped – Happy & Sad</u> (CU traits)
Parker et al. (2013)	America: 7 child care centres SES: average annual household income of \$67,500 Ethnicity: 63% White, 22% African American, 9% Asian American, 13% other	N = 55 Age: 3-6 Female: 44%	Aggression Measure: CBCL	Measure: CARE, coded using the FACS & the ACES Stimulus: Child - boys & girls (ethnicity matched)	Age	<u>Grouped – Happy, sad, surprise, disgust, anger, fear & Neutral</u> (Aggression)
Rosenberg-Kima & Sadeh (2010)	Israel: School children SES: Most parents employed and well educated Ethnicity: In 25% of families, 1 or both parents immigrated	N = 134 Age: 7-12 Female: 60%	Externalising & internalising Measure: CBCL	Measure: The balloons task Stimulus: Child	Age, gender	<u>Grouped – Happy, sad and Neutral</u> (Externalising)
Liao et al. (2014)	China: Kindergartens in Beijing SES and Ethnicity: Not reported	N = 47 Age: 4-6 Female: 51%	Aggression Measure: CSBS-TF	Measure: Adapted from Denham & Couchoud. Stimulus: One intensity	Age, gender	<u>Grouped - Happy, Sad, Disgust, Anger or Fear</u> (Aggression)
Kimonis et al. (2016)	Cyprus: Mainstream and high-risk preschools SES: In high risk group average family income was lower (16,771 vs 30,528 Euros) Ethnicity: Not reported	N = 214 Age: 3-6 Female: 47%	CU traits, CP, aggression Measure: ICU, UNSW CU scale, ECBI, PSBS-T, APSD	Measure: Dynamic 1s clips from MPAFC database Stimulus: Men & women	Sample, age, sex	<u>Happy</u> (CU traits) Sad (CU traits) <u>Anger</u> (CU traits) <u>Fear</u> (CU traits)
Martin et al. (2014)	England: Longitudinal Study (ALSPAC) SES and Ethnicity: Not reported	N = 9912 Age: 8-10 Female: 49%	ADHD Measure: DAWBA	Measure: The faces subtest of the DANVA Stimulus: Two intensities	IQ, working memory, Cognitive inhibitory control	<u>Grouped – Happy, Sad, Anger, Fear</u> (ADHD)

Table 2 contd.

Paper	Sample Characteristics	Sample Size, Age Range (Years) and % Female	Type of Externalising Problem and Measure	Measure of FER and Stimulus	Control variables	Findings and Emotions Tested (<u>underlined if significant impairment identified</u>)
Group comparison studies:						
Boakes et al. (2008)	Australia: Diagnosed with ADHD. Control matched for age from the community sample SES and Ethnicity: Not reported	24 ADHD (+24 HCs) Age: 7-12 Female: 0%	ADHD Measure: ADHD diagnosis, CBCL, SNAP-IV	Measure: FAIT using stimuli created from television shows. Stimulus: Cartoons & photos - no main effect found	Verbal and performance IQ	Happiness Surprise Anger Sadness <u>Fear (ADHD)</u> <u>Disgust (ADHD)</u>
Kats-Gold et al. (2007)	Israel: Elementary schools. Study group 'at risk of' ADHD, controls were low in ADHD SES: Middle SES Ethnicity: 15% were immigrants	50 ADHD (+61 HC's) Age: 9- 11 Female: 0%	Externalising & internalising Measure: CCRS-R-S & the SSRS	Measure: Ekman and Friesen (1975) Stimulus: Adult, men & women, black & white photos	Parental education, child age, immigration status and child intelligence	<u>Grouped - Happy, Sad, Anger and Fear (ADHD)</u>
Woodworth & Waschbusch (2008)	Canada: Programme for behaviour problems. Control sample included 6 with ADHD SES: Median family income was \$40 000 (study & control) Ethnicity: 84.3% Caucasian, 4.3% African Canadian, 11.4% in other ethnic categories	56 CP or CP+CU (+17 HCs) Age: 7-12 Female: 25%	CP Measure: DBDRS	Measure: Ekman and Friesen (1976) Stimulus: Adult - male, female & cartoon - Responses collapsed	Age, sex, IQ and ADHD	Happy <u>Sad (CU traits & CP)</u> Surprise Disgust Anger Fear
Corbett & Glidden (2000)	America: Elementary school. Children with a diagnosis of ADHD and control group matched for age, gender & SES SES: Groups matched on SES index Ethnicity: not reported	37 ADHD (+37 HCs) Age: 6-8 Female: not reported	ADHD Measure: Diagnosis of ADHD	Measure: Ekman and Friesen (1976) Stimulus: Adult	Age and gender	<u>Grouped - Happy, sad, surprise, disgust, anger, fear & Neutral (ADHD)</u>
Pelc et al. (2006)	Belgium: Children with ADHD in mainstream schools SES and Ethnicity: Not reported	30 ADHD (+ 30 HCs) Age: 7-12 Female: 23%	ADHD Measure: Diagnosis of ADHD	Measure: Facial expressions (Hess and Blairy [7]) Stimulus: Adult - Male & female, 2 intensities	None stated.	Happy <u>Sad ADHD</u> Disgust <u>Anger ADHD</u>
Shapiro et al. (1993)	America: ADHD and control subjects from participants of a school intervention for ADHD SES and Ethnicity: Not reported	67 ADHD (+38 HCs) Age: 6-11 Female: 25%	ADHD Measure: CBCL, CTRS-R & DICA-R	Measure: MNTAP battery Stimulus: Child - black and white photos	Sex, age, memory	Grouped - Happy, Sad, Anger and Fear (ADHD)

Key: ACES (Assessment of Children's Emotional Skills); APSD (Antisocial Process Screening Device); CARE (Children and Adolescents Recognition of Emotion); CBCL (Child Behaviour Checklist) CCRS-R-S (Conner's Rating System Revised); CET (Child Eyes Test); CSBS-TF (Children's Social Behaviour Scale - Teacher Form); CTRS-R (Revised Conner's Teacher Rating Scale); DANVA (Diagnostic Analysis of Nonverbal Accuracy); DAWBA (Development And Wellbeing Assessment); DBDRS (Disruptive Behaviour Disorder Rating Scale); DICA-R (Diagnostic Interview for Children and Adolescents-Revised); ECBI (The Eyberg Child Behavior Inventory); FACS (Facial Action Coding System); FAIT (Facial Affect Interpretation Task); HCs (Healthy Controls); ICU (Inventory of Callous-Unemotional Traits); MAP-DB (Multidimensional Assessment Profile of Disruptive Behaviour); MNTAP (Minnesota Test of Affective Processing); MPAFC (Montréal Pain and Affective Face Clips); NimStim (A set of facial expression stimuli); PSBS-T (Preschool Social Behavior Scale –Teacher Form); SDQ (Strengths and Difficulties Questionnaire); SES (Socio Economic Status); SNAP-IV (Swanson, Nolan, and Pelham Teacher and Parent Rating Scale); SSRS (Social Skills Rating System); UNSW CU scale (The University of New South Wales Callous Unemotional Scale); YPI-CV (Youth Psychopathic Traits Inventory – Child Version).

Analysis and Synthesis of Findings across Externalising Behaviour Groups

Emotions Measured

Although not all studies reported emotions individually, happiness was tested most frequently by all 16 studies and sadness was tested by 15, shortly followed by anger which was tested by 14 studies, and fear which was tested by 12. Disgust, surprise and neutral were tested 6, 5 and 4 times respectively, and there were few significant results for these emotions. Seven of the 16 studies reported emotion-type findings separately (9 studies grouped performance across emotion types), and of these, all 7 tested happiness and anger, 6 tested sadness, 5 tested fear, 3 tested surprise or disgust and one tested neutral faces.

Eleven of the 16 studies (69%) found a significant effect to suggest that an externalising behaviour construct was related to some aspect of FER performance. Table 3 shows the percentage of studies that found evidence for a significant effect (through group or correlational designs) of each externalising behaviour construct on FER performance for each emotion. As a percentage of the number of studies for which it was tested and reported separately, externalising problems (however measured) were related to poorer performance in 0% (Neutral and surprise stimulus) to 60% (Fear stimulus) of studies, showing that there was variance in whether there was a significant effect of externalising behaviour depending on which emotions were analysed.

Table 3 Number and percentage of studies (where tested) that found evidence for a significant effect (through group or correlational design) of each externalising behaviour construct on FER performance

	Happy	Sad	Surprise	Disgust	Anger	Fear	Neutral	Grouped FER Score
No. of studies reporting significant effect of each externalising behaviour construct on different FER variables/number of studies that specifically tested whether there was an effect (through group or correlational designs)								
CP	1/3 (33%)	1/3 (33%)	0/2 (0%)	0/1 (0%)	0/3 (0%)	0/2 (0%)	0/1 (0%)	0/0 (0%)
ADHD	1/3 (33%)	1/3 (33%)	0/1 (0%)	1/2 (50%)	2/3 (66%)	1/1 (100%)	0/1 (0%)	3/4 (75%)
CU	2/4 (50%)	2/3 (66%)	0/2 (0%)	0/1 (0%)	1/4 (25%)	2/4 (50%)	0/0 (0%)	1/2 (50%)
Aggression / “Externalising”	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/3 (0%)
Total	3/7 (43%)	3/6 (50%)	0/3 (0%)	1/3 (33%)	3/7 (43%)	3/5 (60%)	0/1 (0%)	4/9 (44%)

Publication bias

Five of the 16 studies did not report any significant findings and for only one of those, FER was not the primary focus. Despite the presentation of non-significant findings, publication bias cannot be ruled out as having exaggerated the pattern of significant findings.

Stimulus

Four of the studies used child faces as opposed to adult faces in the FER task, and only one of those (25%) (Bedford et al., 2017) found any evidence for a relationship between FER and externalising behaviour, whereas 10 of the 12 studies which used adult faces (83%) found significant differences. Ages ranges of the participants in the studies where child faces were used as stimulus were no different from the studies which used adult faces. There are too few studies which used child faces to draw firm conclusions, however these results raise some interesting questions regarding stimulus use and external validity. None of the studies

compared child and adult stimulus faces, and so exploration of the impact of stimulus type on performance would be an interesting question for future research.

Sample Population

Of the seven studies which used population or community samples, 3 (43%) found evidence for a significant effect (group or correlational) of externalising behaviour on FER performance. Of the 9 studies which used samples that included children with known behavioural difficulties (e.g., clinic samples or behaviour problem programme samples) the figure was 89%. The different pattern in findings depending on sample type suggests that some community samples might have too few children with high levels of externalising problems for effects to be evident.

The impact of sample age range on key findings was also considered. Fourteen out of the 16 studies could be separated into younger (children aged 7 and under) and older samples (children aged 7-12). 66% of the younger sample studies found a significant effect of externalising behaviour on FER performance; a similar proportion was found in the older sample studies (75%). Thus, this analysis indicates that age range of the sample does not appear to impact upon whether or not there is evidence for FER problems in externalising behaviour groups.

QATSDD Rating

Five of the eight (62.5%) studies which scored over the median (60.7%) on the QATSDD and six of the eight studies (75%) which scored less than the median found a significant link between FER and externalising behaviour. This data indicates that the quality of the study has not clearly affected the likelihood of studies finding significant results.

Externalising Behaviour and Specific Emotions

Fear

Externalising problems were related to poorer FER performance for fear in three (60%) of the five studies which tested and reported it individually (Boakes et al., 2008; Kimonis et al., 2016; White et al., 2016). All of the studies with significant findings utilised samples of children with known behavioural difficulties.

Sadness

Externalising problems were related to poorer FER performance for sadness in three (50%) of the six studies which tested and reported it individually (Kimonis et al., 2016; Pelc et al., 2006; Woodworth & Waschbusch, 2008). All of the studies with significant findings utilised samples of children with known behavioural difficulties.

Happiness

Higher rates of externalising problems were related to poorer FER performance for happiness in three (43%) of the seven studies which tested and reported it individually (Chronaki et al., 2015; Kimonis et al., 2016; Rehder et al., 2017). Of these studies Rehder et al. (2017) was the only one which did not use a sample of children with known behavioural difficulties, they used a birth cohort with a large sample size that was large enough to detect a significant effect.

Anger

Externalising problems were related to poorer FER performance for anger in three of the seven (43%) studies which tested and reported it individually (Chronaki et al., 2015; Kimonis et al., 2016; Pelc et al., 2006). All of the studies which found significant findings utilised samples of children with known behavioural difficulties.

Disgust

Externalising problems were related to poorer FER performance for disgust in one of the three studies (33%) which tested and reported it individually (Boakes et al., 2008). This study used a sample of children with diagnoses of ADHD.

Neutral

One study tested and reported neutral faces individually (Chronaki et al., 2015) and used a sample of children with known behavioural problems, but did not find a significant difference between children with and without externalising problems.

Surprise

Externalising problems were not related to poorer FER performance for surprise in any of the three studies which tested and reported it individually. These studies used a mixture of CP and ADHD presentations in their samples.

Grouped FER Performance

Nine out of 16 studies analysed overall FER performance (i.e., combining ER accuracy across multiple emotions). Four (44%) found evidence to suggest a link between externalising behaviour problems and ER (Bedford et al., 2017; Corbett & Glidden, 2000; Kats-Gold et al., 2007; Martin et al., 2014). Of those, two used samples of children with known behavioural problems (Corbett & Glidden, 2000; Kats-Gold et al., 2007). Of the 7 studies which analysed overall FER performance and did not find any significant findings, all but one (Shapiro et al., 1993) used community samples.

In summary, when studies test and report emotions individually, a link between happiness, anger, fear and sadness has been found with externalising problems an average of 49% of the time that they are tested. There is less evidence for relative problems recognising

neutral, surprise and disgust; however very few studies have considered externalising behaviour in relation to these more complex emotional expressions.

Bias Towards Choosing Certain Emotions

Within the individual studies, a number of response biases were reported. Chronaki, et al. (2015) reported that pre-schoolers generally were more likely to attribute sadness. Kats-Gold et al. (2007) reported that boys at risk of ADHD attribute more sadness and fear. They suggested this may be due to the negative experience of being a child with ADHD. The few studies which reported biases did not find evidence for a bias in children with CP/CU traits. These findings are neither consistent nor conclusive.

Analysis and Synthesis of Findings in Specific Externalising Behaviour Groups

ADHD

Seven of the 16 studies (43.75%) considered ADHD or inattention/hyperactivity in relation to FER (Boakes et al., 2008; Chronaki et al., 2015; Corbett & Glidden, 2000; Kats-Gold et al., 2007; Martin et al., 2014; Pelc et al., 2006; Shapiro et al., 1993). Of these, 6 (86%) found some evidence that FER problems are implicated in ADHD. Chronaki, et al. (2015) used a sample that included both typically developing and clinically referred children, and found that hyperactivity was related to greater difficulty recognising happiness and anger. Boakes et al. (2008) found that both inattention and hyperactivity, in a sample of children where half had a diagnosis of ADHD, were significantly related to difficulty recognising disgust and fear. Pelc et al. (2006) found that in a sample of children where half had a diagnosis of ADHD, the diagnosis was significantly related to greater difficulty recognising sadness and anger. Corbett & Glidden (2000), Kats-Gold et al. (2007) and Martin et al. (2014) grouped the FER findings but also reported a significant association between ADHD and difficulty with FER. Corbett & Glidden (2000) tested all emotions (happiness, sadness, surprise, disgust, anger, fear and

neutral), Kats-Gold et al. (2007) tested happiness, sadness, anger and fear and Martin et al. (2014) tested happiness, sadness and fear.

In combination, these findings do not provide any evidence for difficulty with specific emotions in ADHD. However, there were large differences in methods and samples used which could help explain the non-consistent findings. For example, Boakes et al. (2008) only used two stimulus items for each expression and the expressions were high in intensity. Neither Boakes et al. (2008) nor Kats-Gold et al. (2007) included any girls in their sample, and Corbett & Glidden (2000) did not state the gender of their sample.

Shapiro et al. (1993) found that within their sample of children aged 6 – 11 years old, younger children with ADHD displayed difficulties in FER whereas older children with ADHD did not. The authors took this to indicate that either attention difficulties in young children with ADHD may delay learning about emotions, or that there is a specific difficulty in emotional processing but with age the child gains compensatory strategies. This hypothesis was not supported by Kats-Gold et al. (2007) study where the sample were aged 9 – 11, and they found that children at risk of ADHD had significant difficulties recognising happy, sad, angry and fearful faces.

In summary, the majority of published studies have found evidence for ADHD or inattention / hyperactivity being related to impaired performance in FER tasks. However, the exact nature of the FER difficulties is difficult to summarise, most probably as a result of methodological differences between studies.

Callous Unemotional traits

Six of the 16 studies (38%) considered CU traits (Bedford et al., 2017; Kimonis et al., 2016; Rehder et al., 2017; Sharp et al., 2015; White et al., 2016; Woodworth & Waschbusch, 2008).

Of these, five (83%) found evidence of CU traits being related to impaired performance on FER tasks.

Of the studies which used samples of children with known behavioural problems, Kimonis et al. (2016) found a significant association between CU traits and difficulty recognising happiness, sadness, anger and fear. White et al. (2016) found that low levels of concern (considered by the author as a developmental manifestation of CU traits) were associated with difficulty recognising fear. Both Kimonis et al. and White et al. used large samples with a mix of boys and girls however, Woodworth & Waschbusch (2008) who found that CU traits were associated with difficulty recognising sadness used a smaller sample with a small proportion of girls.

Two of the studies which found a significant relationship used community samples; Rehder et al. (2017) found a significant association between CU traits (and CP) and difficulty recognising happiness, and Bedford et al. (2017) tested happiness, sadness, anger and fear and found that when grouped, impaired FER was associated with CU traits. Sharp et al. (2015) was the only study which measured CU traits but did not find an association with FER. They used a community sample in the Netherlands and importantly, the FER stimulus was only the eye region, not the whole face. In summary the findings suggest a global difficulty (i.e., across emotional expressions) with FER for children with CU traits.

Conduct Problems

Three of the 16 studies (19%) measured CP and of those, two (66%) found a significant effect of CP on FER performance; Rehder et al. (2017) found that CP was related to greater difficulty recognising happy faces and Woodworth & Waschbusch (2008) found that children with CP traits had greater difficulty recognising sadness than the control group. Chronaki, et al. (2015) found no effect for sad or neutral faces, but hyperactivity and CP were linked to greater

difficulty recognising happy and angry faces. In subsequent regression analyses (controlling for each symptom domain) it was attention difficulties and hyperactivity that accounted for poorer FER performance. Woodworth & Waschbusch (2008) controlled for ADHD symptoms but Rehder et al. (2017) did not, so it is not clear to what extent hyperactivity or attention difficulties may account for these correlations.

In summary, there are mixed and minimal results in terms of the relationship between CP and specific emotion impairments in younger children.

Aggression and Externalising Behaviours

Two of the 16 (13%) studies measured aggression. These studies did not find a significant effect of FER performance on aggression (Liao et al., 2014; Parker et al., 2013), they used community samples and a mixture of boys and girls. Furthermore, both studies had relatively small sample sizes. One study looked at internalising vs externalising (Rosenberg-Kima & Sadeh, 2010) and did not find any significant relationships but also used a small population sample. All three of these studies grouped FER.

These findings do not suggest a strong link between aggression or non-specific externalising presentations and broad FER difficulties in the general population.

Discussion

This review met the original aims to systematically appraise the nature of the relationship between FER and externalising problems in children. Specifically, we aimed to firstly investigate whether there is evidence for FER problems across externalising behaviour domains in pre-adolescent children (age 12 and under), and if so, which specific emotions are implicated. Secondly, we considered whether there is evidence for specific patterns of FER problems in the different domains of externalising behaviours (ADHD, CP, CU traits and

aggression). Each of these questions have been explored and the findings are summarised below:

Summary across Externalising Behaviour Groups

This systematic review found mixed evidence for FER skill deficits across pre-adolescent children presenting with externalising behaviours, with insufficient evidence to suggest a clear deficit in relation to any specific emotions. Of the studies that considered the different emotions individually, a link between externalising behaviour and recognising happiness, anger, fear or sadness was identified approximately 50% of the time. There was less evidence for any link between externalising behaviour and relative problems recognising more complex emotions (e.g., neutral, surprise and disgust); although these complex emotions were studied less frequently.

The findings overall were mixed, with 5 out of the 16 studies finding no evidence for FER performance being implicated in externalising behaviour problems, there are a number of possible reasons for these findings. Firstly, associations between externalising behaviours and FER were less evident in community samples than in samples of children that included those with known behavioural problems (e.g., clinically-referred samples). In addition, the stimuli for FER studies varied across studies (e.g., child or adult faces) and whilst this could have impacted upon the results, the data presented here is too limited to draw any firm conclusions. Better understanding of these relationships through future research could inform how best to design interventions to increase FER abilities in pre-adolescent children.

Summary of Specific Externalising Behaviour Groups

Although not fully conclusive, the data suggests that groups of children with both low and clinical levels of ADHD symptomatology are likely to have a generalised difficulty with FER which is not linked to specific emotions or biases. These findings are in line with previous

suggestions that the symptoms of ADHD, such as not properly attending to stimuli and executive function difficulties, might impact upon the development of their emotional knowledge generally (Frazier et al., 2004; Willcutt et al., 2008; Kats-Gold et al., 2007).

Similarly, the data suggests a generalised difficulty with FER for children with high levels of CU traits. This finding supports Dadds et al.'s (2011) argument for general deficits in attention to social-emotional stimuli for children with CP and CU traits. Specifically, they suggested that these children may pay less attention to eyes, hence leading to generalised FER deficits. Interestingly, the only CU study reviewed that did not find an effect of CU traits on ER (Sharp et al., 2015) used stimuli that only included the eye region, and so would have aided the participants in attending to this area.

Crick and Dodge (1994) have previously proposed that individuals with aggression misinterpret ambiguous social cues. Few of the studies provided any in-depth analysis on the different relationship between FER and externalising problems depending on whether the facial expressions were low or high intensity. Thus, this review does not offer any support for or against Crick and Dodge's theory. In addition there were no fear-specific trends which may suggest amygdala hyposensitivity as suggested by Blair et al. (2014).

The findings in relation to CP are less conclusive. One study (Chronaki et al., 2015) suggests that the relationship between CP and FER may be accounted for by hyperactivity and attention difficulties, yet few studies have controlled for this. Given the high levels of comorbidity it is plausible that this explanation applies to a range of externalising problems and requires further research. Unfortunately, Chronaki et al. did not covary for IQ or language skills, which was a major limitation in terms of whether their findings could be generalised.

Limitations

First, there is a very real risk that publication bias might have meant that studies finding a non-significant relationship between FER and externalising behaviours have not been published. Thus, the report of significant findings presented here (which already include several studies finding non-significant effects of externalising behaviours) may be an exaggeration of reality. This review made no attempt to retrieve unpublished data to mitigate for the effect of publication bias.

Second, whilst this review is crucial in taking the first step to systematically appraise and collate the available research regarding FER in pre-adolescent children with externalising behaviours, the generalisability of these findings is limited. The country under study varied significantly and therefore there are a number of relevant cultural factors which are beyond the scope of this review. In addition, whilst a number of studies achieved close to 50/50 in terms of the participant's gender, some were either mostly or only boys, and so no conclusions could be drawn regarding gender. Third, as already discussed, the studies used a variety of methods in terms of sample characteristics and measurements, causing problems drawing firm conclusions. Fourth, the labelling of prototypical emotions is the most frequently researched aspect of ER and the easiest to assess, however it is less ecologically valid than assessing labelling of non-prototypical emotions would be (Castro et al., 2016). The vast majority of the measures used in the studies reported rely on participants recognising emotions of people unknown to them. Therefore, whilst these findings are useful they do not reflect the breadth of the conceptual definition of ER (Castro et al., 2016).

Fifth, this systematic review has not explored the role of the child's early life and home environment which is known to affect ER and externalising behaviours (e.g., Brownell, Svetlova, Anderson, Nichols, & Drummond, 2013; Murray & Farrington, 2010). Experiences of abuse and neglect have been found to differentially affect FER (Pollak, Cicchetti, Hornung,

& Reed, 2000; Pollak, Messner, Kistler, & Cohn, 2009; Pollak & Kistler, 2002) as have harsh parenting (Jaffee, 2017), negative parenting, maternal depressive symptoms (Kujawa et al., 2014) and attachment insecurity (Cooke, Stuart-Parrigon, Movahed-Abtahi, Koehn, & Kerns, 2016). Externalising behaviours have been linked to parenting style and conflict (Murray & Farrington, 2010), poorer home environment (NICHD Early Child Care Research Network, 2003, 2005) insecure attachment (Pasco Fearon & Belsky, 2004) and mother child interaction quality (Murray, Hipwell, Hooper, Stein, & Cooper, 1996). Therefore, there are a number of variables which may have affected children's FER skills or their externalising presentations but were not accounted for in this review.

Future Research

This systematic review has highlighted a number of recommendations for future research. Firstly, our findings suggest that FER problems are unlikely to be highly relevant to mild or commonly occurring levels of externalising behaviour, and so future research investigating FER and externalising behaviours should utilise samples enriched with higher levels of psychopathology. In addition, samples should contain a mixture of boys and girls with an appropriate control sample. Bedford et al. (2017) found that ER predicted later CU behaviours however very few studies included in this review studied longitudinal effects of FER performance, therefore future research would ideally be prospective or longitudinal in order to discover causal or directional links with later behavioural problems.

Thus far, much of the research into ADHD and CP is conducted separately. Given the initial evidence that attention difficulties or hyperactivity may account for relationship between CP and FER, further research is needed that looks into the independent relationships of CP or CU presentations and attention/hyperactivity.

Many of the studies examined did not control for likely variables that might impact upon a child's performance on FER tasks of children in younger age groups (most notably verbal ability/IQ). Therefore, future research should include verbal ability / IQ as a covariate. Some of the inconsistencies in findings covered in this review might be due to the broad measures of FER used assessing multiple underlying processes. It might be that specific manifestations of behavioural problems are linked to more specific aspects of emotional/empathic function. For example, the extent to which attention is focused on the eyes appears to be predictive of FER performance (Dadds et al., 2008) in some externalising groups. One variable not considered in the studies included in this review is children's basic cognitive and affective 'Theory of mind' (ToM) abilities (i.e., the ability to see other people as having distinct thoughts and emotions to oneself). ToM is at a key stage of development in younger children (Guilé, 2014), particularly between the ages of 4 and 6 (Astington & Gopnik, 1991; Miller, 2009). Delays in ToM development might impact upon the levels of attention that children give to the emotional expressions of others, thus impacting upon their FER development. Further research should attempt to disentangle which aspects of cognitive and affective empathic function most reliably predict different behavioural manifestations.

Finally, external validity and clinical application should be considered carefully when selecting stimulus for future FER research. One second clips have been found to provide more robust results (Kimonis et al., 2016) and researchers should test a wide range of emotions (reporting their findings individually) displaying a range of intensities. In addition, it would be beneficial to study both child and adult stimulus faces.

Clinical Implications

The overall findings suggest that many children with significant externalising problems do have problems with FER, and thus it might form part of an important pathway to externalising problems in some children. Given the long-term implications of externalising behaviours,

many children at risk of later problems would likely benefit from constructive assessment and support with their emotional and relational skills (including FER) early in life, rather than only their academic skills. Services should be aware when assessing children that the evidence base does not show clear relationships between specific skill deficits and clinical diagnosis, and therefore prescribed interventions will need to be informed by more thorough individualised assessment and formulation.

There is preliminary evidence that relatively short-term, low cost, and focused training can be given successfully to adolescents with CP, with positive effects on FER skills and behaviour (Hubble et al., 2015). This review indicates that it would be worthwhile to adapt such training to younger populations to see whether it is of clinical benefit for children with externalising behaviours (particularly those with ADHD or CU traits). Furthermore, it is likely that interventions delivered earlier in development are more likely to have an impact than when administered later, when behaviours have become entrenched. Also, emotion-based interventions are a particularly neglected area in the treatment of ADHD-related problems; hence this review would support further research about the impact of such interventions in ADHD groups.

Given the evidence that FER develops in families where there are frequent displays of positive emotions and fewer displays of negative emotion (Denham & Kochanoff, 2002; Laible, 2011; McElwain et al., 2007), then whole family approaches that include emotional training and strategies (e.g., Mentalisation Based Treatment for Families; (Asen & Fonagy, 2012); or Parent Child Interaction Therapy; (Eyberg, 2008)) might also be useful for improving FER skills in children with externalising behaviour problems. It would be interesting to study whether already evidenced behavioural parenting programmes (Webster-Stratton & Reid, 2004) improve in terms of effectiveness when they include strategies to increase emotion-based talk. In addition, projects or policies which enable families, reduce stressors, provide

opportunities and support where needed, are likely to have a positive indirect impact on children's ER abilities.

Conclusions

Overall, there was the strongest evidence for significant findings regarding FER problems in ADHD or CU presentations, and in samples of children with higher levels of externalising problems rather than in community samples. Within the various externalising behaviour groups there was no clear evidence for specific emotion deficits, which is consistent with other reviews in older children and adults (Dawel et al., 2012; Bons et al., 2013; Collin et al., 2013).

Facial Emotion Recognition and Theory of Mind in Young Children with Externalising Behaviours

**Prepared in accordance with the author guidelines for
Child Neuropsychology (Appendix A)**

Word Count: 7521, excluding references, figures and tables.

Abstract

Understanding the relationship between social-emotional skills and externalising behaviours in young children is crucial to understanding the development of those problems and how best to intervene. The current study examined two important social-emotional skills, namely Facial emotion recognition (FER) and Theory of mind (ToM). It also investigates the relationship between ToM and FER, and their associations with externalising problems (specifically, hyperactivity and conduct problems). Sixty-eight children (4–7-years-old), oversampled for externalising problems, completed measures of verbal ability, FER, and ToM. The FER measure included stimuli of Happy, Sad, Fearful, Angry and Neutral adult faces, at high and low intensities to explore participants' understanding of ambiguous facial expressions. Four false-belief tasks assessed different aspects of ToM. Teacher ratings of conduct problems and hyperactivity were collected.

Older children (aged 6-7) evidenced stronger FER and ToM performance than younger children (aged 4-5). Emotion, intensity and their interaction affected FER accuracy. High intensity emotions and happiness were easier to recognise, and of the negative emotions sad faces were easier than fearful ones. Children with weaker ToM had lower verbal IQ and poorer FER performance even when controlling for IQ. Relatively high hyperactivity and/or conduct scores were related to lower scores on anger recognition, and regression analyses indicated that hyperactivity accounted for more of this variance. Hyperactivity and/or conduct problems did not predict ToM performance. The study has potential research and clinical implications for young children exhibiting externalising behaviours.

Keywords: Emotion recognition, Theory of mind, Child, Conduct, Hyperactivity

Introduction

There has been a large amount of research linking the development of conduct problems (CP) and psychopathic traits in adolescence and adulthood to poorer emotion recognition (ER) (e.g. Dawel et al., 2012). Less research has examined the relationship between ER and behavioural problems in younger children; this is particularly important as emotional skills are at a crucial stage of development (Denham et al., 2003) and thus it is an opportune time for intervention. The current study aimed to investigate both Facial emotion recognition (FER) and Theory of mind (ToM) and their relationship to externalising behaviours in young children.

Emotion Recognition

ER has been conceptualised as a component of “cognitive empathy” which is the ability to understand and recognize emotions and take other’s perspectives (Bons et al., 2013). Facial expressions are one of the most powerful ways to communicate emotions (Frith, 2009). Children use such social cues to inform their behavioural responses (Cicchetti, 2016) and develop relationships (Chronaki et al., 2015). ER develops throughout childhood (Herba & Phillips, 2004; Herba et al., 2006). Most studies suggest that by the age of 4-5 most children can reliably identify the six basic emotions of happiness, sadness, anger, fear, surprise and disgust across a range of stimuli (Camras et al., 1988; MacDonald et al., 1996; Russell & Widen, 2002; Schultz et al., 2000). These pre-school years are a crucial developmental period, so children’s experiences and skills at this age form the basis of their later social and emotional competence (Denham et al., 2003).

Theory of Mind

ToM is another social-emotional skill, defined as “the understanding of mental states, what we know or believe about thoughts, desires, emotions, and other psychological entities both in

ourselves and in others” (Miller, 2009 p. 749). ToM has two subcomponents, cognitive ToM which is knowing that others have different knowledge and beliefs, and affective ToM which is an empathic understanding of how the person is feeling (Shamay-Tsoory et al., 2007).

“False-belief tasks” are regularly used to assess ToM in 2-8-year-olds (Hughes, 2016). First-order false-belief tasks assess children’s understanding that it is possible to hold false-beliefs about the world (Miller, 2009); the most common of these is the Sally-Anne task (Baron-cohen, Leslie, & Frith, 1985). Despite some criticism regarding over-reliance on language ability (Bloom & German, 2000), a meta-analysis by Wellman, Cross, and Watson (2001) demonstrated this assessment to be a valid measure of ToM with consistent results across studies as well as a consistent developmental patterns across cultures and task manipulations. Most typically developing children succeed in such first-order false-belief tasks by age 4 (Astington & Gopnik, 1991) however this can range from 3-5 (Jenkins & Astington, 1996). Second-order false-belief tasks are more advanced and assess children’s understanding that it is possible to hold a false-belief about someone else’s belief, in which children typically succeed age 5-6 (Miller, 2009).

A number of factors have been found to influence the development of ToM; including executive function (Carlson & Moses, 2001) and children’s production of, and exposure to, internal state language such as feelings, desires and thoughts (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; and Ruffman, Slade, & Crowe, 2002). Both cross-sectional studies (Adrian, Clemente, Villanueva, & Rieffe, 2005; Astington & Baird, 2005; Astington & Jenkins, 1999; Dunn, Brown, & Beardsall, 1991) and studies involving ToM training programmes (Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003) have shown that language plays a crucial role in the development of children’s understanding of the mind (Milligan, Astington,

& Dack, 2007). Findings suggest a bi-directional, but not equal relationship between ToM and language with language having a greater influence on ToM (Slade & Ruffman, 2005).

The Relationship Between Emotion Recognition and Theory of Mind

Strand, Downs, and Barbosa-Leiker (2016) used a longitudinal design to explore the relationship between FER and ToM in 417 pre-schoolers. They found that the development of FER predicts the development of perspective taking (a component of ToM). Both FER and ToM abilities are affected by and often rely on language ability (De Stasio, Fiorilli, & Di Chiacchio, 2014; Strand et al., 2016). Dunn (2000) suggested ER develops before ToM because emotions are more visible than beliefs and intentions, and neuroimaging studies later supported this claim (Saxe, Carey, & Kanwisher, 2004). Evidence has also suggested that ER may contribute to developing an understanding of intentionality (another component of ToM) in infants (Phillips, Wellman, & Spelke, 2002). Coricelli (2005) then proposed that ToM develops in two steps. The first step is an unconscious process of intention recognition (including ER) and the second step is a conscious process of considering the intentions of the other person (ToM). Finally, some theorists have proposed that ToM and ER are important components of the broad concept of “cognitive empathy” (Bons et al., 2013). Therefore, of the few studies have looked at the relationship between ToM and ER in children and adults, most have shown that these abilities are related.

Externalising Behaviours in Childhood

One way of grouping concerning behaviours in children is by categorising them as either “internalising” or “externalising”. Internalising behaviours are those which are inhibited or controlled such as anxiety or social withdrawal, whereas externalising behaviours are manifested “outside”. The most widely studied externalising diagnostic group is ADHD, characterised by hyperactivity, impulsivity, and/or inattention (Leibson & Hall Long, 2003;

Wilens & Spencer, 2010) and associated with interpersonal/relationship difficulties (e.g., Melnick & Hinshaw, 2000). Another group are those with conduct problems (CP), which refer to angry, defiant, antisocial, aggressive, and norm violating behaviours in children and adolescents and which subsumes the diagnostic terms of Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) (Lorber, 2004). Long-term, ADHD is associated with adverse outcomes across education, employment, substance use and criminality (e.g., Erskine et al., 2016; Mannuzza, Salvatore Klein, 2000). CD is associated with substance use difficulties, violence, early pregnancy, antisocial personality disorder, and failure to complete high school (Erskine et al., 2016). The co-occurrence of both inattention/hyperactivity and CP in childhood is predictive of poorer longitudinal outcomes than either diagnosis alone (e.g., Moffitt, Caspi, Harrington, & Milne, 2002) and although highly comorbid (Biederman et al., 2002), treatment pathways for ADHD and CP tend to be different (NICE, 2013a, 2018). Understanding the underlying mechanisms (such as social-emotional skills) for inattention/hyperactivity or CP could lead to more evidence based and focused interventions.

Emotion Recognition and Externalising Behaviours

Although some findings are mixed, research shows that problems recognising emotions exist in adolescent CD and adult antisocial behaviour groups, including psychopathy (Dawel et al., 2012; Bons et al., 2013; Collin et al., 2013). Bowen et al. (2014) found that young offenders were worse at recognising sadness, low intensity disgust and high intensity fear, and Fairchild et al. (2010) found that girls with CD were impaired in recognising anger and disgust. In pre-adolescent children, associations have been found between CP and CU traits and the recognition of happiness (Rehder et al., 2017) and sadness (Woodworth & Waschbusch, 2008). When CU traits have been analysed the majority of studies have found evidence of impairment in FER (Bedford et al., 2017; Kimonis et al., 2016; White et al., 2016). However Sharp and

colleagues, who used a community sample and limited the stimulus to the eye region, did not find an effect (Sharp et al., 2015).

Very few of these child, adolescent and adult studies have controlled for symptoms of inattention/hyperactivity which are often a precursor for the development of significant antisocial behaviour problems. ADHD or hyperactivity has been linked to difficulties recognising both positive (happy) and negative (anger, sadness, fear and disgust) emotions in 6 to 12-year-old children (Pelc et al., 2006; Martin et al., 2014; Boakes et al., 2008; Corbett & Glidden, 2000; Pelc et al., 2006; Kats-Gold et al., 2007). Chronaki, et al. (2015) found that in a sample of 3-6-year-olds, some of whom had been clinically referred for behaviour problems, hyperactivity but not CP was associated with difficulty recognising angry and happy faces. Chronaki et al. did not control for verbal ability or IQ. Woodworth and Waschbusch (2008) also controlled for ADHD and found an association between CP and the recognition of sadness in participants aged 7-12. It may be that, given the high levels of comorbidity, hyperactivity at earlier ages before CP's fully manifest account for the relationship between CP and FER difficulties.

Various theories relating to externalising behaviour problems propose a role for ER. Crick and Dodge (1994) proposed that individuals with aggression are hypersensitive to emotions such as anger and misinterpret ambiguous emotion expressions, leading them to behave in hostile ways with the effects of peer responses (e.g., rejection) maintaining this pattern. Dadds et al. (2011) have argued that deficits in FER in CP populations may reflect general deficits in attention to social-emotional stimuli. Marsh et al. (2008) found reduced amygdala activation during processing of fearful facial expressions in youth with CP and hypothesised that this results in children being 'under-reactive' to fear-related stimuli and less likely to inhibit aggression. It has also been suggested that children with CP are more likely to

come from home environments which are less supportive of the development of ER abilities (Bowen et al., 2014). Finally, for children with a diagnosis of ADHD, it has been argued that attention difficulties would affect children's ability to attend to and therefore learn about facial emotions (Kats-Gold et al., 2007).

Theory of Mind and Externalising Problems

ToM is not commonly considered in studies that focus on the relationship between FER and externalising behaviours (Hughes, 2016). This variable has been studied most frequently in people with Autism (Frith, 2001; Frith & Frith, 2001). In young children, ToM is at a key stage of development (Guilé, 2014) and delays in ToM development might impact upon the levels of attention that children give to the emotional expressions of others, thus impacting upon their ER abilities. Studies of ToM skills in people with diagnoses of CD are few and inconsistent (Bons et al., 2013). In one study of children with CD, no deficits in ToM or ER were identified (Buitelaar, van der Wees, Swaab-Barneveld, & van der Gaag, 1999a) however others have found relationships between poor ToM skills and CP (Donno, Parker, Gilmour, & Skuse, 2010; Ha, Sharp, & Goodyer, 2011). Although studies are limited, it has been shown that children with ADHD have impairments in both first and second-order ToM tasks (Buitelaar et al., 1999a; Sodian, Hülshen, & Thoermer, 2003) and this has been linked to poor interpersonal skills (e.g., Mary et al., 2016). Thus far no studies have focused on ToM and FER skills in relation to externalising problems in young children.

Summary

In conclusion, understanding the relationship between social-emotional skills (FER and ToM) and externalising behaviours in younger children is crucial to understanding the development of those problems and how best to intervene. There is a need for future research to specifically consider whether CP or hyperactivity are independently related to FER problems, and to

examine the potential role of ToM in understanding any relationship. Furthermore, given the relationship between verbal/language ability and developing social-emotional skills, the impact of verbal skills on any relationships between externalising behaviours and FER and ToM should also be considered in any such studies.

Aims and Hypotheses:

We aimed to examine FER and ToM performance in a young sample oversampled for externalising behaviour problems, including examining the differential effects of age, emotion type and emotion intensity. The second aim of the study was to investigate the relationship between ToM and FER performance, and their relationships to externalising problems.

The following hypotheses were tested:

- (1) Children with weaker ToM performance will have poorer FER performance.
- (2) Children with weaker ToM performance will have greater hyperactivity and CP.
- (3) There will be an inverse relation between inattention/hyperactivity and CP and FER performance; it was also predicted that inattention/hyperactivity would be a better independent predictor than CP of poorer FER performance.

Method

Participants

A sample of 37 children aged 4-7 were referred by their teachers to the Neurodevelopment Assessment Unit (NDAU) at Cardiff University for an in-depth assessment of their abilities in various domains (e.g., FER, ToM, but also other areas not reported here such as executive functioning). The NDAU provides a report back to the school of the children's strengths and difficulties, and the information collected is used for research purposes. The referral criteria were that the teachers had concerns about the children's emotions and behaviours, but that they

had not been assessed for or diagnosed with Autism. In addition, a typically developing sample of 31 children were recruited from a primary school for the purposes of this specific study, in order to provide a dimensional approach. These participants were children who were not known to be experiencing significant difficulties in school and did not have any confirmed psychiatric diagnosis.

In total, 68 children were tested between 08/08/2017 to 23/03/2018. The non-referred children were well matched in terms of sex, ethnicity, age, income and verbal IQ, and differed significantly from the referred children only in terms of teacher ratings of CP and hyperactivity; see Appendix C.

The research reported here was scrutinised and approved by Cardiff University School of Psychology Research Ethics committee (see Appendix D). The parents of the children who participated gave written informed consent (Appendix E and F).

Measures

Teacher Questionnaire Measure

The Strengths and Difficulties Questionnaire (SDQ, see Appendix G) is a brief questionnaire covering the main domains of child psychopathology (emotional symptoms, CP, hyperactivity-inattention, and peer problems) as well as strengths (prosocial behaviour) which for this study was completed by teachers. Although the full measure was completed, only the hyperactivity and CP were analysed due to the a priori aims of the study and to reduce the possibility of finding false positive statistical results.

Factor analysis of both the parent and teacher versions has previously indicated that the questionnaire consists of five factors which correspond with the hypothesised domains of psychopathology. Internal consistency and test–retest stability has been found to be satisfactory

(Goodman, 2001). In terms of validity, SDQ scores predict other relevant measures of psychopathology (Goodman & Scott, 1999). It also discriminates well between children with and without psychopathological symptoms (Goodman, 1999)

Tasks Administered to Children

Please note that fuller descriptions of the tasks used including photographs can be found in Appendix H.

Verbal IQ (Lucid Ability Assessment).

Verbal intelligence was assessed using a verbal reasoning assessment from the Lucid Ability Assessment Version 5.15 (Lucid Research Ltd, Beverley, UK, www.lucid-research.com). This is a computerised assessment system with separate verbal tests for age ranges 4-6 (Picture Vocabulary) and 7-16 (Link Words). The tests in the Lucid Ability were standardised on a total of 2300 children aged 4 –16 years across 24 schools in the UK. Concurrent validity measures were obtained by comparing results of Lucid Ability tests with comparable conventional tests. For the purposes of this study, only the verbal subtest was administered (age corrected percentile scores were used as a covariate in analyses).

Facial Emotion Recognition Measure

Firstly, to ensure the participants understood the emotions, they were asked to label a series of cartoons and photographs showing each emotion clearly (100% intensity). If they were unsure the emotion was explained using examples, this was also an opportunity to check the labels they use for emotions (e.g. mad or cross for anger). The FER measure consisted of 60 photographs of adult males and females of varying ages, displaying four emotions (happiness, sadness, fear and anger) plus a neutral expression. The photos were taken from the Radboud Faces Database (Langner et al., 2010) and were morphed to be of high (60-80%) or low (20-40%) emotional intensity. The hair and background of the image had been blacked out so that

only the facial features remained. Participants were then asked to answer the question ‘what emotion (if any) is this person showing?’ for each of the 60 test photographs. They were given four options of the target emotions or neutral. Participants were required to state aloud which emotion they thought was being displayed and their response was recorded by the researcher.

Theory of Mind: Contents False-Belief – Smarties

The Contents False-belief Task was described by Wellman and Liu (2004) and derived from one used by Perner, Leekam, and Wimmer (1987). The child sees a ‘Smarties’ box and learns that there are pens, not Smarties inside the box. A toy tiger is then introduced and the child is told that the tiger has never seen inside the box. The child is asked what Tiger thinks is in the box (the target question) and then a memory question “Did Tiger see inside the box?”. To be scored as “correct” the child must answer the target question “Smarties” and answer the memory question “No.”

Theory of Mind: Belief Emotion Task – Coco-pops

This belief emotion task was described by Wellman and Liu (2004) and derived from one used by Harris, Johnson, Hutton, Andrews, and Cooke (1989). Children see a toy teddy and a closed Coco-pops box. They learn that the teddy loves coco-pops and then teddy leaves the area. The box is opened to reveal rocks and then closed again before teddy returns. The child is told that teddy has never seen inside the box before and asked the target question “So, how does Teddy feel when he gets this box? Happy or sad?”. The box is opened and an emotion control question is asked “How does Teddy feel after he looks inside the box? Happy or sad?”. To be correct, the child must answer the target question “Happy” and answer the emotion-control question “Sad”.

Theory of Mind: False-Belief – Max and Sally

The most common variation of the unexpected location false-belief task is the Sally-Anne task (Baron-cohen et al., 1985). In this study the characters were changed to Max and Sally to support the participants' ability to differentiate the characters by providing a mix of genders and support their engagement as most of the referred children were expected to be boys. There are two dolls, Sally and Max. After checking the child knows which doll is which, Max places a football into his basket then leaves the scene. Sally moves the football into her box. When Max returns, a critical belief question is asked "Where will Max look for his football?". The correct answer is in the basket, and this is confirmed with two control questions; "Where is the football really?" (reality question) and "Where was the football in the beginning?" (memory question).

Theory of Mind: Second-Order False-Belief Task – Nic and Alex

This task was adapted from the second-order belief paradigms used by Coull, Leekam, and Bennett (2006) and Perner and Wimmer (1985). The child is told a story by the researcher, which is enacted with plastic Playmobil® figures. Gender neutral names are used for the characters (Nic and Alex), and the mother figure is referred to as 'Mum'. Nic places his teddy in his bed and leaves the room. He returns to see Alex moving his teddy to the cupboard, but Alex doesn't see him. When he later returns the child is asked the second-order false-belief question "Where does Alex think Nic will look for the teddy?" followed by a justification question "Why?" and three story comprehension questions "Does Nic know that the teddy is in the cupboard?", "Does Alex know that Nick saw her hide the teddy?" (also, a first-order question) and "Where will Nick look for the Teddy?". To be rated as successful on second-order false-belief, the child must be successful on the second-order question, all comprehension questions and provide an appropriate justification.

Procedure

School Referred Sample

On receipt of a teacher referral, a researcher contacted the parents to provide verbal information about the study and gain verbal consent. Parents were then invited to the NDAU for an assessment with their child, and written consent was sought (see Appendix E for information and consent forms). A wide range of assessments were completed. The Lucid Ability Assessment, FER and ToM tasks were presented in the first half of the assessment.

Typically Developing Sample

Approximately 5 months after testing had begun in the NDAU, a school which was demographically similar (socially deprived) to the children who had been referred agreed to support the collection of further data. A letter was sent home to all parents of children aged 4-7 providing a summary of the study, and those who responded with consent forms were assessed (see Appendix F for information and consent forms). Assessments for these children took place in school, in a private room and lasted half an hour. The researcher (a trainee Clinical Psychologist) explained what would happen in basic terms to the children, and their verbal consent was obtained before testing commenced. In exchange, the school were given a voucher and some teacher training about emotions and attachment by the trainee Clinical Psychologist. The researcher later phoned parents to gather ethnicity and SES data.

Testing

For both groups the assessment took place in a private room with one researcher. The FER task was completed on a computer and the children gave verbal responses. For the assessment of ToM, researchers followed a script to tell a story using prompts and the children's responses

were transcribed. The LUCID verbal IQ is a computer-based programme which records the children's responses.

Sample Size Estimation and Calculation of Statistical Power

The most similar study to the current design (in terms of age group, sample type and measures) found significant relationships between measures of ER with ADHD and CP (Chronaki et al., 2015). They reported significant correlation coefficients (r) in the range of .30 to .40. To detect at the 0.05 probability level (two-tailed) with 80% power, a correlation coefficient of between .30 and .40, a sample of between 46 and 84 was required (Erdfelder, Faul, & Buchner, 1996). Therefore, a sample of 68 participants was thought to be adequate.

Data analysis

In accordance with advice from an expert in ToM research (S. Leekham, personal communication, April 20, 2018), it was decided that overall ToM performance should be analysed by group comparison (i.e. a stronger ToM group vs a weaker ToM group), rather than computing an artificial continuous variable. Based on past research that children in the age range of 4-7 should be developmentally able to pass 1st order but are likely to struggle to pass 2nd order tasks (Astington & Gopnik, 1991; Miller, 2009), the following procedure was used to split the sample into two groups. If children passed all three 1st order ToM tasks or two first-order tasks and the second-order task, then they would be grouped as having “stronger ToM performance” as there is good evidence that 1st order ToM has been achieved (1st order ability is required for 2nd order false belief tasks). If they passed two or fewer 1st order tasks without passing the second-order task, then they would be grouped as having “weaker ToM performance” as there is insufficient evidence that they have acquired 1st order ToM.

The percentage correct score for each emotion at high and low intensities was calculated for the FER. The hyperactivity and CP scores from the SDQ were calculated for the externalising variable, and for verbal IQ, the age-normed percentile score was used.

For each non-categorical variable outliers were identified and, if more than 3 standard deviations from the mean, winsorized. Where the data did not fulfil the assumptions of normality for parametric statistics (Field, 2017) transformations were applied dependent on how successfully skewness was reduced. FER Happy high was significantly negatively skewed and so underwent a square transformation. There was missing data for two participants for the FER data due to technical difficulties during administration and one for SDQ data due to incomplete data; there were no attempts to estimate these missing data points.

To meet the first aim, differences in FER accuracy were examined as a function of emotion, emotion intensity, and their interaction using one-way repeated measures ANOVAs. Following this analysis (see details below) it was decided to analyse FER both by emotion and emotion intensity. Post hoc analyses were then used to compare the FER variables. To examine the effect of age on the FER and ToM tasks, the sample was divided into two age groups (4-5 and 6-7-year-olds), and a series of t-tests and chi-squared comparisons were conducted to analyse differences between the age groups.

The second aim was to explore the relationship between ToM and FER, and their relationship with externalising behaviours. We tested the first hypothesis and examined the relevance of ToM skills on FER performance by splitting the sample into two groups (children with weaker ToM with those with stronger ToM). Given that the two ToM groups differed in terms of verbal IQ, ANCOVAs (controlling for verbal IQ) were conducted to analyse differences in FER performance between the two groups.

To test the second hypothesis, hyperactivity and CP in children with weaker/stronger ToM were compared by a series of ANCOVA's (again, controlling for verbal IQ).

To test the third hypothesis, bivariate correlations between FER scores and teacher ratings of CP and hyperactivity were calculated. A multiple regression was calculated for the significant findings to determine the relative contribution of hyperactivity and CP over and above IQ in explaining FER performance.

Results

Aim 1: To examine Facial Emotion Recognition (by emotion type and intensity) and Theory of Mind Performance Across Age Groups

To consider whether individual FER variables could be combined (by emotion type or intensity), FER performance across the whole sample was examined. Figure 2 is a graph of the overall sample's performance in the FER tasks by emotion type and intensity. A one-way repeated measures ANOVA was conducted to determine whether Emotion and/or Intensity significantly contribute to performance in FER. Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated for emotion $\chi^2(5) = 11.04$, $p = .051$, intensity $\chi^2(0) = 0$ or their two-way interaction (emotion*intensity) $\chi^2(5) = 2.37$, $p = .795$. In predicting FER ability, there were significant main effects of emotion ($F(3, 195) = 23.89$, $p < .001$, partial $\eta^2 = .27$) and intensity ($F(1, 65) = 94.68$, $p < .001$, partial $\eta^2 = .59$); there was also a significant two-way interaction between emotion and intensity ($F(3, 195) = 3.27$, $p = 0.022$, partial $\eta^2 = .05$). These results indicate that in subsequent analyses, the FER variables (emotion type, intensity) should be considered separately.

Post hoc analysis of the emotion variable with a Bonferroni adjustment revealed that FER Happy scores were significantly higher than FER Sad ($M = 16.04$, 95% CI [7.19, 24.89], $p < .001$), Scared ($M = 34.09$, 95% CI [21.99, 46.19], $p < .001$) and Angry ($M = 22.41$, 95% CI [11.75, 33.07], $p < .001$). FER Sad scores were also significantly higher than FER Scared ($M = 18.06$, 95% CI [5.38, 30.73], $p = .002$). FER Angry scores were not significantly different

from FER Sad ($M = -6.38$, 95% CI [-17.06, 4.31], $p = .655$) nor from FER Scared ($M = 11.68$, 95% CI [-0.08, 23.44], $p = .053$).

Post hoc analysis of the intensity variable with a Bonferroni adjustment revealed that across emotions high intensity faces were significantly better recognised than low intensity faces ($M = 17.52$, 95% CI [13.92, 21.11], $p < .001$).

The significant interaction was accounted for by the finding that high intensity FER Sad performance was significantly stronger than high intensity FER Anger, $t(65) = 3.11$, $p = .003$; whereas FER Sad and FER Angry performance was not distinguishable at lower intensities, $t(65) = 0.25$, $p = .802$.

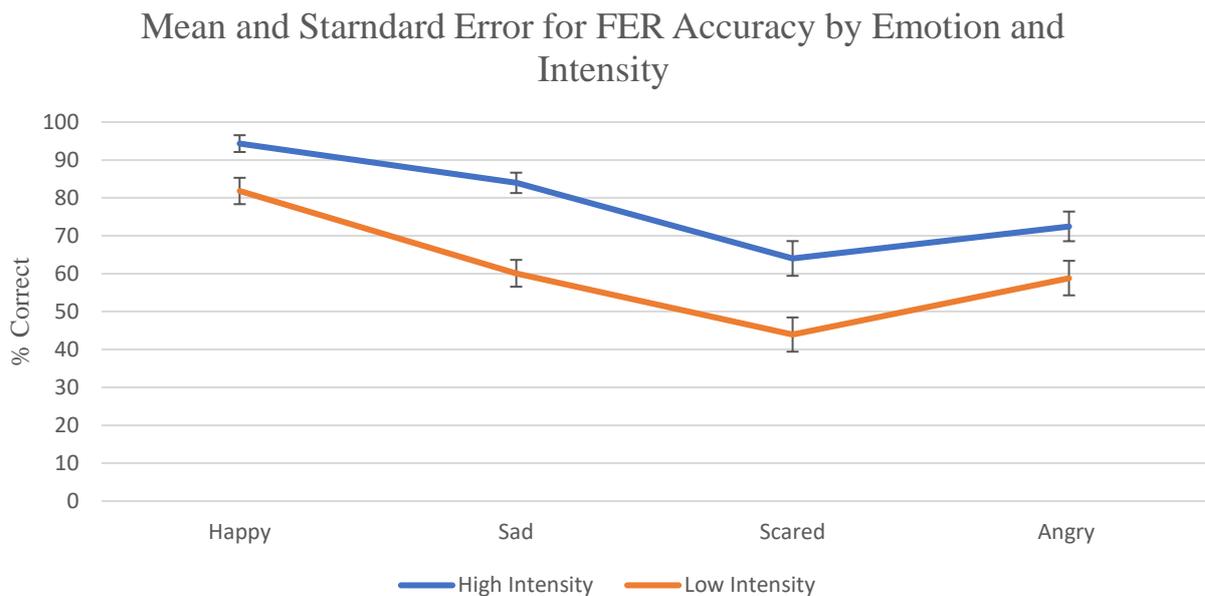


Figure 2 Mean and Standard Error for FER Accuracy by Emotion and Intensity

In summary, children found it harder to identify low intensity faces than high intensity faces across all emotions, and FER Happy was better recognised than any negative emotion. Although it can be seen from the data that of the negative emotions FER Sad scores were the easiest to recognise, followed by FER Angry and then FER Scared, only FER Sad and FER

Scared were significantly different. Thus, emotion, intensity and their interaction significantly affected FER accuracy.

To examine and demonstrate the relevance of age on FER and ToM task performance, the sample was divided into two age groups (4-5-year-olds and 6-7-year-olds), and a series of t-test and chi-squared comparisons were conducted (see Table 4). The two age groups could not be distinguished by any demographic variable (gender, SES, ethnicity and verbal IQ) or their level of hyperactivity or CP. Although there was a clear visible trend for older children performing better across the FER variables (except for low intensity sadness), there was a significant effect of age on FER performance for high intensity fear ($T(64) = -2.22, p = 0.030$) and neutral faces ($T(66) = -3.15, p = 0.002$).

The older age group had higher accuracy rates in all four ToM tasks, but their improved performance only reached significance in two of the three 1st order ToM tasks, the Smarties Task ($\chi^2(1) = 6.40, p=0.01$) and the Max and Sally Task ($\chi^2(1) = 4.64, p=0.030$). The age groups did not differ significantly in terms of the number of children classified as weaker/stronger ToM.

Aim 2: Theory of Mind and Facial Emotion Recognition Performance in Young Children and its Relationship with Externalising Problems

Hypothesis 1: Children with Weaker Theory of Mind will have Poorer Facial Emotion Recognition Performance

Table 5 compares demographics and FER performance by ToM group (weaker/stronger). Children with weaker ToM had significantly lower verbal IQ than children with stronger ToM; however, there were no significant differences in terms of age, gender or SES. This indicates that verbal ability is a better predictor of ToM ability than age, gender, ethnicity or SES. Therefore, verbal IQ was controlled for in subsequent analysis of FER accuracy.

Table 4 Means and standard deviations (or percentages) of the participant demographics, teacher ratings of externalising behaviours, FER and ToM accuracy for the whole sample, and comparing the younger and older age groups within the sample

		Whole Sample N=68	Young Group (Age 4-5) N = 35	Old Group (Age 6-7) N = 33	Statistical comparison of younger and older group
		M(SD)	M(SD)	M(SD)	
Demographics	Age (months)	70.59(11.74)	60.8(5.99)	80.97(5.85)	T = -14.03**
	Gender (% male)	66.18%	65.71%	66.67%	$\chi^2 = 0.01$
	Ethnicity (% Caucasian)	75.00%	74.29%	75.76%	$\chi^2 = 0.02$
	SES (annual family income)	£24561(14269)	£24654(14785)	£24462(13929)	T = 0.06
	Verbal IQ (centile score)	62.26(26.63)	68.14(29.01)	56.03(22.65)	T = 1.91
Teacher SDQ	Conduct problems (CP)	2.51(2.49)	2.63(2.61)	2.38(2.38)	T = 0.41
	Hyperactivity	5.78(3.47)	5.40(3.66)	6.19(3.25)	T = -0.92
	CP and Hyperactivity	8.28(5.54)	8.03(6.00)	8.56(5.08)	T = -0.39
FER - % correct	Happy High	94.32(17.97)	93.38(19.76)	95.31(16.11)	T = -0.43
	Happy Low	81.82 (28.27)	80.88(34.42)	82.81(24.95)	T = -0.28
	Sad High	83.96(21.85)	79.90(24.54)	88.28(17.94)	T = -1.58
	Sad Low	60.10(28.70)	62.99(28.29)	57.03(29.26)	T = 0.84
	Scared High	64.02(37.24)	54.41(39.15)	74.22(32.68)	T = -2.22*
	Scared Low	43.94(36.71)	37.50(33.85)	50.78(38.88)	T = -1.48
	Angry High	72.47(31.79)	69.12(30.81)	76.04(32.91)	T = -0.88
	Angry Low	58.84(36.98)	54.41(36.14)	63.54(37.85)	T = -1.00
	Neutral	60.22(36.09)	47.72(37.55)	73.49(29.61)	T = -3.15**
	Total High Intensity	78.69 (19.88)	74.20 (19.43)	83.45 (19.52)	T = -1.93
	Total Low Intensity	61.35 (20.90)	58.95 (17.21)	63.98 (24.33)	T = -0.97
ToM - % of participants correct	1st Order – cognitive Smarties	60.29%	45.71%	75.76%	$\chi^2 = 6.40^*$
	1st Order – affective Co-co pops	63.24%	60.00%	66.67%	$\chi^2 = 0.33$
	1st Order – cognitive Sally	76.47%	65.71%	87.88%	$\chi^2 = 4.64^*$
	2nd Order cognitive	25.00%	17.14%	33.33%	$\chi^2 = 2.38$
ToM - % of participants	In the 'weaker' group	51.47%	60.00%	42.42%	$\chi^2 = 2.10$
	In the 'stronger' group	48.53%	40.00%	57.58%	$\chi^2 = 2.10$
	Who passed all 3 first order tasks	41.18%	31.43%	51.52%	$\chi^2 = 2.83$
	Who passed 2 first order tasks and the 2nd order	7.35%	8.57%	6.06%	$\chi^2 = 0.16$

** Significant at the 0.01 level (2-tailed).

* Significant at the 0.05 level (2-tailed)

Looking specifically at the weaker and stronger ToM groups. The odds of older participants passing all three of the first order ToM tasks was 1.06 as 17 passed and 16 did not. Whereas for younger participants 11 participants passed all three and 24 failed at least one, meaning that younger participants were 0.46 times (approximately half) as likely to pass all three of the first order tasks. Only 5 participants were put in the ‘stronger’ ToM group by passing two of the first order tasks and the second order task, 3 were in the younger group and 2 were in the older group. The odds ratio for passing all three first order ToM tasks in younger versus older participants is 0.43, 95% CI [0.16, 1.16].

Table 5 Comparison of those demonstrating weaker/stronger ToM in means and standard deviations (or percentages) of participant demographics and FER accuracy rates.

		Weaker ToM (N = 35) M(SD)	Stronger ToM (N=33) M(SD)	Statistical comparison	
Demographics	Age (months)	68.46 (12.09)	72.85 (11.08)	T = -1.56	
	Gender (% male)	68.57%	63.64%	$\chi^2 = 0.19$	
	Ethnicity (% Caucasian)	80.00%	69.70%	$\chi^2 = 0.96$	
	SES (annual income)	£22978(10550)	£26240(17389)	T = -0.93	
	Verbal IQ (percentile score)	53.71(29.595)	71.33(19.735)	T = -2.90**	
				ANCOVA (controlling for verbal IQ)	
FER	Happy	High	90.44 (23.85)	98.44 (6.15)	F = 2.85
		Low	76.47 (32.53)	87.50 (22.00)	F = 1.18
	Sad	High	78.68 (25.48)	89.58 (15.70)	F = 2.55
		Low	54.41 (29.18)	66.15 (27.35)	F = 3.20
	Scared	High	54.41 (39.15)	74.22 (32.68)	F = 4.34*
		Low	37.50 (34.95)	50.78 (37.83)	F = 2.25
	Angry	High	67.89 (31.39)	77.34 (31.98)	F = 0.51
		Low	49.51 (36.00)	68.75 (35.92)	F = 2.28
	Neutral		54.90 (38.18)	66.52 (33.83)	F = 0.17
	High intensity – all emotions		73.55 (22.22)	84.90 (14.99)	F = 3.89
Low intensity – all emotions		54.61 (19.79)	68.29 (19.97)	F = 5.57*	
** Significant at the 0.01 level (2-tailed).					
* Significant at the 0.05 level (2-tailed).					

There was a clear trend across the various emotions and intensities that children with stronger ToM were better at recognising facial expressions. These differences reached significance when controlling for IQ in terms of overall low intensity facial expression performance $F(1, 62) = 5.57, p = 0.021, \text{partial } \eta^2 = 0.82$. The only individual emotion where there was a significant difference was high intensity scared faces $F(1, 63) = 4.34, p = 0.041, \text{partial } \eta^2 = 0.06$.

Hypothesis 2: Children with weaker Theory of Mind scores will have greater Hyperactivity and Conduct Problems.

Table 6 compares hyperactivity and/or CP in children with weaker / stronger ToM skills. A series of ANCOVAs indicated that there were no significant differences between children with weaker/stronger ToM skills and the teacher ratings of hyperactivity and/or CP.

Table 6 A comparison of Hyperactivity and CP ratings in children with weaker/stronger ToM

Teacher SDQ	Weaker ToM (N = 34) M(SD)	Stronger ToM (N=32) M(SD)	ANCOVA (controlling for age and verbal IQ)
Conduct problems (CP)	2.11 (2.34)	2.94 (2.61)	F = 1.50
Hyperactivity	5.86 (3.54)	5.69 (3.44)	F = 0.00
CP and Hyperactivity	7.97 (5.40)	8.63 (5.76)	F = 0.35

** Significant at the 0.01 level (2-tailed).
* Significant at the 0.05 level (2-tailed).

Hypothesis 3: Higher hyperactivity and/or CP will be related to poorer FER performance

Tables 7 displays the bivariate correlations between FER scores and teacher ratings of conduct and/or hyperactivity. Hyperactivity and/or CP were significantly negatively related to high and low intensity anger recognition. FER Angry was therefore further analysed in a regression analysis to determine whether CP or hyperactivity best account for difficulty in this area, the results are displayed in Table 8.

A hierarchical multiple regression was performed to determine the relative contribution of hyperactivity and CP over and above age and verbal IQ in explaining anger recognition at high and low intensities. CP and Hyperactivity were highly correlated ($r = 0.72^{**}$) and so two regression models were performed to prevent violation of the ‘no collinearity’ assumption of multiple regression (Tabachnick & Fidell, 2007). In both models, age and verbal IQ were entered in the first step. In the first model CP was entered into the second step and hyperactivity into the third step. In the second model hyperactivity was entered into the second step and CP into the third step. See Table 8 for full details of each regression model.

Table 7 Bivariate correlations between FER scores and Hyperactivity and CP

			Teacher SDQ Conduct problems	Teacher SDQ Hyperactivity
FER	Happy	High	.04	.02
		Low	.02	-.02
	Sad	High	.06	.01
		Low	-.09	-.09
	Scared	High	-.04	-.06
		Low	-.17	-.12
	Angry	High	-.30*	-.41**
		Low	-.38**	-.45**
	Neutral		-.07	-.09

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 8 Regression analysis of hyperactivity and CP in accounting for the variance in FER Angry

Regression:		FER	
Variable:	Statistic:	Angry High Intensity	Angry Low Intensity
Total Model	R²	0.30	0.34
Control variables:			
Age	β	0.24*	0.18
Verbal IQ	β	0.29*	0.35**
Model 1:			
Conduct problems	ΔR^2	0.11**	0.16**
	β	-0.33**	-0.40**
Hyperactivity	ΔR^2	0.07*	0.04
	β	-0.43*	-0.33
Model 2:			
Hyperactivity	ΔR^2	0.17**	0.19**
	β	-0.44**	-0.46**
Conduct problems	ΔR^2	0.00	0.01
	β	-0.01	-0.16

** Significant at the 0.01 level (2-tailed).
 * Significant at the 0.05 level (2-tailed).

High Intensity Anger Recognition

The full model of age, verbal IQ, CP and Hyperactivity to predict high intense anger recognition was significant, $R^2 = .30$, $F(4, 60) = 6.39$, $p < .001$; adjusted $R^2 = .25$.

In the first model, after age and IQ were controlled for, CP made a significant contribution to the proportion of variance in FER Angry High performance with an increase in R^2 of 0.11, $F(1, 61) = 8.43$, $p = .005$. The further addition of hyperactivity in model 1 led to a further significant increase in R^2 of 0.07, $F(1, 60) = 5.79$, $p = 0.019$.

In the second model, after age and IQ were controlled for, hyperactivity made a significant contribution to the proportion of variance of FER Angry High with an increase in R^2 of 0.17, $F(1, 61) = 15.12$, $p < .001$. The further addition of CP did not lead to any further significant increase in R^2 (0), $F(1, 60) = 0.00$, $p = 0.95$.

Low Intensity Anger Recognition

The full model of Verbal IQ, CP and Hyperactivity to predict FER Angry Low was significant, $R^2 = .34$, $F(4, 60) = 7.81$, $p < .001$; adjusted $R^2 = .30$.

In the first model, after age and IQ were controlled for, CP made a significant contribution to the proportion of variance in FER Angry Low with an increase in R^2 of 0.16, $F(1, 61) = 14.01$, $p < .001$. The further addition of hyperactivity to the prediction of FER Angry Low did not lead to a further significant increase in R^2 (0.04), $F(1, 60) = 3.60$, $p = .062$.

In the second model, after age and IQ were controlled for, hyperactivity made a significant contribution to the proportion of variance of FER Angry Low with an increase in R^2 of 0.19, $F(1, 61) = 17.29$, $p < .001$. The further addition of CP to the prediction of FER Angry Low did not lead to a further significant increase in R^2 (0.01), $F(1, 60) = 0.94$, $p = .337$.

In summary, after controlling for age and verbal IQ, both hyperactivity and CP were individually, significantly related to poorer recognition of high and low intensity angry faces. However, although in model 1 hyperactivity made a further significant contribution in addition to CP for FER Angry High, when hyperactivity was controlled for first (in model 2), CP did not make any further contribution. In addition, comparison of the Figures shows that CP accounted for 11% and 16% of the variance for FER Angry High and Low respectively, whereas hyperactivity accounted for 17% and 19% respectively. These results indicate that both CP and ADHD are associated with greater difficulty with the recognition of high and low intensity angry faces, however hyperactivity seems to account for more of this variance.

Discussion

The findings confirm that in 4-7-year-olds, ER and ToM are in development. There was a trend for improved performance in older children (6-7-year-olds) across the majority of emotions and intensities, and older children were significantly better in recognising high intensity fearful

and neutral expressions. These findings suggest a greater level of difficulty with FER for 4–5-year-olds in the current sample compared to some previous studies that have reported children of this age could reliably recognise the six basic emotions (Camras et al., 1988; MacDonald et al., 1996; Russell & Widen, 2002; Schultz et al., 2000). In relation to the effects of emotion type and intensity, children found high intensity faces easier to recognise than low intensity ones, happy faces easier to recognise than any of the negative emotions, and sad expressions were easier to recognise than fearful ones. As expected, older children (6–7-year-olds) showed better ToM task performance on two of the three first-order ToM tasks and were more likely to consistently succeed at first order ToM tasks. Younger children (4-5-year-olds) did not reliably succeed on the first-order ToM tasks in this sample, as has been found in other studies (e.g., Astington & Gopnik, 1991; Jenkins & Astington, 1996). The comparative under-performance in both FER and ToM in the current sample compared to some previous studies might be due to the current study being oversampled for both externalising problems and socioeconomic disadvantage.

Children with weaker ToM had significantly lower verbal IQ than children with stronger ToM, but these subgroups did not differ significantly in age, gender, ethnicity or SES. This suggests that verbal ability is a better predictor of ToM ability than age, gender, ethnicity or SES and therefore may have a significant role in the development of children’s social-emotional skills, in line with previous findings (De Stasio, Fiorilli, & Di Chiacchio, 2014; Strand et al., 2016).

Children with weaker ToM performed worse when recognising low intensity emotions (significant) and high intensity emotions (marginally significant), even when controlling for verbal IQ. These findings suggest a global association between ToM skills and FER skills in line with findings summarised by Mier et al. (2010).

In terms of ToM skills and specific emotion performance, although there was a clear trend across the emotions and intensities for children with weaker ToM to have poorer FER performance, it was only high intensity fearful faces that was significant. Difficulty identifying fear has been theorised to be associated with reduced amygdala activation (Marsh et al., 2008). Amygdala activation was not measured in this study but future research may benefit from assessing both FER and ToM in relation to neural activity.

In this study, hyperactivity and CP did not predict ToM skills; this is consistent with Buitelaar et al.'s (1999a) findings in relation to children with a diagnosis of CD, but not with some other studies which did find a relationship (Donno et al., 2010 and Ha et al., 2011). Our findings in relation to hyperactivity are different from previous research in children with ADHD (Buitelaar et al., 1999a; Sodian et al., 2003) that found poor ToM performance in the diagnosed group compared to controls. However, this difference may reflect our strategy of measuring hyperactivity as a dimension rather than sampling children who have a diagnosis. Given that there was no apparent relationship between ToM and hyperactivity and CP in the current sample, no further analyses were conducted to consider whether ToM impacted upon the relationship between externalising behaviours and FER performance.

Higher hyperactivity and CP were related to significantly worse performance in recognition of high and low intensity angry faces. Previously hyperactivity has been found to relate to difficulties with both positive and negative FER in several studies rather than anger specifically (Boakes et al., 2008; Chronaki et al., 2015; Corbett & Glidden, 2000; Kats-Gold et al., 2007; Martin et al., 2014; Pelc et al., 2006). The closest study to the current one in terms of sample characteristics and age group (3-6-year-olds made up of typically developing and referred children) also found a significant correlation between anger recognition and hyperactivity and CP. However, they also found that impaired happiness performance was related to hyperactivity and CP. Fairchild et al., (2010) describe how angry facial expressions

can act as 'social punishment signals' which inform the child that they should inhibit their behaviour. Research suggests that adolescents with CD may be less sensitive to these weaker signals of punishment (Fairchild et al., 2009). This was supported by Bowen et al. (2014) who found that young offenders scored lower than controls on the recognition of low intensity anger but higher than controls in the recognition of high intensity anger.

Difficulty recognising high and low intensity angry faces was associated with both CP and hyperactivity, but regression analyses indicated that hyperactivity accounted for more of the variance, and CP did not offer anything further once hyperactivity was accounted for. This is a key finding as studies investigating CP often do rarely account for hyperactivity. This finding is consistent with the only other study to have looked at the independent relationship between FER and hyperactivity and CP in young children (Chronaki et al., 2015). The current study furthers Chronaki et al's by confirming that verbal IQ does not account for the stronger predictive value of hyperactivity over CP. Thus, our research, alongside that of Chronaki, et al. (2015), indicates that in younger children, early manifestations of attention/hyperactivity problems are more predictive of FER problems than early manifestations of CP. As argued by Kats-Gold et al. (2007), attention difficulties and hyperactivity would impair children's ability to attend to and learn about emotions, which may also have a role in explaining the subsequent development of CP later in development.

Limitations

Despite this study making a valuable contribution to the literature base there are some noteworthy limitations. First, the sample was too small to detect any smaller effect sizes. Second, there were not enough girls in the sample to justify examining the effect of gender. Past research has found differential relationships between FER and ToM variables depending on gender (Buitelaar, van der Wees, Swaab-Barneveld, & van der Gaag, 1999b). Third, despite

every effort being made to ensure consistency in methodology, there is a risk that there were some differences in data collection between the referred sample and the control group. Fourth, there are some potential limitations with analysing overall ToM performance by group comparison. The age at which typically developing children succeed in first-order false-belief tasks can range from 3-5 (Jenkins & Astington, 1996) thus it is possible that within this sample of 4-7-year olds there are some children who were developing normally but were in the 'weaker' group. Alternatives would have been to create an artificial continuous variable however this would require more ToM tasks which would have taken too long to administer with this age group. Fifth, although this study built on past research by including IQ and ToM performance in analyses of FER and externalising behaviour in young children, there might have been other variables that were not measured that could have influenced FER performance. For example, children's attention to the eye region (e.g., Dadds et al., 2008) and the nature of the child's early or home environment (e.g., Brownell, Svetlova, Anderson, Nichols, & Drummond, 2013) which have been found to have a significant impact on FER performance. Sixth, the study was cross-sectional, and so no conclusions about any causal relationships between FER, ToM and externalising problems can be made.

Implications for Future Research

The variation in findings in 4–5-year-olds and 6–7-year-olds in this study, and differing performance depending on emotion type and intensity, indicate that future research with larger sample sizes should study the links between FER and externalising problems in discrete age groups. Longitudinal designs of this nature would also be of benefit to properly investigate any causal links between FER performance and the development of later behavioural problems. It could be that at each discrete developmental period, there is a distinct pattern of relationships between FER and externalising behaviour problems (this might explain the inconsistent pattern of results regarding specific emotion performance between studies). Furthermore, the findings

of this study indicate that these patterns will be affected by verbal IQ and thus this should be controlled for and explored further. Knowing about these patterns could help inform our understanding of the development of externalising behaviour problems and would be informative for developing age-specific interventions for children exhibiting externalising behaviours. Future research is also needed which includes a greater proportion of girls to analyse any interaction of gender and FER performance on externalising behaviours. In addition, the literature base would benefit from further exploration of the effect of internalising problems in relation to FER and ToM in younger children, as this was beyond the scope of this study. It would also be beneficial for future research to assess the correlation between anger FER performance and children's responses to aversive stimuli (e.g., in decision-making tasks) which have also been linked to CP and ADHD (e.g., Hobson, Scott, & Rubia, 2011). Finally, it is clear that when analysing either CP or hyperactivity, the other should be considered in analyses given the high levels of comorbidity and the potential that inattention/hyperactivity may account for some difficulties.

Clinical Implications

The finding that children with externalising behaviour problems have problems recognising anger (which has also been found in other studies with children in a similar age range; e.g., Chronaki, et al., 2015), might have implications for interventions. If a child is not recognising an aversive stimulus, such as anger, it might mean that any behaviours that produce an angry response (whether low or high in intensity) in others (peers, parents or teachers) are not corrected, negatively affecting a child's learning of how to behave pro-socially. Hence, in the future, emotion training interventions for children with externalising problems (e.g., Hubble et al., 2015) might be useful tools in helping a child better read social cues in order to learn how to modify their behaviour in a more prosocial manner.

The role of hyperactivity should not be underestimated in affecting children's learning, social abilities and behavioural difficulties. Emotion-based interventions are a particularly neglected area in the treatment of ADHD-related problems; hence this paper would support further research about the impact of such interventions in ADHD groups.

Although causation cannot be drawn from this study, it is clear that verbal IQ and FER and ToM are related. Specifically, we found that verbal ability was a better predictor of ToM ability than age, gender, ethnicity or SES and this is in line with previous findings in relation to social-emotional skills (De Stasio, Fiorilli, & Di Chiacchio, 2014; Strand et al., 2016). It is therefore crucial that social-emotional interventions take into account children's verbal IQ in ensuring that they are delivered in an accessible format. Furthermore, the importance of verbal IQ in the development of social-emotional skills should not be overlooked or neglected as research suggests it forms the basis of a number of these skills. Interventions to support the development of verbal ability will therefore be necessary alongside or prior to those which support the development of social emotional skills.

Conclusions

This study confirms that ER and ToM are in development in 4-7-year-olds. We found that verbal ability was a better predictor of ToM ability than age, gender, ethnicity or SES and may therefore be significant in the development of children's social-emotional skills. When verbal IQ is controlled for, children with weaker ToM still performed worse in ER tasks suggesting a global association between ToM skills and FER skills. In addition, children in this age range found it difficult to recognise fear. Hyperactivity and CP were not related to ToM skills but were related to poorer anger recognition and attention/hyperactivity problems were more predictive of these difficulties than CP. The study has potential implications for future research and clinical interventions for younger children exhibiting externalising behaviours.

Disclosure Statement

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Critical Evaluation

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Introduction

This paper is a critical evaluation and reflection on the first two papers of this thesis and the research process as a whole. It contains discussion of the areas not covered in the main two papers, the reasons for the decisions made, as well as a critique of the methodologies used. Clinical and theoretical implications will be discussed, as well as dissemination and directions for future research. The first two parts of this thesis were:

- (1) Facial Emotion Recognition in Children who present with Externalising Problems: A Systematic Review.
- (2) Facial Emotion Recognition and Theory of mind in young children who present with Externalising Behaviours.

Topic Selection and Context

The author chose to join the Neurodevelopmental Assessment Unit (NDAU) at an early stage of its development, studying young children who do not have a diagnosis of Autism and are displaying behaviours in school which disrupt their learning and are difficult for teachers to manage. The NDAU is led by Professor Stephanie van Goozen. It is a 3-year feasibility study funded by the Waterloo Foundation to consider whether a research study can also provide a useful service to a school in the form of summary reports about assessed children. The NDAU study team includes researchers and clinicians (a Clinical and an Educational Psychologist). It is hoped that in the future, the feasibility study will be the basis for further funding of the current research-based service, longitudinal follow up studies, and trials of targeted interventions for specific presentations, such as emotion recognition problems (e.g., Hubble et al., 2015).

The overall NDAU assessment of children is designed to measure constructs that fall in various “Research Domain Criteria” domains (RDoC), and thus provide a non-diagnostic profile of the children’s strengths and weaknesses. The RDoC is an initiative by the National Institute of Mental Health (a major US funding body). It aims to be a framework for understanding psychiatric/psychological difficulties which is more valid than the DSM system (in that the framework aims to be fully derived from research data at a number of levels, from the cellular or genetic level, to the cognitive or behavioural level). The papers in this thesis are focusing on constructs that fall under one of the five RDoC domains (“Systems for Social Processes”); however, the NDAU as a whole collects data on the children that cover other domains of human functioning.

Following assessment in the NDAU an assessment report is produced for each child which summarises the child’s specific (norm based) strengths and difficulties and provides

recommendations overseen by an Educational Psychologist. This is sent to the referring teacher or SENCO to share with the parents. Thus far, the feedback from schools has been positive, particularly as educational psychology provision is scarce across South Wales (Welsh Government, 2015). Within NHS Wales, there has been the introduction of neurodevelopmental teams (T4CYP, 2015) which aim to provide a consistent approach to the assessment of neurodevelopmental conditions for children across Wales. Unfortunately, conduct problems (CP) alone do not currently meet the criteria to access these services and many of the neurodevelopmental teams are only able to provide assessment and diagnosis, not intervention. Although CAMHS services in Wales do see children presenting with ‘violent or angry behaviour’ the demand is such that they cannot currently meet the need (T4CYP, 2016) and therefore many children with CP alone will not be seen by NHS services. This is concerning given that we know that Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) are predictive of a range of adult psychopathology (e.g., Kim-Cohen et al., 2003). Therefore, a key strength of the NDAU is that many of the referred children who will not meet criteria for services, will have access to a thorough assessment which they may not have otherwise had unless their families could finance this privately. Additionally, working with schools in this way is a significant development as both the research team and the schools have benefitted, which will ultimately benefit the children. The research team have gained access to a specific sample of children who have been identified by teachers or SENCOs. The teachers have provided their perspectives on the children’s presentation at the referral stage, and the reports have facilitated conversations with the parents.

One original attraction to this thesis idea was that it might be particularly relevant for the future development of the NDAU. The finding in the empirical paper that aspects of emotion recognition (ER) were related to externalising behaviour problems in young children, gives a rationale for future research on the impact of emotion-training interventions (e.g.,

Hubble et al., 2015) in younger populations. The systematic review also indicated that many studies (particularly those studies including referred children) find that externalising behaviour groups tend to have problems in some aspects of FER (which might vary by specific sample characteristics and measurements used). Potential future steps for the NDAU will be to apply for funding to trial emotion training interventions for younger children which is a novel area of research, to see whether such interventions improve FER skills and whether this has a knock-on effect to the child's behaviour. Alongside this thesis, separate analyses will be undertaken of other aspects of the data collected including parental factors of the child-parent relationship (using the Five-Minute Speech Sample and coded parent-child interactions), parental mental health problems, life events, and other aspects of cognitive (e.g., executive functioning) and social-emotional skills (e.g., pupil response and eye tracking) to consider how these might influence ER skills.

The author has a particular interest in working with schools from a clinical and research perspective. Teaching staff are increasingly finding they need to understand and respond to social-emotional and behavioural difficulties as well as educational ones. They are also a skilled workforce who are largely eager to learn from and work with clinical services and research teams. Thus, there is a significant opportunity to collaborate and share resources and skills. Whilst the NDAU has a system in place to collaborate with schools who refer children in the form of open days, feedback forms and the feedback reports, the author was aware of the need to also collaborate with the school that provided the non-referred sample. Therefore, this school was provided with some training about attachment and trauma by the author. Attachment problems is an area which schools can find difficult to understand and respond to but have limited funds to "buy in" training. In providing the training, the author's experience was that the teaching team were very receptive, ensuring each member of the team had the opportunity to attend by agreeing three separate training slots rather than a full day. Whilst the

sessions were short, the feedback was very positive in that it aided staff's understanding of why children might present in particular ways, and why common behavioural strategies may not work for some children. The author was able to provide suggested reading and resources for staff who were particularly eager to explore this further. This trading of time and resources felt very positive at a time when all services need to work prudently.

There is a Clinical Need

In clinical practice, the author has observed a need for research that supports the development of earlier, preventative interventions. For children who are presenting with externalising behaviours, and specifically those presenting with hyperactivity and CP, there is a significant level of need. Simon, Pastor, Reuben, Huang and Goldstrom (2015) found that of school-aged children with emotional and behavioural difficulties, nearly half do not receive any services, and parents reported unmet needs. Parents and teachers are often told (explicitly or not) to wait until the children are older or difficulties increase because they do not meet the threshold for services currently available. The demand for services is higher than the resource available, and so there is a need to better understand these difficulties and the interventions required, and to offer support where possible.

For services locally, this is an area which is important to understand as both emotional wellbeing and bullying are key priorities in the Children's Commissioner for Wales latest plan (Children's Commissioner for Wales, 2016). Ensuring interventions to address these areas are evidence-based is crucial. Whilst there are NICE guidelines for CP in young people (NICE, 2013a) there are significantly more services and clinical resources for children with diagnoses of an Autism and ADHD. Furthermore, the services that are available to children with CP are different to those provided to children with diagnoses of ADHD, particularly in regard to the likelihood of psychological/parenting strategies or prescribed medication being recommended

(NICE, 2018), despite high levels of comorbidity. There is a need for greater understanding of the underlying processes which independently relate to different presentations to inform interventions, as well as those that are shared across presentations. Although the RDoC is in its infancy, there is an implicit aim of such a research agenda that over time, research into the effectiveness of interventions will be focused on domains of functioning (e.g., emotional processing problems) that are shared across DSM diagnostic categories, rather than the diagnostic categories themselves. Such a research agenda might then have a knock-on effect in terms of the provision of interventions. Children would be more likely to be offered interventions or service pathways (psychological or medical) that are based on their specific profile of difficulties, rather than the diagnostic category that they fit into (as is the case currently).

Psychologists Role

As a trainee Clinical Psychologist, the author is acutely aware that Clinical Psychologists are an expensive resource, often placed in specialist services and so only see a very small proportion of children who present with these types of difficulties. When working with individuals, Clinical Psychologists would use a preventative model wherever possible. It is becoming increasingly clear that there is a responsibility to also consider how this approach can be applied wider than services or individuals (e.g., school-based preventative interventions). Clinical Psychologists have a key role in exploring the earliest signs of difficulties in children, understanding the specific skill deficits and their underlying causes to contribute towards the development of evidence-based interventions on a wider scale.

Developing the Initial Research Questions

Rationale for Empirical Paper

This thesis focusses on externalising behaviours with particular attention in the second paper to inattention/hyperactivity and CP, both of which have been linked to distress and difficulties in adulthood.

The author became aware that CP and hyperactivity are a crucial area of research for several reasons. Longitudinal data has suggested that approximately a third of children with ADHD are later diagnosed with an antisocial disorder and two thirds of those are arrested (Mannuzza and Klein, 2000). CP have also been linked with antisocial presentations in adulthood (de Wied et al., 2010). The prevalence of Antisocial Personality Disorder (ASPD) is 3% in men and 1% in women. In prison populations prevalence is around 50% and of relevance here; of those presenting with ASPD, a history of aggression, unemployment, and unstable and short-term relationships are very common (NICE, 2015). Thus, many of the difficulties described can lead to further distress including long term poverty and can affect others in the form of victims of criminality (Erskine et al., 2016). In total, the difficulties associated with CD are thought to cost £100,000 more per person in services in the UK than someone who does not have CD between the ages of 10 and 28.

Unfortunately, there is a paucity of research on ASPD in adults (NICE, 2013b). One area of developing evidence is Mentalization Based Treatment (MBT), the primary focus of which is improving perspective taking and the ability to reflect on one's own and other's emotions. These underlying treatment targets of MBT overlap with the constructs which were studied in the systematic review and empirical paper of this thesis (Facial ER and Theory of mind), suggesting there may be value in teaching these skills at a much younger age to aid the

development of mentalizing skills. The benefits of understanding these presentations therefore go beyond the individual and are a crucial area of research.

ER difficulties exist in adolescent CD and adult antisocial behaviour groups (Dawel et al., 2012; Bons et al., 2013; Collin et al., 2013) and in pre-adolescent populations presenting with hyperactivity (Boakes et al., 2008; Corbett & Glidden, 2000; Pelc et al., 2006; Sinzig et al., 2008). Studies of theory of mind (ToM) skills in people with diagnoses of CD are few and inconsistent (Bons et al., 2013) but it has been found that children with ADHD have impairments in both first and second order ToM tasks (Buitelaar et al., 1999a; Sodian et al., 2003). Thus, the author became interested in assessing the links between ToM and ER.

ER is critical, it represents the early use of social cues which children's subsequent interpretations and behavioural responses depend on (Cicchetti, 2016). During childhood, facial ER (FER) skills help in forming positive relationships (Chronaki et al., 2015) and what is learnt at this stage has significant implications for children's lifelong social competence (Denham et al., 2003; Izard et al., 2001).

ToM has been defined as "the understanding of mental states, what we know or believe about thoughts, desires, emotions, and other psychological entities both in ourselves and in others" (Miller, 2009 p. 749). ToM skills enable children to successfully comprehend, interpret, predict and respond to the behaviour of others (Guilé, 2014).

Although it has not been frequently studied, the research available shows a correlated performance between ToM and ER (see Mier et al., 2010) and some have found that ER may contribute to ToM (e.g., Strand et al., 2016). The author also considered that given the importance of attention in ER, children with poorer ToM might be less interested in the emotions of others (and therefore attend less to other's facial expressions). Understanding the roles of these specific skills in relation to the presenting difficulty is crucial in aiding the

identification of early signs and precursors of difficulties and informing the type of intervention which would be most effective for different groups of children. Individual interventions for ToM and ER have been developed for certain groups (e.g., the Incredible Years classroom social skills and problem solving curriculum; Webster-stratton & Reid, 2004). However as both are thought to be part of cognitive empathy (Bons et al., 2013) and both have been associated with a number of behavioural difficulties, it may be that emotion-training interventions should also include theory of mind training and vice-versa.

Therefore, it was felt that there was a need for a study to assess associations between ER, ToM and behavioural difficulties in young children. The empirical study aimed to develop our understanding of these constructs and their inter-relations and inform how best to intervene. Also, research up until this point had not fully understood the independent contributions of CP and hyperactivity (Chronaki et al., 2015). In addition, many previous studies did not control for variables that might impact upon a child's performance on FER tasks, such as language ability or IQ, and so this was needed to further develop the research base. The study was novel in its use of an enriched sample including young children exhibiting problems in school.

Rationale for the Systematic Review

Following the decision of where to focus the empirical paper, it became clear that there was a need for a review of the status of the evidence for ER and its relationship to externalising behaviour in pre-adolescent children. It is clear from the literature that difficulties with ER have been linked to a number of externalising behaviours throughout the lifespan, however research has focussed primarily on older children/adolescents and specific domains of externalising problems. Furthermore, research often focuses on particular externalising categories (e.g., ADHD or CP alone) when it is clear there are very high comorbidities across the different categories. Examining ER across the various externalising categories (ADHD, CP,

aggression and callous unemotional traits) in a sample of younger children was needed to establish whether the evidence is sufficient to conclude whether or not FER problems are shared or distinct across the domains. It was decided to focus on pre-adolescent children due to the lack of a review focusing on that developmental stage, and to inform preventative and earlier interventions. In addition, younger children's performance is less likely to be affected by other factors such as substance abuse, and early identification provides greater opportunities for enhancing our understanding of the development of difficulties. The first paper in this thesis, the systematic review, therefore aimed to systematically appraise the nature of the relationship between FER and externalising problems in pre-adolescent children. "Adolescence" was defined for the purpose of this review as over 12 years old. It is appreciated that some definitions define adolescence as beginning earlier (e.g., the World Health Organisation defines it as beginning at age 10). However, having a younger cut-off would have significantly limited the amount of papers that could be reviewed. Hence age 12 was chosen.

Systematic Review

As described, it was hoped that the review would provide some context for the second part of the thesis. Therefore, guided by the empirical study, the initial topic was FER, ToM and externalising behaviours. Two previous reviews were identified. However although they explored ER and antisocial presentations (including CD) they did not control for hyperactivity or include any studies of children that were primarily focused on the pre-adolescent stage (Dawel et al., 2012; Bons et al., 2013). Collin et al. (2013) explored FER across a wide range of psychiatric conditions but again this focused on older childhood and adolescence. In addition, they concluded that the evidence was too preliminary to draw any strong conclusions contrasting disorders, and there has been a number of studies in younger children since that time. Few studies have explored both ToM and FER and thus it was decided that it would be

more beneficial to focus the systematic review on FER, to establish the key findings in this age group before exploring the relationship with ToM in the empirical paper.

Strengths

Novelty

Prior to this thesis, no review has been conducted that specifically focused on pre-adolescent children when ER skills are at a more sensitive stage of development. Therefore, this systematic review was novel and timely, addressed a gap in the literature and is likely to be publishable.

Systematic Review Methodology

There was a contrast between what some journal articles argued to be strong conclusions and the conclusions that came from the systematic review. This highlighted the value in an objective empirical systematic review conducted by an author who was not predisposed to be biased towards a particular theory. A systematic review is designed to locate, appraise and synthesise the evidence for a specific research question, and to provide an objective evidence-based summary. They are considered ‘gold-standard’ because of their defined steps and replicability (Boland, Cherry, & Dickson, 2017).

Looking Across Externalising Behaviours

A key strength of this systematic review is that it explored different constructs of externalising behaviour which are often studied in isolation, thus drawing together research which will be helpful for researchers and clinicians. It has been argued that the rates at which comorbidity occurs between ADHD and CP greatly exceeds what would be expected based on the prevalence of each disorder alone (Newcorn & Halperin, 2000). Danforth, Connor & Doerfler (2016) propose that genetic, parenting and cognitive factors operate together in the

development of ADHD and CP, and therefore studying the two presentations in combination is an important next step.

The Use of Empirical Measures Only

Only studies which used validated FER tasks were used and not studies which used self or parent/teacher report measures of ER. This ensured that the results reflect the construct which is the focus of the question (in this case FER) and reduces the possibility that the measure is significantly affected by, for example, the relationship between the informant and the child.

Quality Appraisal Tool

To enable critical appraisal of findings, articles included in a systematic review should be assessed for methodological quality using validated tools (Armijo-Olivo, Stiles, Hagen, Biondo, & Cummings, 2012). The tool aids the author in evaluating whether studies are accurately and thoroughly described, a lack of which is often an indicator of poor design or unmerited findings or conclusions (Fenton, Lauckner, & Gilbert, 2015).

A number of quality assessment tools were reviewed for use in this systematic review. A tool which can be used to consider studies with varying methodologies was needed in order to undertake an integrative review (Fenton et al., 2015). Many tools are aimed at studies which use consistent methodologies (e.g., “CASP Checklists - CASP - Critical Appraisal Skills Programme,”) which reduced the options available. The Quality Appraisal Tool for Studies with Diverse Designs (QATSDD; Sirriyeh et al., 2012) has been explicitly designed for studies with diverse designs. A key strength of this tool was the description for each rating which was felt to increase the objectivity of the rating, and reduce the subjective decision making of the raters. However, the QATSDD is not without limitations. It has been argued that some of the criteria should be scored higher than others, such as sample characteristics over service user involvement in design, and that the descriptions require further definition and explicit examples

(Fenton et al., 2015). However, it has also shown good validity and reliability (Sirriyeh et al., 2012) and was therefore chosen as the most appropriate tool for this systematic review.

The author rated all studies. A 2nd rater independently rated 4 studies (25%) to determine inter-rater reliability which was very good ($\kappa = 0.97$). The difference in the quality ratings was due to one rater rating 'statistical assessment of reliability and validity of measurement tools' for Sharp et al.'s (2015) paper as complete and one as moderate. This discrepancy was resolved through discussion and it was agreed that although the reliability and validity had been stated for the other measures in the study, this was not the case for the measure of FER.

Limitations

Quality of Studies

The limited number of studies available resulted in all relevant studies being included in the review, irrespective of quality rating. Whilst this was acknowledged in the review and study quality was accounted for in the analysis by ensuring that the lower quality studies did not have a different pattern of results, it may be that there would have been different findings if more studies were available and therefore only the highest quality studies could have been included.

Publication Bias

It is possible that several more relevant or better-quality studies have been conducted and not reported due to non-significant findings; such a publication bias may have significantly affected the conclusions drawn in the review. We did not attempt to retrieve unpublished data to mitigate for the effect of publication bias. This would have involved a more extensive search including unpublished manuscripts and emailing relevant authors in the field. Given the time intensive nature of the systematic review presented, it was beyond the scope of a thesis to

consider unpublished data. It was also noted that in this particular area, non-significant findings in several of the studies were published.

Culture

Of the studies included, six were conducted in America, two in England, two in Israel and one each in the Netherlands, China, Cyprus, Australia, Canada and Belgium. Whilst there will be commonalities across all children in terms of development, and the six basic emotions have been found to be universal (Ekman et al., 1987), there will also be significant cultural factors affecting their development and behaviours which were beyond the scope of this review. For example, Rehder et al. (2017) found that ER accuracy in children with CP and callous unemotional traits were moderated by race. In European American children, there was a difference in accuracy between children with and without CP and callous unemotional traits, whereas in African American children there were no group differences. The education system in (and within) each of these countries will vary significantly, as will parenting practices, social norms, and other social and community factors. We decided it remained worthwhile to gather the available evidence, however further research is needed to establish the consistencies and differences in findings across different cultures.

Gender

The over-representation of boys in the studies described means that these findings are not generalisable to girls, who generally perform better than boys on ER tasks (McClure, 2000). This gender difference is thought to be due to differences in socialisation and maturation patterns. A future research study could be to assess FER skills in a larger sample of younger children with an equal representative of boys and girls. Specific questions could be considered such as to what extent gender moderates any relationship between externalising and internalising problems and ER (particularly as girls are more likely to internalise than boys).

Ecological Validity

The systematic review only considered studies with validated FER tasks which all involved labelling of prototypical emotions of unknown people. It could be argued that such a method is less ecologically valid than assessing labelling of non-prototypical emotions or emotions of familiar people would be (Castro et al., 2016). Studies that have lower ecological validity are limited in the extent to which findings can be generalised to other settings (in this case the extent to which ER in a task applies to recognising emotions of others in that child's everyday life). However, lower ecological validity in this case is necessary as there would be no standard and adequately scientific way of assessing FER of familiar faces across a sample. Nevertheless, concerns about generalisability should be considered carefully in planning interventions. It may be that emotion interventions would be more effectively delivered by parents and in everyday life. Evidence indicates that attachment based approaches which focus on improving the child-parent relationship are beneficial for child development generally, neurologically and in terms of the child's social-emotional skills and self-regulation (Newman, Sivaratnam, & Komiti, 2015). Furthermore anxious and avoidant attachment styles have been associated with impaired emotional processing (e.g., Heimberg, Hart, Schneier, Liebowitz, 2001) and mental health difficulties in adulthood (e.g., Williams & Riskind, 2004). Examples of such interventions include Circle of Security (Marvin, Cooper, Powell & Hoffman 2002), Watch Wait and Wonder (Muir, Lojkasek, Cohen, & Hincks-Dellcrest, 1999) and Video Interaction Guidance (Kennedy, Landor, & Todd, 2011). Such examples aim to improve the parent's ability to recognise and respond to infants distress signals and have been found to improve self-regulation and behaviour (Fisher, Gunnar, Dozier, Bruce, & Pears, 2006). Furthermore, neurobiological evidence suggests that such targeted early interventions can reduce the impact of early adversity (Newman et al., 2015). Unfortunately, the literature base has not yet identified the specific mechanisms of change and so further evaluation of these interventions

is needed. Furthermore, future studies using novel methods should attempt to study the relationship between children's accuracy in labelling the emotions of parents, peers or teachers to their accuracy in standardised tasks. Such studies would contribute to discussions around the relative role of familiarity to the person and ER skills.

Search Criteria

For this systematic review, the author was not able to include non-English language and thus these papers were excluded which may have led to some bias. To include as many studies as possible within this limit, the author ensured that both English and American spellings were used in the search terms and used a range of terminology for child focused studies to reduce the chances of excluding relevant studies. "Emotion recognition" is a well-established construct within the literature, so this was used as a topic and keyword. It is possible that these search terms excluded some relevant studies so the references of the identified studies were also explored.

What was Not Studied

This systematic review looked specifically at studies using empirical measures of the recognition of photographic facial stimuli, and a validated measure of externalising behaviours. In deciding on this focus there were a number of areas which were not explored. There are several studies which use self-report measures for externalising behaviours. We decided not to use these studies in the review due to the children's ages, and the prevalence of attention difficulties, hyperactivity and CP would further limit many of the children in being able to accurately report on their behaviour. In addition, there are studies which use parent and teacher ratings of ER and other social-emotional skills. Whilst parent and teacher ratings can be valuable, in this instance we chose to gather objective and empirical data to ensure that the systematic review was of higher scientific quality. A child's ability to recognise emotions

would be difficult to rate without measuring objectively, as it would often be interpreted based on the child's responses to situations and behaviours which may also be dependent on a number of other factors. In addition, ratings would rely on the emotional, social and observational skills of the rater, and multiple raters would further confound this style of measurement.

Finally, this systematic review focused on the 6 core emotions of happiness, sadness, anger, fear, surprise and disgust (Ekman et al., 1987) as these have been studied most frequently and are thought to be consistent across cultures. Some of the studies included in this review also studied more complex emotions (e.g., Sharp et al., 2015) however this data was not included.

Empirical Paper

Strengths

Young Age Group

A key strength of this study is its use of a young sample. This is a time in development when both ER and ToM are in development (Camras et al., 1988; MacDonald et al., 1996; Russell & Widen, 2002; Schultz et al., 2000; Jenkins & Astington, 1996; Miller, 2009) and the skills developed at this age form the basis of their later social and emotional competence (Denham et al., 2003). This makes it an opportune time for interventions which support the development of these skills as children are receptive and theoretically able to access these. In addition, behavioural difficulties presenting at this age predict a plethora of poorer longitudinal outcomes (e.g., Moffitt et al., 2002) meaning that understanding behavioural difficulties and reducing them at this stage could have significant long term benefits for individuals and societies. Finally, associations have been found between ER, ToM and externalising problems, but their inter-relations are not fully understood, and thus further assessment at this early stage in development is key in considering how best to intervene.

Enriched Sample

This study oversampled for children presenting with behavioural difficulties. Although this is more difficult to achieve in high numbers, the children studied are more clinically relevant and likely to require support from services in the future. This means that the research findings will be of high clinical utility.

Bridging Two Areas of Research

The study also explored both hyperactivity and CP which have previously often been studied separately. The findings of the study demonstrate this value in finding that associations between CP and ER may be accounted for by hyperactivity. There is significant value in highly specialised areas of research with specific research questions, however there is also value in bridging areas of research based on theoretical and empirical findings to further our knowledge.

Controlling for IQ

Controlling for verbal IQ was crucial as it affects both ToM and ER (Strand et al., 2016). Controlling for IQ also ensured that this study was novel and made a valid contribution to the literature base, as it furthered the work by Chronaki, et al. (2015) who found that hyperactivity was a better predictor of FER difficulties than CP. However, the authors acknowledged that IQ might have accounted for their findings.

Novelty

To the author's knowledge, the combination of the above strengths is a first in the literature. This study is key in contributing to our understanding of the early signs of difficulties in children who can go on to present significant challenges during their adolescence and adulthood, particularly as hyperactivity is rarely controlled for.

Methodology

The use of a FER task which included a variety of stimuli (both low and high intensity emotions, a range of emotion expressions including neutral expressions, and both male and female faces) was a strength. The use of multiple first order ToM tasks, rather than one task only, was also a strength given that some children may be correct by chance.

Transdiagnostic Approach

This study used a dimensional, transdiagnostic approach to assessment which does not rely on diagnoses. This allows exploration of the basic dimensions of functioning which span all behaviour, both helpful and unhelpful, and the varying degrees of skills and difficulties (RDoC, 2018). A further strength of this approach is the ability to better understand and thus intervene with difficulties which may not yet reach criteria for diagnosis.

Limitations

Recruitment

The sample size for this study, whilst sufficient to detect most medium or large effects, was relatively small, and thus the study was underpowered to detect smaller effect sizes. We specifically sampled children presenting with behavioural difficulties in school, and without a diagnosis of Autism, to ensure that we had the most appropriate sample for the research question. However, the author was also mindful that teachers are likely to find it difficult to find the time to refer such children and so the difference between those that did refer and those that did not may have produced some bias. A strength of this study was that the non-referred children, who were recruited to enable a more thorough dimensional analysis, were very well matched to the referred children in terms of age, gender, SES, verbal IQ and ethnicity (see Appendix C).

What was Not Studied

Empathy

In deciding to explore the relationship between ER and ToM, only specific “cognitive” aspects of the broader concept of “empathy” were considered. Empathy refers to the ability to recognise, comprehend and share other’s emotions (Decety & Moriguchi, 2007) and is thought to consist of motor empathy, emotional empathy and cognitive empathy (Blair, 2005). Motor empathy is the body’s unconscious reactions to emotional stimuli, including mirroring of other’s facial expressions, also known as facial mimicry (Bons et al., 2013). This aspect of empathy was not measured in this study. Emotional empathy is the internal experience consistent with and in response to other’s expressed emotions (Bons et al., 2013). Whilst emotional empathy was measured within the NDAU, the data was not analysed in this study as it is measured through a video-taped empathy task which is lengthy, and thus would have been unfeasible to administer to the non-referred participants within the constraints of a Doctorate in Clinical Psychology thesis. Cognitive empathy is the ability to recognise emotions, understand them and take another person’s perspective (Bons et al., 2013). Therefore, within this definition both the constructs analysed in this study, FER and ToM, are part of cognitive empathy. Cognitive empathy is thought to develop later than affective empathy (Knafo et al., 2009) and so it was decided that it is the most relevant to study in this age group.

Other Aspects of Externalising Behaviours

We also decided to focus specifically on CP and hyperactivity. These constructs were selected because both have been associated with further difficulties in adulthood. These are also specific dimensional constructs rather than diagnoses and so refer to a specific group of children whilst also allowing for exploration of the high levels of comorbidity. Whilst teachers completed the whole SDQ and other aspects of this data are being analysed within parallel studies, we did not include all of the dimensions available to avoid so called ‘data dredging’ (Smith & Ebrahim,

2002). We also did not include an analysis of callous-unemotional traits even though these are relevant to ER as our review demonstrated. The reason for this is to avoid overlap with other intended published research in the NDAU (being led by a postdoctoral researcher with expertise in this area), which will be considering aspects of cognitive and motor empathy in relation to callous-unemotional traits in this younger sample.

CBCL Data

In addition to the teacher SDQ, we also gathered SDQ and CBCL (Child Behavior Checklist, Achenbach; 1991) data from parents. This data was not used as there was more missing data (N = 6) from parents meaning that the study would have lost power if they were analysed. There were also concerns about the validity of some of the parent questionnaires that were taken in both samples, due to English not being the first language of many of the parents. In addition, parent reports of child behaviour have been found to be more affected by their own emotional wellbeing than teacher reports, which are generally seen as more robust and objective measures of a child's behaviour (Van Dusen Randazzo, Landsverk, & Ganger, 2003). The SDQ has, however been found to be better at detecting attention difficulties and as good as the CBCL at detecting externalising problems (Goodman & Scott, 1999)

Emotion Recognition Biases

It was decided to look specifically at FER accuracy, not biases. Although there are a number of interesting findings in relation to FER biases, in the interests of not having too many variables and to limit data dredging, given the sample size it was decided to focus on children's ER accuracy only.

The Influence of the Early Environment

Neither the systematic review nor the empirical paper explored the role of the child's early life and home environment, which is known to affect ER, ToM and externalising behaviours.

The nature of the child's early or home environment has been found to impact on ER (e.g., Brownell, Svetlova, Anderson, Nichols, & Drummond, 2013). FER difficulties have been found in children who have experienced neglect more than those who have experienced abuse or neither (Pollak et al., 2000). Children who have experienced physical abuse are particularly sensitive to recognising anger (Pollak et al., 2009; Pollak & Kistler, 2002). Biases towards angry faces have also been identified in children exposed to normative forms of harsh parenting (Jaffee, 2017). So whilst not all children who exhibit externalising problems have been maltreated, their experience of threat is an important consideration. Kujawa et al. (2014) examined maternal depressive symptoms and negative parenting and found that negative parenting better predicts poorer ER. However, children of mothers with depressive symptoms are particularly susceptible to this effect. Finally, Cooke et al (2016) conducted a meta-analysis and found a robust relationship between emotion understanding and attachment security, which had been hypothesised to allow for open emotion communication and foster emotion understanding. Also, ToM development is affected by levels of family conflict, talk about internal states (Dunn & Brown, 1993; Howe, 1991) and pretend play (Youngblade & Dunn, 1995).

In relation to CP, parenting style, parental conflict and exposure to abuse have been found to predict externalising behaviours (Murray & Farrington, 2010). Improved attention has also been associated with better quality early home environments (NICHD Early Child Care Research Network, 2003, 2005) and poorer attention has been associated with insecure attachment (Pasco et al., 2004) and mother child interaction quality (Murray et al., 1996). In addition, children who experience early adversity and trauma (including physical and sexual abuse and neglect) have been found to have lower overall IQ (e.g., De Bellis, Woolley, & Hooper, 2013) and some studies have found specific difficulties in attention (e.g., Vasilevski

& Tucker, 2016). Therefore, the early environment is likely to have a significant impact on the factors explored in this thesis.

These studies on the potential impact of early experiences and later cognitive and emotional development are valuable contributions to the literature which can contribute to developing improved preventative measures. Whilst data in the NDAU sample data has been gathered regarding the participants' early years and home environment, and although equally worthy of exploration, in this study we chose to focus specifically on the relationship between behaviours and social-emotional skills. The study of underlying causes for behaviours and skill deficits would require analysis of multiple variables and therefore need a high number of participants to have sufficient power. Such a large sample size would not have been available in the timescales of this thesis. Also, longitudinal designs would be of most benefit in examining the link between early environment and later ER, ToM or externalising behaviour difficulties. Furthermore, there is value in both preventing the causes of such difficulties and in reducing the impact once the first signs of difficulty arise. For many children, the first known signs of concern will be the externalising behaviours in schools (rather than in-depth knowledge of that child's home environment). Therefore, understanding the links between these presentations and the underlying skill deficits is crucial in designing timely interventions at this stage. Such interventions can ultimately reduce the longer-term impact of any early causal experiences.

Ethical Considerations

When meeting and assessing children, it is always crucial to be mindful of potential risks and child protection concerns, therefore confidentiality and the times at which we may break confidentiality was explained to all parents. The author was also conscious of the threshold for services. Where relevant, the research team checked whether families or teachers had spoken

to their GP or accessed support. Furthermore, the Cardiff University Safeguarding Policy (CUSP) was followed within this study. Whereas no safeguarding issues were raised within the testing of the typically-developing sample, when there have been concerns raised within the referred (NDAU) sample; the CUSP has been followed.

Reflections on Testing

Whilst conducting testing the author noted the difference between a clinical and a research role. At times, whereas a clinician might have explored a difficulty further (e.g., parents reporting a child struggling with changes in routine), this was not within the scope of the research role. There were also differences in the assessment between this research setting and how it may have been conducted in a clinical setting. As the children were in a school setting, they were generally happy to complete some tasks and appeared to particularly enjoy the ToM (story-based) tasks. In many ways this is not dissimilar to cognitive assessments which may be completed in a clinical setting (e.g., Wechsler, 2004). However, the ones selected for the research were more focussed on assessing specific skills rather than broad domains. In a clinical setting, although a cognitive assessment might be considered for a child presenting with attention difficulties, in practice they are rarely conducted and most children who present with CP would not receive a cognitive assessment. Instead clinicians would likely use developmental, behavioural or attachment models to understand the antecedents and maintaining factors as well as any needs in terms of parenting or support. A developmental history would also be taken to consider both the child's early development and any life events and to learn more about the family context, support and capacity. In reflecting on these differences, there are strengths in both. Whilst it is possible that differing assessments may arrive at the same conclusion (e.g., assessment of social-emotional skills and functional assessment of triggers may lead to the same conclusion that the child misinterprets social situations) it is equally possible that pertinent factors could be missed with either approach.

Discussion of the Thesis as a whole

Implications for Theory and Clinical Practise

The systematic review collated the findings currently available regarding ER and externalising problems in pre-adolescent children. This was an important development in the literature base to summarise evidence for and against the various theories which have been proposed.

The review supports suggestions that ADHD is linked to difficulties with FER which may be due to children not properly attending to stimuli (Frazier et al., 2004; Willcutt et al., 2008; Kats-Gold et al., 2007). Therefore, interventions aimed at improving social-emotional skills in pre-adolescent children with ADHD symptomology should focus on both improving children's ability to attend and directive teaching and training with regard to what they should attend to. An emotional training programme has been developed at Cardiff University and so far trialled on adolescents with significant CP with positive outcomes (Hubble et al., 2015). The systematic review indicates that such a training programme (with appropriate age-related modifications) could be useful for pre-adolescent children (when emotions are at a crucial phase of development) with a wider variety of externalising problems (i.e., including children with ADHD).

The review also supports Dadds et al.'s (2011) argument for general deficits in attention to social-emotional stimuli for children with callous-unemotional traits. This leads to similar clinical implications as ADHD and Sharp et al.'s (2015) findings have suggested that these children benefit from prompts to look at the eye region of faces.

The findings from the empirical paper, and previously Chronaki, et al. (2015) that hyperactivity accounts for a greater proportion of the variance than CP in predicting FER problems suggest an important role for inattention/hyperactivity in children presenting with CP. Specifically, some of the previous findings in relation to CP (and potentially callous-

unemotional traits) and FER difficulties, may actually be accounted for by inattention/hyperactivity. The empirical study of this thesis furthers Chronaki, et al. (2015) findings as it also controlled for verbal IQ, which may otherwise have accounted for their findings. Thus, our research alongside that of Chronaki, et al. (2015) indicates that in young children, early manifestations of attention/hyperactivity problems are more predictive of ER problems, than early manifestations of CP. The high levels of comorbidity mean that it is plausible that this explanation applies to a range of externalising problems and thus requires further research.

No fear-specific trends were identified in the review; in the empirical paper they were found for children with weaker ToM but not for children with high hyperactivity and CP. Difficulty recognising fear is in line with Blair et al. (2014) and Marsh et al.'s (2008) suggestions of reduced amygdala activation and subsequent hyposensitivity. Future research would benefit from exploring the relationship between neural activity, ToM and ER to understand this further.

A global association between ToM skills and FER skills was supported, this is in line with findings summarised by Mier et al. (2010). The empirical paper suggests that ER and ToM is still developing in children aged 4 to 5. However, our data also indicated that verbal IQ is a stronger predictor of ToM than age.

Hyperactivity and CP were related to difficulty recognising anger which was also found by Chronaki, et al. (2015) who studied a similar age group. Differing theories have suggested that children with hyperactivity or CP are either hyper-reactive or hypo-reactive (Fairchild et al., 2009) to punishment signals (Crick and Dodge; 1994). Referring back to the discussion around early environment, there may be a number of causes for this such as increased exposure to anger or threat (punitive punishment, abuse or violence) or a lack of parental supervision or interaction. Alternatively, it may be that the difficulties these children experience impact their

social experience through peers and teachers, and this further affects the development of their social-emotional skills. Our findings might have implications for interventions, as children who do not recognise anger will be less likely to learn to inhibit behaviours that produce an angry response from others, and therefore ER training for children with externalising problems may be useful for the children to read social cues and modify their behaviour.

Evidence-Based Practice and Practice-Based Evidence

The author's experience of this thesis has highlighted the value of increasing the links between clinicians and researchers. As an example, the assessment from the NDAU is different to what a child might receive if they accessed primary or secondary CAMHS, parenting or behavioural disability services. It may be that if good quality norms were developed further for these novel research-based tasks, then clinical settings could more frequently adopt some of these measures. Such measures might help clinical assessments become more evidence based (and more focused on relevant transdiagnostic constructs), and researchers could access more data in clinical settings to increase the knowledge base about complex samples that have the most psychological needs.

Future Research

Both papers make recommendations for future research and there are some particularly exciting areas. Progression of the current project in gathering longitudinal data with greater numbers of participants, including girls would greatly add to the literature including potential causal links. Furthermore, analysis of very discrete age groups may shed some light on previous studies finding differing results and inform age specific interventions. This in combination with analysis of the parent and home environment data, will be valuable in understanding both causal and protective factors in the development of difficulties at this early age. One particular area of interest which is currently being investigated uses eye tracking data to explore the links

between FER skills, externalising behaviours and the areas of the face which the participants focus on. Future research could also explore ER more broadly by exploring non-prototypical emotions or emotions on the faces of people they know (Castro et al., 2016). Finally, following the specific findings in relation to anger recognition it would be valuable to explore the correlation between anger FER performance and children's responses to aversive stimuli more generally (e.g., monetary losses or balloon pops indecision-making tasks) which have also been linked to CP and ADHD (Hobson et al., 2011).

Dissemination

The first two papers of this thesis will be submitted for publication to Child Neuropsychology (Appendix A). In addition, the findings will be presented to the principle investigator of the NDAU study and shared within the research team and psychology department at Cardiff University via relevant lab groups. Finally, the empirical paper will be submitted to the British Psychology Society's Faculty for Children, Young People and their Families Annual Conference 2018. The author will look for further opportunities to present, where appropriate.

Personal Reflections

For the author personally, this research area is largely focused on children's deficits and difficulties and an equally valuable line of research may be to understand the skills and potential which could be built on in these children and families. This is balanced with the acknowledgement that identifying specific skill deficits is likely to contribute towards the identification of the underlying causes and potential interventions, which has significant value in reducing and preventing these difficulties in the future.

Overall the author has enjoyed this opportunity to take a key role in the research process. It has been a welcome opportunity to gain research and analytical skills as well as becoming more aware of the barriers and opportunities for greater links between research and

clinical settings. In particular it has been exciting to be part of a bigger research project and learn about the areas of study which are running alongside this thesis and thinking about how each area links together. It has also been an opportunity to reflect on the role of a Clinical Psychologist in terms of both research and evidence-based practice to think carefully about how our skills are best applied.

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Appendices

Appendix A: Author guidelines for selected journal: Child Neuropsychology

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Child Neuropsychology is an international, peer-reviewed journal publishing high-quality, original research. Please see the journal's [Aims & Scope](#) for information about its focus and peer-review policy.

Please note that this journal only publishes manuscripts in English.

Child Neuropsychology accepts the following types of article:

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Regular (Original) Articles, Brief Reports, and topical Review Articles, as well as specific

Test or Book Reviews

Should be written with the following elements in the following order: title page; abstract; keywords; main text introduction; methods; results; discussion; acknowledgments; disclosure statement; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figures; figure captions (as a list)

Work with a very narrow focus or that otherwise does not warrant a full article can be considered for a Brief Report. In a Brief Report, there should be no subsections in the Method, and the Results and Discussion should be combined.

Please include a word count for your paper.

There are no word limits for articles in this journal.

A typical Brief Report for this journal should be no more than 2000 words; this limit does not include two tables or figures.

Should contain an unstructured abstract of 250 words.

Between 3 and 5 **keywords**. Read [making your article more discoverable](#), including information on choosing a title and search engine optimization.

Style Guidelines

Please refer to these [quick style guidelines](#) when preparing your paper, rather than any published articles or a sample copy.

Please use American spelling style consistently throughout your manuscript.

Please use double quotation marks, except where “a quotation is ‘within’ a quotation”. Please note that long quotations should be indented without quotation marks.

Footnotes should not be used unless absolutely necessary. Essential footnotes should be indicated by superscript figures in the text and collected on a separate page at the end of your paper.

Results of statistical tests should be given in the following form: “.. results showed an effect of group, $F(2, 21) = 13.74$, $MSE = 451.98$, $p < .001$, but there was no effect of repeated trials, $F(5, 105) = 1.44$, $MSE = 17.70$, and no interaction, $F(10, 105) = 1.34$, $MSE = 17.70$.” Other tests should be reported in a similar manner to the above example of an F -ratio. For a fuller explanation of statistical presentation, see the APA Publication Manual (6th ed.).

Abbreviations that are specific to a particular manuscript or to a very specific area of research should be avoided, and authors will be asked to spell out in full any such abbreviations throughout the text. Standard abbreviations such as RT for reaction time, SOA for stimulus onset asynchrony or other standard abbreviations that will be readily understood by readers of the journal are acceptable. Experimental conditions should be named in full, except in tables and figures.

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Updated 17-01-2018

Appendix B: Quality Assessment Tool, the QATSDD

R. Siniyeh *et al.*

Reviewing studies with diverse designs

Table 1 Quality assessment tool and scoring guidance notes

Criteria	0 = Not at all	1 = Very slightly	2 = Moderately	3 = Complete
Explicit theoretical framework	No mention at all	Reference to a specific theoretical basis.	Reference to a specific theoretical basis.	Explicit statement of theoretical framework and/or constructs applied to the research.
Statement of aims/objectives in main body of report	No mention at all	General reference to aim/objective at some point in the report indicating abstract.	Reference to broad aims/objectives in main body of report.	Explicit statement of aims/objectives in main body of report.
Clear description of research setting	No mention at all	General description of research area and background, e.g. 'in primary care'.	General description of research problem in the target population, e.g. among GPs in primary care.	Specific description of the research problem and target population in the context of the study, e.g. nurses and doctors from GP practices in the east of England.
Evidence of sample size considered in terms of analysis	No mention at all	Basic explanation for choice of sample size. Evidence that size of the sample has been considered in study design.	Evidence of consideration of sample size in terms of saturation/ information redundancy or to fit generic analytical requirements.	Explicit statement of data being gathered until fit exact calculations for analytical requirements.
Representative sample of target group of a reasonable size	No statement of target group.	Sample is limited but represents some of the target group or representative but very small.	Sample is somewhat diverse but not entirely representative, e.g. inclusive of all age groups, experience but only one workplace. Requires discussion of target population to determine what sample is required to be representative.	Sample includes individuals to represent a cross section of the target population, considering factors such as experience, age and workplace.
Description of procedure for data collection	No mention at all	Very basic and brief outline of data collection procedure, e.g. 'using a questionnaire distributed to staff'.	States each stage of data collection procedure but with limited detail or states some stages in detail but omits others.	Detailed description of each stage of the data collection procedure, including when, where and how data were gathered.
Rationale for choice of data collection tools	No mention at all	Very limited explanation for choice of data collection tools.	Basic explanation of rationale for choice of data collection tools, e.g. based on use in a prior similar study.	Detailed explanation of rationale for choice of data collection tools, e.g. relevance to the study aims and assessments of tool quality and/or statistically, e.g. for reliability & validity, or relevant qualitative assessment.
Detailed recruitment data	No mention at all	Minimal recruitment data, e.g. no. of questionnaire sent and no. responses.	Some recruitment information but not complete account of the recruitment process, e.g. recruitment figures but no information on strategy used.	Complete data regarding no. approached, no. recruited, attrition data where relevant, method of recruitment.
Statistical assessment of reliability and validity of measurement tools	No mention at all	Reliability and validity of measurement tools discussed, but not statistically assessed.	Some attempt to assess reliability and validity of measurement tool(s) but insufficient, e.g. attempt to establish test-retest reliability is unsuccessful but no action is taken.	Suitable and thorough statistical assessment of reliability and validity of measurement tool(s) with reference to the quality of evidence as a result of the measures used.
Fit between stated research question and method of data collection (Quantitative only)	No research question stated.	Method of data collection can only address some aspects of the research question.	Method of data collection can address the research question but there is a more suitable alternative that could have been used or used in addition.	Method of data collection selected is the most suitable approach to attempt answer the research question.
Fit between stated research question and content of data collection tool (e.g. interview schedule) (Qualitative)	No research question stated.	Structure and/or content only suitable to address the research question in some aspects or superficially.	Structure & content allows for data to be gathered broadly addressing the stated research question(s) but could benefit from greater detail.	Structure & content allows for detailed data to be gathered around all relevant issues required to address the stated research question(s).
Good justification for analytical method selected	No mention at all	Basic explanation for choice of analytical method	Fairly detailed explanation of choice of analytical method.	Detailed explanation for choice of analytical method based on use of research question(s).
Assessment of reliability of analytical process (Qualitative only)	No mention at all	More than one researcher involved in the analytical process but no further reliability assessment.	Limited attempt to assess reliability, e.g. reliance on one method.	Use of a range of methods to assess reliability, e.g. triangulation, multiple researchers, varying research backgrounds.
Evidence of user involvement in design	No mention at all	Use of pilot study but no involvement in planning stages of study design.	Pilot study with feedback from users informing changes to the design.	Explicit consultation with steering group or statement of formal consultation with users in planning of study design.
Strengths and limitations critically discussed	No mention at all	Very limited mention of strengths and limitations with omissions of many key issues.	Discussion of some of the key strengths and weaknesses of the study but not complete.	Discussion of strengths and limitations of all aspects of study including design, measures, procedure, sample & analysis.

Appendix C: Participant demographics

Characteristic	School Referred participants N = 37	Typically developing participants N = 31	Statistical comparison
Sex (% male)	73% male	58% male	$\chi^2 = 1.68$
Ethnicity (% Caucasian)	91%	68%	$\chi^2 = 1.60$
	M(SD)	M(SD)	
Age	70.92 (11.74)	70.19 (11.91)	T (66) = 0.25
Family Income (per year)	£26765 (15540)	£21931 (12321)	T (66) = 1.40
Verbal IQ – LUCID percentile rank	60.19 (29.35)	64.74 (23.20)	T (66) = -0.70
Teacher SDQ - Conduct	3.72 (2.40)	1.10 (1.76)	T (65) = 5.04**
Teacher SDQ – Hyperactivity	7.94 (1.96)	3.26 (3.13)	T (65) = 7.46**

** Significant at the 0.01 level (2-tailed).

* Significant at the 0.05 level (2-tailed).

Appendix D: Ethical approval

From: psychethics <psychethics@cardiff.ac.uk>
Subject: Ethics Feedback - EC.16.10.11.4592GR
Date: 7 November 2016 at 15:26:35 GMT
To: Stephanie Van Goozen <VangoozenS@cardiff.ac.uk>

Dear Steph

I passed on your query and the Ethics Committee has considered your revised project proposal: *A Feasibility Study of a Neurodevelopmental Disorders Assessment Unit (EC.16.10.11.4592GR)*.

The project has now been approved. Please note that if any changes are made to the above project then you must notify the Ethics Committee.

Best wishes,
Mark Jones

Appendix E: Referral process, information sheet and consent form for referred participants

CONSENT AND REFERRAL FORMS

Neurodevelopment Assessment Unit
Cardiff University Centre for Human Developmental Science
School of Psychology
Cardiff, CF10 3AT



NDAU





Neurodevelopment Assessment Unit
Cardiff University Centre for Human Developmental
Science
School of Psychology
Cardiff, CF10 3AT

thewaterloofoundation*



Expression of Interest Form

Name of parent:	
Name of child:	
Child's date of birth:	
Child's gender	Female <input type="checkbox"/> Male <input type="checkbox"/>
Family contact address:	
Family contact email:	
Family contact telephone:	

Name of Referrer	
Contact address of referrer:	
Contact email of referrer:	
Contact telephone of referrer:	

Once complete, please return this form to:

The Neurodevelopment Assessment Unit
Cardiff University Centre for Human Developmental Science
School of Psychology
Cardiff, CF10 3AT

Or email this form to: NDAU@cardiff.ac.uk



Overview of Pupil's Needs

This sheet is designed for the class teacher and/or SENCo to complete in order to provide the NDAU staff with a brief summary of the pupil's needs, the current interventions used and any current assessment information.

Overview of Presenting Needs	<i>Please give a brief summary of the pupil's presenting needs or areas for development. For example, social, emotional, motor, learning, etc.</i>
Overview of Interventions	<i>E.g., current approaches with pupil</i>
Overview of School-Based Assessment Data	<i>E.g., baseline assessments, foundation phase profile level, national curriculum levels, literacy levels, Language Link scores, etc.</i>

Agency involvement: Please check school files and record external agency involvement.

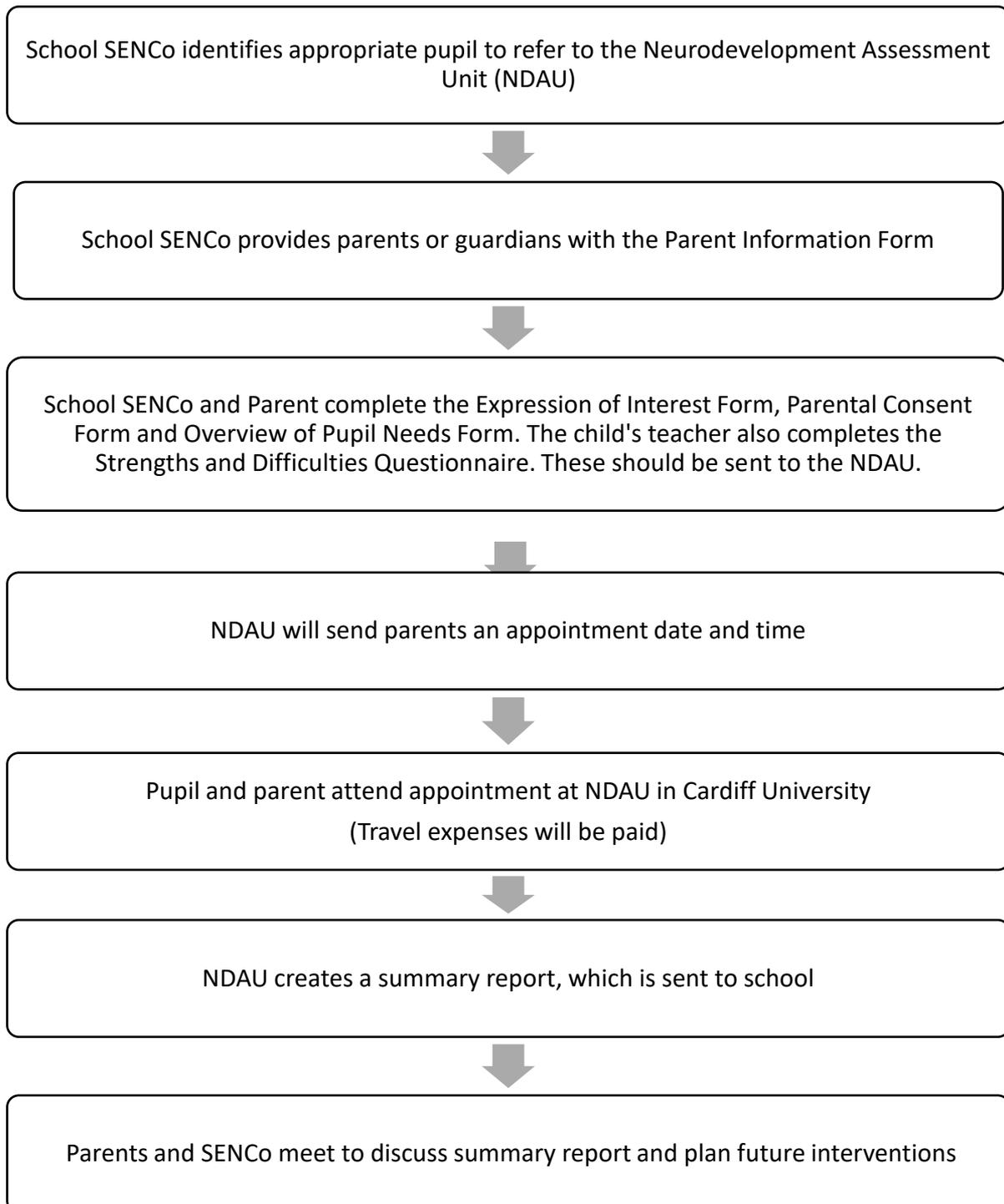
	<i>Involved? (Y/N)</i>	<i>Brief Details</i>
Behaviour Support Services		
Learning Support Services		
Child and Family Service / CAMHS		
Children's / Social Services		
Speech & Language Therapy Service		
Occupational Therapy		
Other Health Services		
Other		

PLEASE ALSO ENSURE THAT YOU OR A RELEVANT MEMBER OF STAFF COMPLETES THE STRENGTHS AND DIFFICULTIES QUESTIONNAIRE (SDQ-Teacher version).

Please indicate here whether you are happy with the school's SDQ ratings of the child to be included in the report: YES / NO (please circle)



Referral Pathway Flow Chart





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 Cardiff. CF10 3AT



STUDY CONSENT FORM

(for parents of children aged 4-7 years)

This is to be completed by parents on behalf of their child and themselves.

Please initial box

1. I confirm that I have read and understood the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that my participation and that of my child is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected.
3. I am happy for the research team to make contact with me if there are any future research studies that might be of interest to me.
4. I agree for my child to perform the developmental assessments as part of the study named above.
5. I agree to complete the parental interview and questionnaires as part of the study named above.
6. I understand that relevant sections of my child's data collected during the study (including my ratings about my child on the Strengths and Difficulties Questionnaire) may be looked at by individuals from the NDAU study team, from regulatory authorities or by my child's referring agent, where it is relevant to their taking part in this research. I give permission for these individuals to have access to my child's data.
7. I understand that a video recording will be made of my child's assessments for research, safety and training purposes. I understand that brief clips from the video may be used to illustrate important aspects of child development, and to train new researchers, and so such clips may be shown to students or at professional meetings. I give consent for such clips to be taken from this video record, with the understanding that my name or my child's name will never be associated with the video clip. I understand that the video will remain in the possession of Prof. Van Goozen and the NDAU research team, and will never be given to other unauthorised individuals.

 Name of parent

 Date

 Signature

 Name of person
 taking consent

 Date

 Signature

Appendix F: Information sheet and consent form for typically developing participants



Study Information Sheet (for parents of children)

We would like to invite you and your child to take part in a research study. Before deciding, we would like you to understand why we are doing this research and what it would involve. It would be very helpful if you could take a few minutes to read this information.

What is the purpose of this research study?

The Neurodevelopment Assessment Unit (NDAU) is part of the School of Psychology at Cardiff University, and is funded by the Waterloo Foundation. The NDAU is run by a group of scientists interested in understanding the social, emotional and behavioural problems experienced by young children. We work with each child to assess different skills that are important for their learning and behaviour – such as short-term memory and understanding emotions.

Alongside the work on the NDAU, we are seeking to test some extra children in schools on a small number of tasks used in the NDAU study. The tasks concern emotion recognition, 'theory of mind' and verbal skills. We will look at differences in performance on these tasks between children with and without social, emotional and behavioural problems.

Why have we been invited to take part?

XXX Primary School has approved our research and agreed to send this information sheet on our behalf to **all** parents of children in Reception, Year 1 and Year 2.

Do we have to take part?

No, it is up to you to decide to take part or not. **If you agree to take part, we would ask you to complete the attached consent form (returning it to the school)**, and then your child will be seen by a researcher whilst at school to complete some tasks (they will take around 30 minutes to complete). We will also contact you to complete a questionnaire about your child over the telephone (10-15 minutes). Even if you have provided consent, you are still free to withdraw at any time without giving a reason.

What will happen if we decide to take part?

A Trainee Clinical Psychologist (Sara Cooper) will sit with your child and work through a small number of assessments in verbal skills, theory of mind and emotion recognition. These are all designed for use with young children and take around 5 to 10 minutes each.

What are the possible advantages and disadvantages of taking part?

There are no risks involved in taking part; the procedures that are used have already been tried and tested in children with no ill effect. The advantage of taking part is that many of the tasks are fun for children as they have been designed to be like games.

Will our information be kept confidential?

Yes. We will follow ethical and legal practice and all information about you and your child will be handled in confidence. All information is stored securely and in anonymised form that prevents non-authorized users (people from outside of the research team) from linking it with any information that identifies the child or family.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the Director of the NDAU, Professor Stephanie van Goozen (contact details below). In the very unlikely event of anything untoward happening, Cardiff University covers all volunteers against negligent harm.

What will happen to the results of this study?

The scientific results of the study will be analysed and studied by the research team; only members of the research team will have access to the data. The data may be reported in scientific papers and published in journals and may be presented at conferences. You and your child will not be personally identifiable in our description of our findings.

I am interested in taking part, what should I do next?

Please complete the attached consent form and return it to the school. If you have any questions, please email one of the researchers mentioned below.

Contact details of the research team:

Professor Stephanie van Goozen (Director of the NDAU): vangozens@cardiff.ac.uk.

Sara Cooper (Trainee Clinical Psychologist): BassettS4@cardiff.ac.uk

Neurodevelopment Assessment Unit,

Cardiff University Centre for Human Developmental Science,

Park Place,

Cardiff, CF10 3AT

Tel.

Email: NDAU@cardiff.ac.uk

Appendix G: Strengths and Difficulties Questionnaire (SDQ)

Strengths and Difficulties Questionnaire

T4-17

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour over the last six months or this school year.

Child's Name

Male/Female

Date of Birth

	Not True	Somewhat True	Certainly True
Considerate of other people's feelings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Restless, overactive, cannot stay still for long	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often complains of headaches, stomach-aches or sickness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shares readily with other children (treats, toys, pencils etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often has temper tantrums or hot tempers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rather solitary, tends to play alone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generally obedient, usually does what adults request	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many worries, often seems worried	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helpful if someone is hurt, upset or feeling ill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Constantly fidgeting or squirming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Has at least one good friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often fights with other children or bullies them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often unhappy, down-hearted or tearful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generally liked by other children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easily distracted, concentration wanders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nervous or clingy in new situations, easily loses confidence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kind to younger children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often lies or cheats	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Picked on or bullied by other children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Often volunteers to help others (parents, teachers, other children)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thinks things out before acting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Steals from home, school or elsewhere	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gets on better with adults than with other children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many fears, easily scared	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sees tasks through to the end, good attention span	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have any other comments or concerns?

Please turn over - there are a few more questions on the other side



NDAU Task Information Sheet

Facial emotion recognition

What is facial emotion recognition?

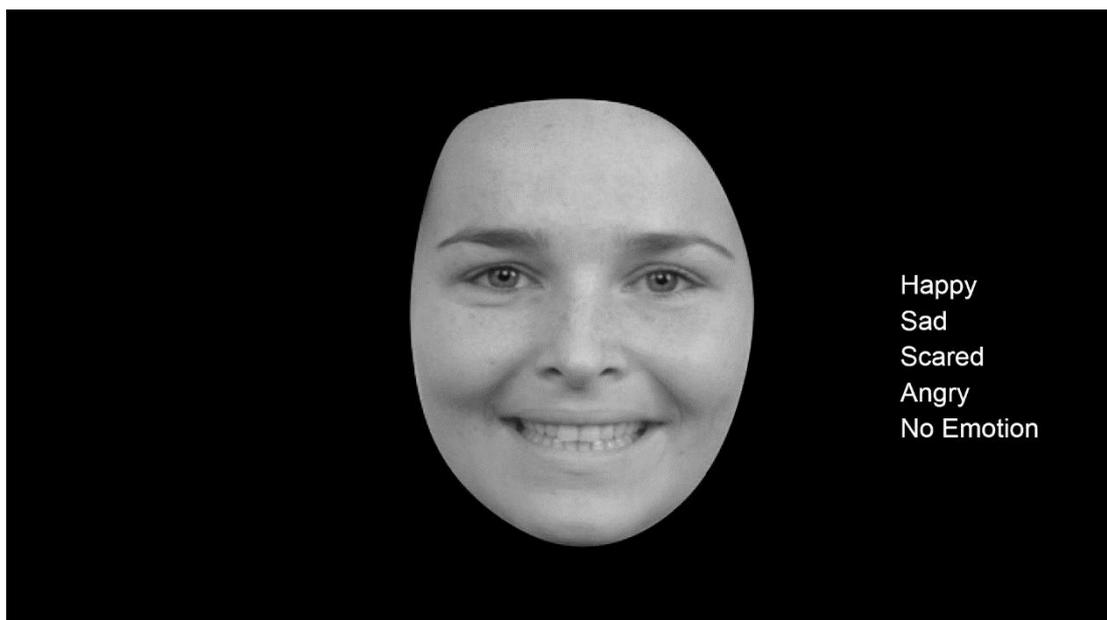
Emotions like happiness or sadness are associated with specific emotional expressions. The ability to accurately identify these facial expressions develops and improves throughout childhood, aiding our understanding of other's feelings. This accurate understanding of the expressions of others is important for appropriate social communication, and so is critical for everyday functioning. Difficulties in identifying facial expressions can have negative consequences on an individual's ability to understand or relate to other's emotions, interfering with the ability to engage in appropriate social behaviour and to maintain friendships.

How does the NDAU measure the ability to recognise facial emotion?

The NDAU measure an individual's ability to recognise facial emotion through presenting the child with different facial expressions and asking them to identify how that person is feeling.

The child is presented with images of different male and female faces, either displaying expressions of happiness, sadness, fear, anger or no emotion. The child is asked to identify how that person is feeling. The intensity of the expression also varies from more subtle to overt facial expressions of emotions.

Many children have completed this task, and so we can compare each child's ability to recognise facial emotions to the performance of children of a similar age in order to determine their developmental progress.



NDAU Task Information Sheet



Theory of mind

What is Theory of mind?

Theory of mind is the ability to attribute mental states to oneself and to others. This function enables an individual to understand or predict other people's behaviour in social situations. As children develop, so does their theory of mind understanding; they increasingly see human beings as individuals with beliefs, desires, intentions and feelings that are separate to their own. Without this ability, students may struggle to develop the social skills needed for social pretend play, reciprocated friendships and appropriate cooperation.

How does the NDAU measure Theory of mind?

At the NDAU Theory of mind is measured through telling children a series of stories using soft toys and toy figurines. Each story creates a situation in which a child is led to believe something about a current set of circumstances, but this belief is different from the belief that is held by the main character of the story.

For example, in one story, commonly known as the 'Sally-Anne Location Task', children are introduced to a toy figurine called Max (see figure 1.). Max wants to keep his football safe while he goes out to play, and so he hides it in a cupboard. Children then watch as another toy character, named Sally, moves the football from the cupboard and into a basket after Max has left the room. The child is aware of the football's new location, but Max is not.

Following each story children are asked about the main character's mental state and/or behaviour, such as 'Where will Max would look for his football?'

To pass the task, the child must be able to understand that another's mental representation of the situation is different from their own. The child must also be able to predict behaviour based on that understanding. Their performance on these tasks can be compared to other children of a similar age in order to determine their relative current ability.



Figure 1. Sally-Anne Location Task

NDAU Task Information Sheet



Verbal Reasoning

What is Verbal Reasoning?

Verbal reasoning involves the ability to use words and language to think, such as comparing or contrasting, using verbal memory for facts or descriptions, expressing an opinion, or problem solving. Children with good verbal reasoning ability are thought to do well in curriculum areas that necessitate fluent verbal thinking, such as English, history and modern languages.

How does the NDAU measure Verbal Reasoning?

In the NDAU we measure verbal reasoning through a software programme called Lucid Ability, which uses colourful games and tasks to engage the child. It has been standardised and norm referenced. This means that we can compare the scores of a child against those of children of the same age and highlight how they are performing at this stage of their development.

The task that a child will do at the centre will depend on their age. Children aged 4-6 receive the Picture Vocabulary test (see Figure 1). In this test five pictures appear on the screen in random positions. One is the target picture and the other four are distractors. The child is given audio instructions: "Which picture goes best with the word ...?" and has to click on the chosen picture.

Children aged 7 will receive the Link Word task (See Figure 2). In this task two pictures are presented on the screen and separated by six words. The child's task is to identify the word that provides the best conceptual link between the two pictures: For example, in Figure 2 the pictures are of a bottle of milk and a piece of cheese. Out of the six words on the list, the best word that links these pictures conceptually is 'dairy'. If the child wishes, the computer will speak the words when they are clicked on, so reading competence is not necessary.

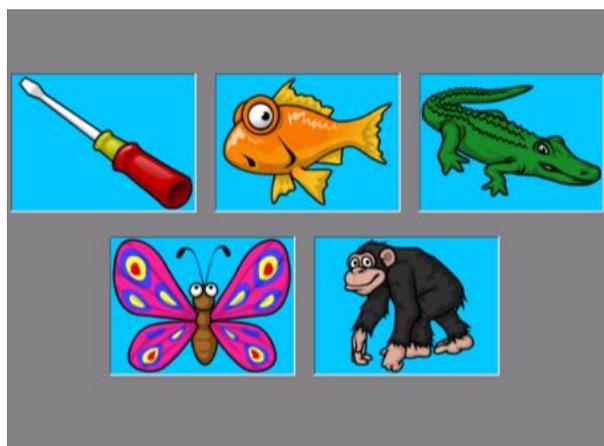


Figure 1. Picture Vocabulary

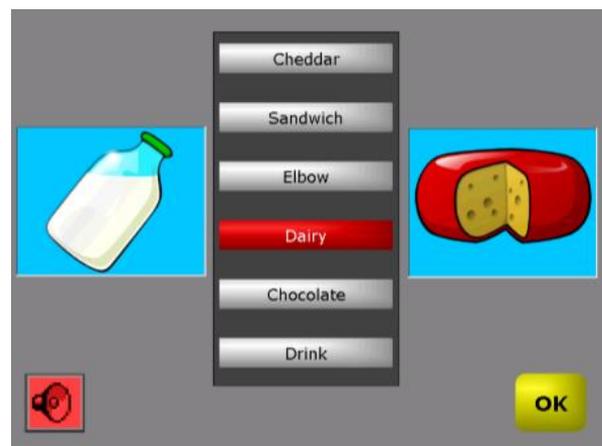


Figure 2. Link Word Task