STRESS, THEORY OF MIND AND EMOTIONAL AND

BEHAVIOURAL DIFFICULTIES IN CHILDREN

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Overview

This thesis investigates the links between stress, Theory of Mind (ToM) and emotional and behavioural difficulties in children.

Part 1 reviews the literature on individual differences in ToM in relation to emotional and behavioural difficulties, considering peer relationships, attention, behaviour, bullying and internalising difficulties.

Part 2 is the report of an empirical study investigating the effect of social stress on ToM. A group of 9 - 11 year old children were exposed to either the Trier Social Stress Test for Children (TSST-C; Buske-Kirschbaum et al., 1997) or a control condition prior to completing two ToM tasks. Physiological stress reactivity was measured by determination of salivary cortisol at two time points. The two groups did not differ in salivary cortisol levels and a group difference in ToM performance was not found. However, in the stressed group, an association was found between a measure of salivary cortisol post stressor and performance on one of the ToM tasks. The study also investigated associations of stress physiology and ToM with emotional and behavioural difficulties, however, these were not found. The results are discussed with reference to the limitations of the study. This was part of a joint project with James Fairbairn, Trainee Clinical Psychologist (*Stress, cortisol and executive functioning in pre-adolescent school children*').

Part 3 is a critical appraisal of this thesis. This includes research and clinical implications of the empirical study and a personal reflection of the research process. The appraisal ends with a brief summary of the thesis.

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TABLES

FIGURES

ACRONYMS

ADHD	Attention deficit hyperactivity disorder
CBCL	Child Behaviour Checklist
CBT	Cognitive Behavioural Therapy
CD	Conduct disorder
EF	Executive function
ESAT`	Epistemic state attribution task
fMRI	Functional magnetic resonance imagining
HPA	Hypothalamic-pituitary-adrenocortical
Mach	Machiavellian
ODD	Oppositional defiant disorder
PDD	Pervasive developmental disorder
PFC	Prefrontal cortex
ToM	Theory of mind
TSST-C	Trier Social Stress Test for children
SAT	Standardised assessment test
SES	Socio economic status
SS-PC	Strange Stories – physical control
SS-ToM	Strange Stories – theory of mind
VAS	Visual analogue scale

PART 1

LITERATURE REVIEW

IS THERE EVIDENCE THAT INDIVIDUAL DIFFERENCES IN

THEORY OF MIND RELATE TO EMOTIONAL AND

BEHAVIOURAL DIFFICULTIES IN CHILDREN?

Abstract

This review focuses on the nature of individual differences in Theory of Mind (ToM) and examines evidence concerning the links between ToM and children's emotional and behavioural problems. An introduction to ToM is given, followed by a brief synopsis of what is known about the influences on individual differences in ToM. The review considers ToM in relation to peer rejection, attention and behavioural difficulties, bullying and emotional difficulties. Research in these areas is in its infancy and the review describes the difficulties intrinsic to this type of research (for example, measuring ToM) as well as drawing the reader to the importance and potential implications of ToM research in child development and the development of psychological difficulties. Ideas for further research are proposed.

Introduction to Theory of Mind

'Theory of mind' (ToM) or 'mentalization' are terms used to describe the ability to predict and explain others' behaviour with reference to mental states. In other words, it is the capacity to hypothesise about another person's thoughts or beliefs, with the recognition that they may be the same or different to one's own. Classically, the false-belief paradigm is used to demonstrate if a participant has a ToM and is often referred to as the 'litmus test' for ToM. False-belief tasks require the participant to predict another's behaviour when something unexpected happens (e.g. a change in location of an object) by referring to the other's false belief. A classic example is the Sally-Ann task (Baron-Cohen, 1985), in which Sally puts her ball in a basket and leaves the room, in her absence Ann moves the ball to a box and the participant then has to say where Sally will look for the ball when she returns.

Typically, the acquisition of ToM is experimentally observed in 4 year old children who begin to pass false-belief tasks. Research has been carried out investigating ToM acquisition and development in both typical and atypical development. For example, a multitude of ToM research over the past twenty years has focused on individuals with autism who are shown to exhibit impaired ToM skills. With the development of new, more advanced ToM tasks, research is moving away from considering ToM as something which is present or absent, towards individual differences in ToM. Some research on individual differences has been carried out with different adult clinical populations, for example those with schizophrenia (e.g. Langdon & Coltheart, 1999), borderline personality disorder (e.g. Bateman & Fonagy, 2004) and those known to be sex offenders (e.g. Keenan & Ward, 2000).

Other research has examined associations between ToM and functioning within the normal range both in adults and children.

This literature review focuses upon individual differences in ToM and relationships to emotional or behavioural problems in childhood, considering peer rejection (and popularity), attention and behaviour difficulties, bullying and emotional difficulties. The reviewed literature was gained from searches cross matching 'Theory of Mind' or 'Mentalization' with many different terms using 'PsychInfo' and 'Web of Science'. The literature will be reviewed in terms of the quality of the research carried out and tentative conclusions will be drawn from the research to date. The review does not include literature on ToM in relation to children with autism (see Baron-Cohen, 2000 for a review), those who are deaf (see Peterson, 2003) and those with acquired brain injury (e.g. Snodgrass & Knott, 2006). The study of ToM in these groups of children is informative for typical development and some of the difficulties these populations face highlight the importance of ToM in the social worlds of children, however it is outside the scope of this review to consider this research.

Prior to examining studies on the association between ToM and children's functioning, sources of influence on individual differences are briefly reviewed.

Influences on Individual Differences in ToM

Social communication is seen in normally developing infants from birth through their efforts to interact with people and to impel others to interact with them. Behaviours such as engagement in joint visual attention, social referencing and pretend play are

all thought to be milestones in ToM development. There is evidence to suggest that both genetic and environmental factors effect ToM development and this will be reviewed in brief here (see Hughes & Leekham, 2004 for a more in-depth review).

Genetic influence

A genetic influence on ToM development is suggested by evidence that children with autism, a highly heritable disorder, often perform poorly on tests of ToM. Several theoretical accounts highlighting the innate nature of early ToM development have been proposed (e.g. Baron-Cohen, 1995). In order to investigate this hypothesis, Hughes and colleagues used twin studies, comparing monozygotic and dizygotic twins. They gave a battery of ToM tasks to 119 pairs of 42-month-old twins and found that 60% of the sample variance in ToM could be attributed to genetic factors using model-fitting regression (Hughes & Cutting, 1999). However, a larger study with 1,104 twin pairs aged 60 months, found that genetic factors did not account for significant variation in ToM performance, but rather shared and non-shared environmental factors were important (Hughes et al., 2005). Interestingly, the small amount of variance in ToM attributable to genetic factors was also found to influence verbal ability. The discrepancy between the two studies may be due to the differences in statistical power and/or because there was a higher proportion of children from lower socio-economic status backgrounds in the second study. Additionally, the results may indicate different influences at 42 and 60 months of age and may provide support for a hybrid model, whereby the environment becomes more influential with age (Tager-Flusberg, 2001). More recently Ronald, Happe, Hughes & Plomin (2005) found evidence for the influence of genetic, shared and non-shared environment on ToM.

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Attachment, ' mind-mindedness' and ToM

Individual differences in exposure to 'mental state talk' commence at an early age

and this is hypothesised to have an effect on ToM development (e.g. Symons, 2004).

Indeed, attachment research has focussed on the mothers' ability to mentalize about

her child's needs. Mind-mindedness describes 'the mother's proclivity to treat her

infant as an individual with a mind' showing sensitivity and responding appropriately

to the infant's mental states (Meins, Fernyhough, Fradley & Tuckey, 2001). Meins et

al. (2001) found that appropriate mind-related comments were a significant predictor

of infants' security of attachment at 12 months. They also found that mind-

mindedness was able to distinguish between categories of attachment, namely secure,

secure-avoidant and secure-resistant. Mothers in the insecure groups made fewer

appropriate mind-related comments than in the secure group.

Modelling this ability to represent another's mind seems to be one of the important

factors for the infant's development of ToM. Securely attached children are seen to

outperform their insecurely attached peers on standard ToM tasks (e.g. Fonagy,

Redfern & Charman, 1997). Research has also shown that children whose parents

use disciplinary strategies focusing on mental states succeed on false-belief tasks

earlier (e.g. Ruffman, Perner & Parkin, 1999).

Socio economic status (SES)

Correlations have been found between ToM performance and SES (e.g. Hughes et

al., 2005) and parental occupational class and mothers' education (Cutting & Dunn,

2002). Maternal talkativeness is also related to SES, with overall talk and child-

directed talk less in low SES families. This in turn predicts young children's

vocabulary and indeed has recently been shown to mediate the effect of SES on early

vocabulary developments (Hoff, 2003). Hughes et al. (2005) argue that their results

suggest that maternal speech may mediate the effect of SES on ToM. This hypothesis

is yet to be tested, but it is worth considering the benefits of exploring why mothers

from low SES families do not talk to their children as much and designing

interventions to encourage more talking, especially in regard to mental states.

Culture

Originally, Avis & Harris (1991) found evidence for cross-cultural similarities in

ToM acquisition, but since then Wellman & Langattuta (2000) and Vinden (1999)

have demonstrated cultural variation in the rate and course of false-belief acquisition.

In addition, Lillard (1998) found cultural differences in ToM in adults. It has been

argued that these differences have close links to language use.

Sibling factors

Children from larger families tend to show accelerated understanding of false-belief

and it appears that there is a stronger effect for younger siblings (Ruffman, Perner,

Naito, Parkin & Clements, 1998). This is in contrast to the usual advantage of first-

borns in their language and cognitive development. The possible explanations for

this finding are that older siblings act as a social partner for the younger sibling or

that younger siblings observe older siblings within their interactions with others

(Hughes & Leekham, 2004). Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki &

Berridge (1996) have proposed a 'general apprenticeship' model in which

interactions with a variety of family members are important. Interestingly, the link

between family size and ToM is strongest for less linguistically competent children (Jenkins & Astington, 1996).

In summary, there are cognitive, neurological and social factors to be considered when studying the development of individual differences in ToM. There is evidence that ToM ability is affected by verbal ability (Jenkins and Astington, 1996) and, in addition, executive function (see Perner & Lang (1999) for a review). It is also influenced by exposure to 'mental state talk' (Symons, 2004) which arguably could account for many of the social factors discussed.

While evidence is limited, it may be that there are stronger effects of genetics on early ToM milestones and that there is an increasing effect of the environment on ToM development as a child gets older (Tager-Flusberg, 2001). An interesting consideration is that there may be bi-directional relationships between ToM and many of the environmental factors or other aspects of cognitive development. For example, ToM may further the development of peer relationships and this in turn may provide more opportunities for promoting ToM development. It is clear that ToM continues to develop past the pre-school years, throughout school and continues to develop into adolescents and adulthood (e.g. Bosacki & Astington, 1999; O'Connor & Hirsch, 1999).

Measuring ToM

ToM research began with the use of classic (or 'first-order') false-belief tasks and it was found that most children started to pass these tasks around 4 years of age (see Table 1). Different tasks are often used in a battery and the scores aggregated, for

example between 0 - 5. The advantage of doing this is that a continuum of scores can be obtained and individual differences in the consolidation of ToM abilities can be looked at. However, most children older than 4 years pass these false-belief tasks and therefore the tasks are subject to ceiling effects with older children. Second order false-belief tasks (see Table 1) can be used with children between 4 - 8 years as they are more complex, requiring children to predict behaviour based on what a story character thinks another person thinks. Again, ceiling effects are likely to be found with older children. Researchers have therefore devised more advanced tests of theory of mind which can be used with older children and adults (see Table 1). Very recently, simple deception tasks have been developed and used with children younger than 3 years in order to measure ToM at this early age (see Table 1).

A primary difficulty in measuring ToM is operationalising it. ToM is used within everyday social interactions and it is a challenge to reflect this within a research task. It is important to bear in mind what is actually being measured by the ToM tasks in a research study and how this relates to everyday use of social cognition. Some researchers have tried to navigate round this challenge by measuring behaviours (observation or parent / teacher ratings) thought to require ToM, or by using transcripts of interactions (e.g. Barsch & Wellman, 1995).

As ToM is related to verbal ability and age, in order to look at individual differences in ToM, controlling for these factors is important.

Table 1

Theory of Mind tasks

Age typically administered	Type of ToM task	Scoring	Requirements	Examples
Less than 3 years	Deception	Pass/ fail	Ability to deceive another person	Penny hiding game (Baron-Cohen, 1992; Hughes et al., 1998)
	Pretence	Pass/ fail	Ability to show pretence	Elicited pretend play (Fein, 1975 cited in Hughes & Ensor, 2006)
3-4 years old	First order false-belief – considered the 'litmus test' of ToM	Pass/ fail -scores from a set of tasks are often aggregated.	Ability to predict another's behaviour by referring to their mental state	Sally-Ann task (Baron-Cohen, 1985) The Smarties test (Perner et al, 1989); Can't sleep picture book (Moerbeek, 1994)
4-8 years old	Second order false-belief or advanced test of ToM	Pass/ fail	Prediction of another's behaviour or mental state based on what a story protagonist thinks another person thinks	Second order false-belief (based on Perner & Wimmer, 1985),
8 years upwards	Advanced tests for older children/ adults	Continuum	For example, decide what a person is thinking or feeling from a picture of their eyes (Baron-Cohen et al., 2001)	Strange Stories (Happe, 1994) Eyes (Baron-Cohen et al., 2001)

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The relationship between ToM and emotional and behavioural difficulties

Peer rejected children and popularity

Peer rejected children tend to lack positive interactions with their peers and typically show aggressive or withdrawn behaviour. Peer rejection shows continuity over time and is associated with a wide range of short and long term effects, such as school withdrawal, anxiety and academic failure (Malik & Furnham, 1993).

Competency in false-belief comprehension has been associated with many positive outcomes for children's peer interactions, including increases in shared pretend play (Hughes & Dunn, 1997; Taylor & Carlson, 1997; Youngblade & Dunn, 1995), connected communication with peers (Slomkowski & Dunn, 1996) keeping a secret and ability to play 'hide and seek' (Peskin & Ardino, 2003). ToM can be viewed as a powerful social tool. Some evidence has been generated showing an association between ToM performance and measures of social performance (for example the work of Dunn and colleagues) and this is reviewed by Astington (2003) in the aptly named chapter 'Sometimes necessary, never sufficient'. This refers to the evidence linking ToM to social ability, but acknowledges a complex relation in which context, motivation and choice influence how ToM is used. For example, it has long since been acknowledged that a well developed ToM does not guarantee prosocial behaviour (for example in bullying) and this will be discussed later.

Some research suggests that social skills are associated with popularity (e.g. Watson, Nixon, Wilson & Capage, 1999). With this in mind and in light of research suggesting associations between social skills and ToM (albeit complex), it could be

tentatively hypothesised that ToM and popularity may be associated. There are six

studies looking at ToM in relation to peer acceptance and rejection (see Table 2 for

details of each study). The research is carried out with 3 - 6 year old children. All

studies used first order false-belief tasks, except Badenes, Estevan & Bacete (2000)

who additionally used the Strange Stories (Happe, 1994).

ToM and popularity was originally investigated by Watson et al. (1999), who found

that false-belief understanding was a significant predictor of teacher rated social

skills, but not teacher rated popularity. In support of this finding, Cuming and

Repacholi (1999, cited in Repacholi, Slaughter, Pritchard & Gibbs, 2003) found that

children with no or few mutual friends at preschool were better at ToM than those

with many friends.

The study by Watson et al. (1999) is the only study reported here to measure

popularity by teacher ratings, as subsequent research has measured popularity using

peer nomination, whereby children nominate who they like to play with the most and

least. Typically the number of ratings assigned to each child is summed and the child

is categorised as popular, average, controversial or rejected. This can be referred to

as their 'sociometric status'. The five other studies in Table 2 indicate associations

between ToM and popularity. The results of the Watson et al. (1999) study may

differ because of this methodological difference. It is also difficult to compare the

results of the Watson et al. (1999) study to the other studies because Watson et al.

(1999) did not analyse their data by age or gender as in some of the other studies.

Badenes et al. (2000) found a gender difference at the beginning of their analysis and so analysed males and females separately. They found a difference between popular girls and 'rejected and average girls' and in particular popular girls were better at deception. Interestingly, this was true even when a self concept measure was controlled for and so it is suggested that this was due to competence rather than confidence in the girls. However, it should be noted that they only had five girls in the rejected group and so the results do not show us much about them, but rather a difference is indicated between popular and average children. An interesting finding regarding the male subjects was a significant interaction between age and sociometric status in their effects upon ToM. On closer analysis they found that within the six year old age group, significant differences were found between the sociometric groups, but this was not the case for the four or five year old groups: peer-rejected boys in the older group obtained the lowest score on the White-lie task (from Happe, 1994) compared to the popular and average boys.

McNab (2001) measured the peer acceptance of 80 4 - 5 year olds in three different ways: as rated by all the children in the class, as rated only by males, and as rated only by females. Interestingly, with language ability controlled for, false-belief performance was correlated with peer acceptance as rated by females only. This study may suggest differences between how boys and girls rate their peers. It may be the case that girls value ToM skills (or social behaviours influenced by ToM) in their friends more than boys.

The gender differences found by Badenes et al. (2000) and McNab (2001) are very interesting; it is of note that research often shows female superiority in ToM tasks

(e.g. Baron-Cohen, Joliffe, Mortimore & Robertson, 1997). It may be that ToM skills flourish in popular girls and that ToM skills make girls more attractive to have as friends. ToM skills may be of less importance to boys and their friendships and, in particular, to younger boys.

In a study by Slaughter, Dennis and Pritchard (2002; see Table 2 for details), initial analysis of the data, with age and verbal scores controlled for, showed that ToM was not a significant predictor of sociometric category although prosocial behaviour was. However, using a mean age split, Slaughter et al. (2002) found comparable results to Badenes et al.'s (2000) male participants for both boys and girls analysed together. They found that, in children younger than 61 months prosocial behaviour was the only significant predictor of social preference. In other words younger children's peer acceptance is best predicted by their behaviour and this may be more important than the ability to read mental states. However, in children older than 61 months ToM was the best predictor although the result did not reach significance (p < .08) and neither did the regression equation. However, some evidence is generated here that may suggest that as children grow older it becomes more important for friends to have ToM skills.

Results from Badenes et al. (2000) and Slaughter et al. (2002) suggest that ToM may become more important for peer popularity as children get older. It is hypothesised that children older than 5 years who are lacking ToM skills may not be able to develop and sustain peer relations at a level now more deeply required by this age group. For example, being able to infer the thoughts, feelings and motivations of their friends and being able to act sensitively as a result. This may have serious

consequences, as they are likely to be less popular or rejected as a result, and consequently will not be exposed to social interactions imperative for ToM development. Sociometric status may, therefore, be perpetuated for some children by eventual impairments in ToM. However, the limitations of the studies should be borne in mind and firm conclusions can not be drawn.

Peterson & Siegal (2002) identified 57 popular and 52 rejected children from a sample of 285 preschoolers aged 3 - 5 years using peer nomination. Interestingly, they also looked at the effects of having one stable, mutual friendship on children within both groups. Popular children scored significantly higher on false-belief performance than rejected children. Importantly, a stable mutual friendship was shown to be important for false-belief performance in both popular and rejected children. Of interest, there was no significant difference between popular and rejected children who scored above the median verbal mental age. However, rejected children scoring below the median were significantly worse than the popular children scoring below the median.

Finally, a study by Cassidy, Werner, Rourke & Zubernis (2003) examined the relation of social behaviour, as measured by several different means (see Table 2), and ToM. They found that verbal ability and ToM uniquely contributed to the prediction of sociometric rating of popularity, however the total amount of variance explained was modest. They also found that affective perspective taking predicted unique variance for receiving prosocial behaviour from peers. The results suggest that better ToM skills can result in being liked more by peers and receiving more prosocial responses from them.

Table 2

ToM, peer rejected children and popularity

Authors (Year)	Title	Age	N	ToM tasks used	Social behaviour/ Peer acceptance measure
Badenes et al. (2000)	Theory of mind and peer rejection	4-6y	313	Sally Ann (Wimmer & Perner, 1983) Deception task (Peskins, 1992) 12 strange stories (Happe, 1994)	Peer rated sociometric status (Arruga's, 1983) Pupil Evaluation Inventory (Pekarik et al, 1976) Self-concept questionnaire (Piers, 1977)
Cassidy et al. (2003)	The relationship between psychological understanding and positive social behaviours	3y1m-5y5m	67	False-belief (modified form Wimmer & Perner, 1983) Deception (adapted from Chandler, Fritz & Hala, 1989). Emotion state understanding: affective perspective taking (APT, Denham, 1986).	Teacher: Social skills rating system – Preschool Form (Gresham & Elliot, 1990). Peer rating sociometric status (Denham & Holt, 1993). Classroom observation.
McNab (2001)	Peer acceptance and theory of mind	4-5y	80	Social false-belief task (Nguyen & Frye, 1999)	Peer sociometric rating (Denham, McKinley, Couchoud, & Holt, 1990) Perceived Competence Scale for Children (Harter, 1979)
Peterson & Siegal (2002)	Mind reading and moral awareness in popular and rejected preschoolers	4y8m	109	Location task (adapted from Baron-Cohen et al., 1985). Misleading appearances of objects (false-belief)	Peer rated sociometric status (Coie & Dodge, 1983). Friendship interview (adapted from Gershman & Hayes, 1983 by Sanderson & Siegal, 1995)
Slaughter et al. (2002) - study 1	Theory of mind and peer acceptance in preschool children	4y5m-6y0m	78	2 unexpected contents (Gopnik & Astington, 1988) Conflicting emotion task Conflicting	Peer rated sociometric status (Coie & Dodge, 1983)

				desire task The Four Sweets task (Baron-Cohen, 1994)	
Slaughter et al. (2002) - study 2	Theory of mind and peer acceptance in preschool children	4y0m-6y7m	87	2 change in location (adapted from Baron-Cohen, Leslie & Frith, 1985) 2 unexpected contents (Gopnik & Astington, 1988)	Peer rated sociometric status (Coie & Dodge, 1983) Headteacher rated questionnaire - prosocial behaviour, aggressive behaviour and Machiavellianism (see later).
Watson et al. (1999) - study 2	Social interaction skills and theory of mind in young children	3y4m-6y11m	52	2 false-belief tests (adapted from Perner & Wimmer, 1987	Perceived Competence Scale for Children (Harter, 1979) – teacher rated
Watson et al. (1999) -study 1	Social interaction skills and theory of mind in young children	3y9m-6y8m	26	2 false-belief tests (adapted from Perner & Wimmer, 1987	Teacher rated social skills on 5 pt likert scale

Attention difficulties and behaviour problems

Attention difficulties in children vary in severity and some children have co-occurring difficulties with hyperactivity and impulsive behaviour, and thus can be diagnosed as having attention deficit hyperactivity disorder (ADHD; DSM-IV, 1994). Behaviour problems can be classified in different ways, for example children with disruptive or aggressive behaviour and children diagnosed as having conduct disorder (CD). DSM-IV criteria allow for differential diagnosis between groups, for example with ADHD and CD, but in clinical practice these difficulties often co-occur. In younger children there is much lower reliability of diagnoses and in terms of research, much broader categories have been identified, for example 'hard-to-manage' children (Hughes, Dunn & White, 1998) or 'at-risk-of-ADHD' children (Perner, Kain & Barchfield, 2002).

The relationship between ToM and attention difficulties and/ or behaviour problems has been studied in children from 2 - 18 years (see Table 3). Due to the continual development of ToM, researchers have used different ToM tasks depending on age. It was originally hypothesised that children with CD would have impaired or different ToM skills, possibly due to environmental influences (Happe & Frith, 1996). Indeed, it was thought that impaired ToM may account for their social difficulties as this had been found in children with autism (Happe & Frith, 1996). Of note from the literature already covered, Badenes et al. (2001) found that the total scores for the Strange Stories (Happe, 1994) correlated negatively with aggressive and socially withdrawn behaviour, but the presence of overt aggression was not related to poor performance on ToM. Cassidy et al. (2003) did not find a significant relationship between a problem behaviour score and ToM abilities.

Pre-adolescents

ToM was first studied in relation to behavioural problems in pre-adolescents with

CD. Happe & Frith (1996) investigated ToM in 18 children (16 boys and 2 girls)

with CD (satisfying criteria from DSM-IV; APA, 1994) aged 6 - 12 years. They used

a control group of 8 children aged 7 - 9 years of average ability. Participants were

matched for verbal mental age although the control group had a significantly higher

verbal IQ. All the children passed two standard first order false-belief tasks.

Happe & Frith (1996) also administrated the Vineland Adaptive Behaviour Scales

(VABS; Sparrow et al, 1984) with supplementary social and maladaptive items. Half

of the supplementary items were categorised as behaviours requiring mentalization

and half did not require this. The VABS indicated overall substantial social

impairment within the CD group. Interestingly, 10 out of 18 of the children with CD

scored poorly on the items requiring mentalization compared to only one child from

the normal group. This gives some evidence that the children with CD have some

impairment in mentalizing in their everyday lives. Of interest, children with CD most

clearly showed their mentalizing ability for antisocial behaviour, for example lying

and teasing and this led to Happe and Frith (1996) suggesting a *theory of nasty minds*

(see later).

Also researching pre-adolescents, Sutton, Reeves & Keogh (2000) looked at ToM

(Eyes Task, Baron-Cohen, 2001) in relation to disruptive behaviour and avoidance of

responsibility in a group of 11 - 13 year olds. They found that ToM was not

significantly correlated with disruptive behaviour, but that ToM was positively

correlated with a denial/ lack of remorse factor. In order to investigate the theory of

nasty minds they also examined correlations between the type of stimuli in the Eyes

Task (either positive, neutral or negative) correctly identified and an avoidance of

responsibility scale or a disruptive behaviour scale. No correlations were found.

Both of these studies suggest that ToM task performance is not impaired in pre-

adolescent children with behavioural difficulties. In fact, there is some evidence to

suggest that those with high scores on a denial/ lack of remorse factor have better

ToM skills. However, the studies both have weaknesses in their attempts to address

this question: Happe and Frith (1996) used first order false-belief tasks which every

child passed, hence a ceiling effect may have masked any differences in performance

between the two groups. Sutton et al. (2000) used a community sample rather than a

clinical sample and therefore none or few of the children may have been very

disruptive or avoidant of responsibility. Furthermore, there was a discrepancy

between the results found in these two studies, as Sutton et al. (2000) did not find

evidence for a bias in ToM skills as suggested by Happe & Frith's (1996) analysis of

teacher rated behaviours. It is possible to consider an alternative explanation for the

results found by Happe & Frith (1996) as they did not control for impaired language

skills and executive difficulties (often co-morbid with CD) and these factors may

account for the differences in teacher rated behaviours. Nevertheless, it is of

consideration that although not apparent through experimental testing, children with

behaviour problems may be different to others in their *everyday use* of mentalization

skills (Happe & Frith, 1996).

Fahie and Symons (2003) recruited 26 participants, aged 5 - 9 years, from a clinical

population and the children had a mixture of ADHD and behavioural problems.

Aggregated scores for ToM (see Table 3), executive function (EF) and behaviour

problems (parent and teacher rated) were made. After controlling for age, language and socioeconomic (SES) status, ToM was significantly related to all measures of EF. Parent and teacher ratings of social problems negatively related to ToM and EF. However, social problems and ToM were unrelated once overall EF was partialled out, whereas social problems and EF remained related after ToM was partialled out. In other words, ToM did not provide unique contributions above general executive skills. EF was found to be critical for social function, and a psychosocial impact was found on this. Interestingly, children with low SES had lower EF and ToM scores and it is suggested that further research is needed to look at this. The study also indicates the need to investigate and potentially control for EF when examining ToM in children with emotional and behavioural difficulties.

However, the study was limited by the younger children possibly performing at floor on the second-order false-belief tasks. Fahie et al. (2003) compared their results to other studies and estimated that the children in the study were delayed by about 2 years in their ToM performance compared to a community comparison group. The study would have benefited from a control group. It would also have been interesting to have looked at inter group differences, for example those with ADHD and those without, in order to gain more information about causal factors.

Pre-school age

Hughes and colleagues studied ToM in much younger children exhibiting some behavioural disturbance. Using a questionnaire they identified groups of children from a community setting who were labelled as 'hard-to-manage' using Goodman's (1997) Strengths and Difficulties Questionnaire (SDQ). Children with a classification

of 'hard-to-manage' scored above the 90th percentile on the hyperactivity scale and 80% of these children also scored above the 90th percentile for CD.

Forty children, aged between 3 ½ - 4 ½ years rated by parents as 'hard-to-manage' were compared with forty control children who were matched for age, gender, school and ethnic background (Hughes et al., 1998). With verbal ability taken into account, there was a small but significant delay in development of ToM in the hard-to-manage preschoolers. Additionally, an uneven profile of performance across story contexts was found (nice v nasty surprises). Hard-to-manage children were significantly more likely to pass a nasty story than a nice story. However, a significant proportion of each group passed neither story and so the statistical model used here involved very few numbers and the result should be interpreted cautiously. This result, if interpreted as a significant difference, could give evidence for a *theory of nasty minds* or it could be that it is an accurate reflection of these children's environments, in other words that they do expect a nasty surprise instead of a nice one. Interestingly, EF and ToM were associated only in the hard-to-manage group suggesting direct & indirect links between the two.

In a further study by Hughes, White, Sharpen & Dunn (2000), videotapes of children playing were transcribed for physical aggression, intimidating behaviour, rule-breaking, snatching, damage to toys, sexual behaviour, helpful actions and expression of positive and negative affect. Children also completed a battery of ToM (see Table 3), emotion understanding and EF tasks. The results showed that compared to the controls, the hard-to-manage group were significantly more likely to snatch, bully, tease, hurt a friend, damage a toy, or rule-break, but significantly less

likely to refuse to share and equally likely to engage in violent talk. Hard-to-manage children showed less empathetic/ pro-social responses to their friends. In the hard-to-manage group and in the control group there was no increase in explained variance in antisocial behaviour when scores on either ToM tasks or affective perspective taking tasks were entered into a hierarchical regression. Anti-social behaviour was predicted by performance on EF tasks in the hard-to-manage group. The results suggest that the inter-personal problems of hard-to-manage children are due to behavioural regulation difficulties rather than ToM.

It should be considered that these two studies do not use clinical samples. Whilst the classificatory group of 'hard-to-manage' may be useful for looking at differences in ToM, it should be noted that it has not been studied in terms of its reliability and validity in the same way as DSM-IV (APA, 1994) classifications have. It could be argued that aggression can be observed in all children and therefore it is viable to study it in community samples, but it may be that much larger studies are needed to detect group differences. An additional problem with the classification is that children were rated as 'hard-to-manage' due to attention and behaviour problems and this gives low specificity as to the cause of any differences found. Further still, the results may not be generalisable to everyday situations as the children were given novel, desirable toys and it is interesting that the most common behaviours recorded were snatching and not sharing; Hughes et al. (2000) suggested that the environment may have been provocative.

Using a similar age group, Spelz, DyKlyen, Calderon, Greenburg & Fisher (1999) found that when general vocabulary and test behaviour were controlled for, a clinical

sample of 80 boys aged 3 - 5 years meeting the criteria for Oppositional Defiant Disorder (ODD), with and without ADHD, had poorer vocabularies for affective states than controls. Although, this may not be a well recognised ToM task, it may reflect a similar ability. However, the study also highlights the need for increased specificity in measuring ToM; whilst the study yielded an interesting finding it is hard to compare this to other studies.

Until very recently, there has been no research on ToM and behaviour problems in toddlers. There may be a few reasons for this: the construct of ToM before false-belief tasks can be passed is not well defined, further still there are few validated ways to measure it, and in addition, it is difficult to reliably identify behavioural problems in this age group. However, Hughes & Ensor (2006) aggregated a score of behaviour problems for 127 toddlers, aged 24 - 36 months, using mothers' ratings of the attention-deficit/ hyperactivity scale from the SDQ, researchers ratings after a laboratory visit and by video-coding of non-compliance in a 5-minute mother-child tidy up. Three ToM tasks were used, looking at deception, pretence and awareness of mistaken beliefs. Hughes and Ensor (2006) also measured verbal ability, EF and harsh parenting. They found that harsh parenting, ToM deficits and verbal ability all predicted unique variance in behaviour problems. EF was only marginally significant in contributing to the variance. Harsh parenting and ToM interacted significantly in their effects on behaviour problems. Mean levels of behavioural problems were low for all children exposed to low levels of harsh parenting, but were raised for children with low ToM skills exposed to medium levels of harsh parenting and for children with low and medium ToM skills exposed to high levels of harsh parenting. The results may suggest that advanced ToM skills buffer young children against the

effects of harsh parenting. For example, Hughes & Ensor (2006) suggest ToM skills

may be protective against hypothesised 'coercive cycles of violence' (Paterson,

1981); it can be theorised that ToM skills enable these children to recognise and

anticipate others' thoughts and feelings. Replication and extension (e.g. a

longitudinal design) of this study is imperative as the results may have great

implications as they highlight just how important ToM can be to very young

children, especially those exposed to harsh parenting. The study suggests that

intervention programs should target ToM skill development in this vulnerable group

of children.

A focus on attention difficulties

Four of the studies in Table 3 have looked specifically at ToM in relation to attention

difficulties in children. As part of a study by Buitelaar, Van der Wees, Swaab-

Barneveld & Van der Gaag (1999; see Table 3), ToM performance was looked at

within a 'non-autistic psychiatric control group' which consisted of children with

either ADHD, CD or dysthymia. Planned comparisons showed that ADHD children

(n = 9) performed significantly worse than normal children on second order ToM

tasks. Those with CD or dysthymia (n = 11) were matched to their controls and no

group effect was found. However, it should be noted that during discriminant factor

analyses seven out of nine children with ADHD were placed within the Pervasive

Developmental Disorder (PDD) group and nine out of eleven with dysthmia or CD

were placed in the normal group. Indeed, many of the children with ADHD had

similar attentional problems to those with PDD. Therefore, although the study

suggests that children with ADHD perform differently on ToM tasks, the findings are

based on a very small sample of children with ADHD who had severe attention

problems. It is understandable that children with severe attention difficulties will perform badly on these conceptual tasks. Indeed, Perner et al. (2002) noted four children in their study as 'predominantly inattentive' (as compared to other children) and found that these children had significantly more difficulties on ToM tasks.

Out of 234 children that Perner et al. (2002) recruited, 24 were rated by teachers and parents as 'at risk of ADHD', using a lenient classification of hyperactivity (requiring the identification of 8 items in contrast to 16 needed for standard classification), impulsivity and /or attention deficit. This classification may be advantageous as ADHD often goes undiagnosed in pre-school years when activities are play-based and less structured than at school (Perner et al., 2002). They found no significant difference between the 'at risk of ADHD' and a control group's ToM scores. However, it should be noted that all children (except those with low IQs) were at ceiling on first order false-belief tasks. Additionally, the design had little power as a small sample size was used initially and a further 6 participants were dropped from analysis of group difference (due to missing data) leaving only 18 in the at-risk-of ADHD group.

It should be noted that many of the studies above had more male than female participants and Charman, Carroll & Sturge (2001) only included male participants. The boys satisfied criteria for ADHD combined disorder (DSM-IV) and hyperkinetic disorder (ICD-10), but children comorbid for CD were excluded. There was no significant difference between the ADHD group and controls in ToM scores (Strange Stories, Happe 1994), although it was noted that this could have been due to a ceiling effect. Importantly, the children were given one to one support in order to complete

the tasks as this is known to help them concentrate. This level of structure or support is unrepresentative of their usual circumstance in the outside world and could account for the lack of correlation between ToM in the clinic to social behaviour outside. Whilst it is a methodological challenge to research this, it will be important to find out if children with ADHD have specific difficulties in applying their ToM skills.

Sodian and Hulsken (2005) endeavoured to do this by including the Epistemic State Attribution Task (ESAT). The ESAT requires online representation of mental states with conflicting behavioural outcomes and high inhibitory demands. This can therefore be viewed as a more naturalistic test of ToM. They recruited 32 children with ADHD and 101 controls aged 6 - 11 years and administered a second order false-belief task, the Strange Stories (Happe, 1994) and the ESAT. They found no significant differences between the two groups on second-order false-belief or the Strange Stories, consistent with Perner et al. (2002) and Charman et al. (2001), but there was a significant group difference on the ESAT. This may be a more appropriate task to use, tapping into the difficulties in ToM which would be expected in this group.

Whilst there is minimal evidence of group differences on first and second order false-belief tasks, it is fascinating that in a study using a more naturalistic ToM task, children with ADHD do not perform as well as controls (Sodian & Huskan, 2005). The more traditional ToM tasks may not pick up the difficulties which children with ADHD have in mentalizing on a daily basis. Indeed, Charman et al. (2001) found a correlation between social skills and ToM performance in a control group, but not in

an ADHD group who were rated by their parents to be less socially competent. A second, interesting finding from these studies is the relationship between ToM and EF; significant correlations were found between ToM and EF (Perner et al., 2002), but some children were significantly impaired on EF tasks in relation to ToM (Perner et al., 2002; Charman et al., 2001), providing evidence for dissociation between these two skills. The research may also suggests that attention difficulties affect ToM ability differently at different ages; studies looking at younger children found evidence of associations, whereas the evidence is mixed in studies with older children. It may be that EF skills are very important for ToM in young children, but as the influence of other factors becomes more important (e.g. peer relationships and interactions with others) the association between EF and ToM weakens. Indeed, Fahie et al. (2003) found that a scatterplot suggested that ToM and EF may be more strongly related for younger children than older children.

A note on aggressive behaviour

Aggression is generally thought to arise from deficiencies or biases in social information processing (Crick & Dodge, 1994). When considering behaviour problems and aggression, it is imperative to incorporate into our thinking research about different types of aggression. Much research has been carried out to distinguish different types of aggression (see review by Coie & Dodge, 1998), for example instrumental versus bullying, relational versus physical and reactive versus proactive. *Reactive* and *proactive* aggression are useful terms in order to make a distinction between 'hot-headed' aggressive reactions and aggression which is pre-planned. In considering this difference, it seems immediately obvious that the ToM skills involved may be different. It may be predictable that children with CD or who are

physically aggressive towards others (typically reactive aggression) will be different

to children using proactive aggression, for example, those who bully verbally or

children described as Machiavellian. This may account for the evidence that some

children with behavioural problems (for example CD) have impaired ToM skills and

some children (for example bullies) may have superior ToM skills. Additionally, it is

useful to consider the possibility of a developmental shift in ToM use in aggression

as there is a general trend from direct to indirect aggression with age (Rivers &

Smith, 2004, cited in Sutton, Smith & Swettenham, 1999b).

Bullying

Bullying is recognised as a serious problem which threatens the emotional wellbeing

and academic achievement of children. Head-teachers throughout the UK have a

duty to have an anti-bullying policy in their schools (dfES, 2007). Whether there are

individual differences in ToM between children playing different roles within a

bullying system is not just an important research question, but has important

potential implications for interventions.

When considering children who bully, it seems prudent to consider two types of

bully; a physically aggressive bully and a more calculating, indirect bully. An intact

ToM seems important for both types of bully in order to avoid detection, but one can

hypothesise that the more verbal, indirect bully who causes more subtle suffering

through relational methods may have a sophisticated ToM and show a superiority in

these skills. It makes sense that this type of bullying (spreading rumours,

undermining people etc) requires good hypothesising about others thoughts, beliefs

and desires. Indeed, evidence for this notion comes from studies on social

intelligence (related to ToM) by Kaukiainen and colleagues (Kaukiainen et al., 1996, 1999; Bjorkqvist et al., 2000) who have found positive relations between indirect aggression and peer-rated social intelligence.

Only two studies have looked at ToM in bullies (see Table 3). Sutton, Smith and Swettenham (1999) used an adapted version of the Participant Role Scale (Salmivalli et al., 1996) as a self/peer nomination interview relating to role in bullying. This derives *bully, assistant, reinforcer, defender, outsider* and *victim*. They used 11 short stories to assess ToM (from Happe, 1994) and emotion understanding (Sutton, unpublished). Teachers also completed questionnaires on type of bullying and motivation to bully. Age and verbal ability were controlled for. *Bullies* scored significantly higher on the stories than all the other groups (*victims, assistants* and *reinforcers*) involved in the bullying process, but not the *outsiders*. Additionally, *bullies* scored higher than *assistants* and *reinforcers* on the emotion stories. The correlation between teacher rated bullying and ToM was not significant. Neither was there a significant correlation between physical bullying and ToM, however a positive correlation between teacher-rated verbal bullying and ToM was found. This supports the notion of ToM being linked to relational or indirect bullying, but not to physically aggressive bullying.

Monks, Smith & Swettenham (2005) investigated the social cognitive abilities, executive function skills and attachment profiles of 104 children aged 4 - 6 years who were classified as *aggressors, victims* and *defenders*. They found no significant difference between groups on ToM or deception tasks and, hence, did not replicate the findings of Sutton et al. (1999).

Sutton (2003) persuades his reader to think of anti-social behaviour as social

behaviour with its own set of goals and motivations such as winning over new

friends. He suggests we consider emotional understanding, empathy,

Machiavellianism, social competition, self-esteem and reputation-enhancement

strategies when considering bulling.

Machiavellianism (Mach)

A person described as Machiavellian (Mach) believes that others can be manipulated

and actively engages in manipulative, exploitive behaviour for his or her own

personal gain (Wilson, Near & Miller, 1996, cited in Repacholi, Slaughter, Pritchard

& Gibbs, 2003). Mach adults are described as successful manipulators, successful

persuaders, better at situations in which they need to steal, lie or cheat and are rated

as more intelligent and charming (see Repacholi et al., 2003). The relationship

between bullying and Mach is currently a focus of research. For example Sutton and

Keogh (2000) found that children who identified themselves as bullies had

significantly higher Mach scores than control children. Indeed it is questioned by

Repacholi et al. (2003) whether a distinction between bullies and Machs can actually

be made.

In order to be a successful Mach it makes theoretical sense that you would have a

well-functioning ToM as you must out-wit others in order to manipulate them,

influencing another's thoughts, feelings and behaviour (Repacholi et al., 2003). One

study in Table 3 has looked at ToM and Mach.

Repacholi and Gibbs (2000; cited in Repacholi et al., 2003) investigated

interrelations between Mach, ToM, attributional style, and empathetic disposition in

9 - 12 year olds. 137 children completed a scale measuring Mach in children and

those at either end of the scale were categorised as low Mach (n = 27) and high Mach

(n = 29). The high Machs had significantly higher social desirability scores. With

language, verbal fluency and gender controlled for, there was no significant

difference between high and low Mach groups in their overall ToM or empathy.

Interestingly, the high Mach group produced more negative intent attributions than

the low Mach group in the non-verbal measure of ToM and were more likely to

predict negative outcomes in the vignettes.

In a study reported earlier in this review (see Table 2), Slaughter et al. (2002) also

looked at the relations between scores on a newly developed Mach scale for children

and verbal ability, ToM, aggressive and pro-social behaviours and sociometric status.

With verbal ability controlled for, Mach scores were negatively correlated with

prosocial behaviour and positively correlated with aggression scores. However, there

was no relation between ToM and Mach scores. Mach scores were not correlated

with social preference scores (indicating how well liked they are) but were with

social impact scores (indicating how noticed they are).

Slaughter et al. (2002) conclude that Mach is a 'distinct interpersonal behavioural

style that develops separately from the cognitive requisite - ToM – that supports it'.

However, the measure and classification of Mach can be criticised in both studies.

The first study used a community sample in which high Machs were classified in

relation to the rest of the group and may therefore not have been particularly

Machiavellian at all. In addition, it would have been useful to have included a control group of average children with which to compare those scoring high and low on the Mach scale; it is not clear if children scoring either high or low on Machiavellianism are both average or superior mind readers. It is possible that both of these groups have superior skills which they use for different purposes. It is unclear what exactly was measured by the Mach scale in the second study as Machiavellianism has not been investigated in children this young before and it was completed by teachers and so reflects behaviour rather than the subjective attitudinal components important of the Mach construct.

Both studies support the hypothesis that children scoring highly on Mach have intact ToM skills, but do not show superior skills. However, a second hypothesis proposed is that high Machs have a specific quality to their ToM, for example a cognitive bias (e.g. Dodge, 1993) or theory of nasty minds (Happe & Frith, 1996). Some support was gained for this as high Machs were more likely to report another's behaviour to include trickery, selfishness or rejection and were more likely to predict that situations were likely to lead to negative outcomes (Repacholi & Gibbs, 2000).

A third hypothesis suggests that Machs may have a lack of emotional arousal which fails to inhibit antisocial behaviour and therefore high Machs can readily apply their mind reading skills to obtain their own objective at the expense of other people (Repacholi et al., 2003). Indeed, evidence for this is suggested by a link between Machiavellianism and a subclinical form of psychopathy. Research suggests that those with psychopathy have intact ToM skills (Blair et al., 1996) but impoverished skills in empathy (e.g. Blair, 1995). Empathizing can be thought of as the emotional

response to another's mental state and can explain why people are typically inhibited from acting antisocially towards others once they have used ToM skills to infer how another person may think or feel. Blair and colleagues have described 'moral socialization', which develops due to the aversive experience most people encounter when they cause distress to another. It is of interest that evidence has been generated to show that behavioural disturbance is related to performance on a moral/conventional distinction task (Blair, Monson & Frederickson, 2001). However, it should be noted that neither of the studies reported here found evidence of a lack of empathy in those children with higher Mach scores. Repacholi et al. (2003) suggest that high Machs may not lack empathetic affect but instead may be better at regulating such feelings. This might be particularly pertinent if they were to interfere with personal goals or it may be that achievement of personal goals produces a positive affect which outweighs any negative feelings. Machs may also use reasoning to justify their actions and therefore limit remorse or guilt.

Finally, a fourth hypothesis would indicate that whilst high Machs have average ToM skills they may choose to use them in specific ways.

What is the evidence for a theory of nasty minds?

The 'theory of nasty minds' suggested by Happe and Frith (1996) was proposed to account for adept mentalization for antisocial behaviour by children with CD. The theory would suggest that some children are biased towards making negative interpretations of others' thoughts or intentions and that they develop better ToM skills for making interpretations of antisocial behaviour. The theory is supported by the findings that children with conduct disorder tend to attribute intentions coming

from other children in aggressive situations as hostile (Dodge, 1993). In a study

reviewed here, Badenes et al. (2000) looked at the percentage of aggressive biases in

answers given for Happe's (1994) Strange Stories. The percentage of aggressive

biases was significantly higher for the aggressive boys (54%) compared to average

boys (33%) and popular boys (13%). Some evidence for this theory was also found

in the study by Hughes et al. (1998). However, other studies have not found a bias,

for example Buitellar et al. (1999) and Sutton, Reeves and Koegh (2000).

Ronald et al. (2005) investigated the theory of nasty minds further in a twin study.

They proposed two models to account for ToM. The 'interaction' model

hypothesises ToM as a single ability, 'which interacts with individual differences in

temperament to produce a variety of behaviours that vary between children'. The

'alternative' model is that 'Nice ToM and Nasty ToM are two distinct cognitive

abilities, with possibly distinct developmental trajectories, and distinct aetiologies'.

Ronald et al. (2005) used twin pairs to investigate nice (prosocial) and nasty

(antisocial) behaviours which either did or did not require ToM as rated by their

mothers. Using exploratory factor analysis four factors were yielded and it was

proposed that these related to prosocial and antisocial behaviour necessitating ToM,

and prosocial and antisocial behaviour not necessitating ToM. Bivariate analyses

indicated somewhat distinct aetiological influences on Nice ToM versus Nasty ToM.

They question if this reflects interactions between ToM and temperament or two

underlying genetic and cognitively distinct ToM abilities.

It seems important to investigate the use of ToM for prosocial and antisocial acts

across all different children. A reasonable conclusion may be that children are

exposed to ToM skills used primarily for one or the other use and this is likely to influence their developing skills in ToM (i.e. if they are better at using it for prosocial or antisocial behaviour). This may develop a bias or it could be regarded as an adaptive response reflecting the child's world, for example where most interactions are hostile, such as peer rejected children or those exposed to harsh parenting.

Individual use of ToM

It is important to consider that many factors may influence how an individual *chooses* (whether consciously or unconsciously) to use their ToM skills, including motivation and possible gains, and inhibitory responses such as moral socialisation and empathy. The notion of intra-individual differences (Keenan, 2003) is important, as it seems plausible that the use of ToM skills will fluctuate according to situations or type of interaction. In some contexts or relationships it has been found that children are more likely to mentalize and at deeper levels (e.g. O'Connor & Hirsch, 1999). Indeed, motivation for both prosocial and antisocial use of ToM will vary greatly according to the situation and context. Emotions and affect regulation appear very important in this regard and other factors such as fatigue, mood or stress are likely to affect one's ability to apply ToM skills. The relationship between stress, affect regulation and mentalization has been studied in much detail and it is widely thought that stress affects one's ability to mentalize. Indeed it is considered that some people will have lower thresholds for 'switching off mentalization', for example those traumatised in childhood (Fonagy, 2006).

Table 3

ToM and attention and behaviour difficulties

Authors (Year)	Title	Clinical population/ control group	Age	N	ToM tasks used
Buitelaar et al. (1999)	Theory of mind and emotion recognition functioning in autistic spectrum disorders and in psychiatric control and normal children	Children were categorized as having either autistic disorder, pervasive developmental disorder (PDD)-not otherwise specified, non-autistic psychiatric controls and normal. Specifically they compared those with ADHD and psychiatric controls.	8y-18y	80	6 First order tasks: Picture sequencing measure (Baron-Cohen et al. 1985) Appearance Reality (Baron-Cohen, 1989), Mental-physical distinction (Baron-Cohen, 1989), Concept of the brain (Baron-Cohen, 1989) M&Ms false-belief task (Perner, Frith, Leslie & Leekham, 1989) Sally-Ann (Baron-Cohen et al. 1985). Second order task: based on Perner & Wimmer (1985).
Charman et al. (2001)	Theory of mind, executive function & social competence in boys with ADHD	ADHD + Control group	8y9m 9y0m	22+ 22	Strange stories (Happe, 1994)
Fahie & Symons (2003)	Executive functioning and theory of mind in children clinically referred for attention and behaviour problems	ADHD and Behavioural problems – recruited through a clinical setting	5-9y	26	Mistaken identity & contents task (Gopnik & Astington, 1988) 2 unintended transfer tasks (adapted from Wimmer & Perner, 1983) Emotional false-belief task (Harris et al., 1989)
Happe & Frith (1996)	Theory of mind and social impairment in children with conduct disorder	Conduct Disorder	6y-12y	18	The Smarties test (Perner et al. 1989) A version of the Sally-Ann task (Baron-Cohen et al, 1985; Wimmer & Perner, 1983)

					VABS and extra items relating to mentalization in everyday life
Hughes & Ensor (2006)	Behaviour problems in 2 year olds: links with individual differences in theory of mind, executive function and harsh parenting.	Behaviour problems	2y	127	Deception-penny hiding game (Baron-Cohen, 1992; Hughes et al., 1998) Pretence-elicited pretend play (Fein, 1975) Awareness of mistaken beliefs (Moerbeek, 1994; Hughes et al., 1998)
Hughes et al. (1998)	Trick or treat?: Uneven understanding of mind and emotion and executive dysfunction in 'hard-to-manage' preschoolers	Hard to manage and controls	3y6m - 4y6m	40+ 40	Can't sleep book (Moerbeek, 1994) False-belief (Bartsch & Wellman, 1989) One-box puppet deception game (Sodian & Frith, 1992) Penny-hiding game (Baron-Cohen, 1992) An emotion understanding task (Denham, 1986)
Hughes et al. (2000)	Antisocial, angry and unsympathetic: 'hard-to-manage' preschoolers' peer problems and possible cognitive influences	Hard to manage	Mean 4y4m	40+ 40	Can't sleep book (Moerbeek, 1994) False-belief (Bartsch & Wellman, 1989) One-box puppet deception game (Sodian & Frith, 1992) Penny-hiding game (Baron-Cohen, 1992) An emotion understanding task (Denham, 1986)
Monks et al. (2005)	Psychological correlates of peer victimization in preschool: social cognitive skills, executive function and attachment profiles	Bullying	4y-6y	104	Deceptive box task (Perner et al. 1987) Unexpected transfer task (Baron-Cohen et al, 1985) Second-order false-belief task Deception task (Sodian & Frith, 1992)
Perner et al. (2002)	Executive control and high-order theory of mind in children at risk of ADHD	At risk of ADHD and control group	4y6m - 6y6m	234	Joke/Lie (Leekham, 1991) Second order false-belief (based on Perner & Wimmer, 1985)

Repacholi & Gibb, (2000)	Machiavellianism in children: Is it related to empathy, social-cognitive ability and parenting? As cited in book	Machiavellian	9y-12y	137	Non-verbal measure of ToM – card sorting (Langdon & Coltheart, 1999) Verbal mind reading task (coding based on O'Connor and Hirsch, 1999).
Ronald et al. (2005)	Nice and nasty theory of mind in pre-school children: nature and nurture	Twins Early Development Study	2y 3y 4y	5195 5436 6427	Questionnaire filled in by mothers about prosocial and antisocial behaviour that do or do not necessitate ToM.
Slaughter et al. (2002)	Theory of mind and peer acceptance in preschool children	Mach	4-6y	87	2 change in location (adapted from Baron-Cohen, Leslie & Frith, 1985) 2 unexpected contents (Gopnik & Astington, 1988)
Sodian & Huskan (2005)	The developmental relation of ToM and executive functions: a study of advanced ToM abilities in children with ADHD.	ADHD + Control group	6y-11y	32 101	Second order false-belief (adapted from Perner & Wimmer, 1985) Strange stories (Happe, 1994) Epistemic state attribution task
Sutton et al. (1999)	Social cognition and bullying; social inadequacy or skilled manipulation?	Bullying	7y-10y	193	Short stories to assess ToM (from Happe, 1994) and emotion understanding (Sutton, unpublished).
Sutton et al. (2000)	Disruptive behaviour, avoidance of responsibility and theory of mind	Disruptive behaviour	11-13y	81	Eyes task (Baron-Cohen)

Internalizing disorders – anxiety and depression

Dunn (1995) initially looked at false-belief understanding in children aged 40 months in relation to self-reports of negative experiences in kindergarten two years later. Correlations between ToM and negative experiences were found and it was also shown that these children were more sensitive to teacher criticism. A small sample size was used and so Dunn and colleagues investigated the finding further.

Cutting & Dunn (2002) looked at individual differences in sensitivity to teacher criticism and ToM in 141 children aged 4 - 5 years. ToM was measured during pre-school and in their first year at school. They found that individual differences in children's sensitivity to criticism were correlated with both time measurements of ToM, but in particular, it was related to ToM performance during pre-school. The children's emotional response to criticism was not predicted by ToM, however the likelihood of them saying that they were good at an activity ('ability rating') after being criticized was predicted by ToM performance. Ability rating is thought to measure most directly the child's self worth after criticism; children with better ToM rated themselves with significantly lower ability following criticism. Cutting and Dunn (2002) suggest that this immediate negative consequence of superior ToM following criticism, may in fact have long term positive consequences if, as a result, children work harder and learn more. However, an alternative hypothesis is that these children develop a frail sense of self as their well developed ToM makes them better at taking on board criticism before their sense of self is developed. Longitudinal research looking at outcome is warranted.

recently ToM deficits have been linked to an increased risk of relapse of major

depression (Inuoe, Yamada & Kanba, 2006) and therefore perhaps investigation of

this in children is warranted.

Much interesting research has been carried out looking at mentalization in adults

with long term mental health problems, for example borderline personality disorder

(e.g Bateman & Fonagy, 1994) and psychosis (e.g. Langdon & Coltheart, 1999).

Risk and resilience factors in children are studied by developmental

psychopathologists and it is worth highlighting that insecure and disorganised

attachments, and childhood trauma are known risk factors (amongst others) for

mental health problems in adulthood. Research with these at risk children will be

extremely useful and the potential implications hugely important.

Table 4

ToM and internalizing problems

Authors (Year)	Title	Clinical/ non-clinical problem	Age	N	ToM task used
Banjeree & Henderson (2001)	Social cognitive factors in childhood social anxiety: preliminary investigation	Social anxiety	USA: 6.4-11.1 y UK: 8.2-9.2 y	63	Standard 2nd order false-belief (Sullivan, Zaitchik & Tager-Flusberg, 1994) Faux pas (O'Riordan et al. 1996) Explanations for deceptions
Cutting & Dunn (2002)	The cost of understanding other people: social cognition predicts young children's sensitivity to criticism	Teacher criticism	4.4-5.7 y	141	TIME 1: False-belief: Four unexpected location (based on Bartsch and Wellman (1989) Two unexpected contents tasks, (based on tasks by Harris, Johnson, Hutton, Andrews & Cook, 1989). The 'Can't sleep' task from Hughes et al., 1998). Emotion understanding: affective perspective taking (Denham, 1986) and an interview. TIME 2: 1st and 2nd order false belief (Sullivan, Zaitchik & Tager-Flusberg, 1994) Emotion understanding: mixed emotions
Dunn (1995)	Children as psychologists: The later correlates of individual differences in understanding of emotions and other minds.	Negative experiences at school and teacher criticism	3y4m	46	Unexpected change (Bartsch & Wellman, 1989)

Conclusions and Future research

Is there evidence that individual differences in Theory of Mind relate to emotional and behavioural difficulties in children?

There is emerging evidence that individual differences in ToM may be associated with children's social, behavioural, attention or emotional problems. There is some evidence that less popular children score lower on ToM tasks and that this may be particularly true for girls, children without a stable, mutual friendship and older children. It seems that girls may consider ToM skills, or the behaviours supported by these skills, in others more important when choosing friends and that these become more important for both girls and boys as they get older. There is some evidence that young children with behavioural problems have impaired ToM, although other research has not found this. Research has suggested that older children with behavioural problems and/ or attention problems do not show impairment on most experimental ToM tasks. However, there is some evidence that these children score lower on more naturalistic ToM measures and this may indicate that they have some impairment with everyday use of ToM. As children get older, indirect aggression (e.g. relational bullying) becomes prevalent in schools and there is some, but limited evidence that indirect aggression is associated with superior ToM skills. It is also suggested that people described as Machiavellian may have superior ToM skills, but this is yet to be shown empirically. Evidence also suggests associations between ToM skills and anxiety/ sensitivity to criticism in young children. However, from the research thus far, it would be imprudent to draw fixed conclusions. Some of the findings are far from robust and is some cases they may be confounded by other factors, such as verbal ability or executive function. Nevertheless,

it seems that some evidence does suggest that ToM ability and the application of ToM can be associated with various childhood difficulties and disorders and the development of adult mental health problems.

There are a number of avenues for further research. Firstly, investigating ToM in relation to other problems in childhood, for example, depression is warranted. Secondly, longitudinal research looking holistically at children's emotional development would be of great interest, to determine if advanced ToM skills are advantageous, at what ages and for which children. There is evidence that children with less well developed ToM may experience peer rejection, are less protected from harsh parenting and are more likely to be victims of bullying. On the other hand, it is suggested that a more developed ToM may cause more negative experiences at school and leave you more vulnerable to the effects of criticism. This research has clinical implications: ToM training has been suggested for school age children lacking ToM skills (e.g. Slaughter et al., 2002) and educational implications: Denham (2006) suggested that ToM skills could be an indicator of school readiness.

Thirdly, future research is warranted to look at everyday use of ToM in relation to emotional and behavioural difficulties in children. A major limitation of the research thus far is the measurement of ToM and further research will require the development of standardised measures of ToM with good validity and reliability. In particular, there is a demand for more naturalistic tasks of ToM to be developed. Two essential differences between an experimental task and real life performance are that ToM is normally used 'online' and in a context of motivation. Indeed, Sullivan & Winner (1993) found that

some children who failed a false-belief task, could pass a similar task involving a real life trick, in other words when the child was motivated and actively involved in tricking the researcher. Tasks should reflect everyday use of ToM for both prosocial and antisocial means and therefore could involve cooperation or competition. One idea is to create computer games involving ToM decisions or use virtual reality to devise situations in which these skills are required.

Fourthly, the nature of relationships between ToM and emotional and behavioural problems is not straightforward; studying individual ToM development within the context of other skill development is likely to prove important, for example in relation to executive function or empathy.

Fifthly, some research is moving away from looking at whether certain children perform well or badly compared to controls on ToM tasks, but differences are being investigated with regard to specific use of these skills, for example for prosocial or antisocial purposes. It is suggested that children with emotional and behavioural difficulties may use ToM skills differently and that this may be a consequence of genetic and environmental factors. The study of children described as Machiavellian suggests further research of other personality or temperament traits in relation to ToM skills and an individual's use of them.

Finally, further research looking at intra-individual differences, considering the application of ToM by an individual in different contexts is warranted. Crucially, this literature review suggests a difference between ToM competence and ToM performance

in everyday situations. Figure 1 depicts the influence of genetic, cognitive and environmental factors upon ToM ability, but also illustrates that ToM performance may, in addition, be influenced by other factors. Consequently, the model is an attempt to bring together information and ideas about the influences on ToM ability and performance. Whilst, there is growing empirical evidence about the genetic, cognitive and environmental effects on ToM ability, less is known about the factors that affect ToM application. It is suggested in Figure 1 that empathy, social moralisation, personality, affect regulation and social information processing biases are all likely to affect an individual's ToM use. Whilst some research has investigated the relationship of these factors to ToM, this has primarily focused on concrete ToM ability rather than everyday ToM use; further research investigating ToM use is warranted. The situational factors listed in Figure 1 are also likely to be influential on ToM performance, for example the individual's relationship to the person in question, motivation, mood, fatigue or stress. Investigating these factors is an exciting line of research, for example it is widely recognised that there is a link between stress and mentalization (e.g. Fonagy, 1999), but this has only been empirically tested once using ToM tasks (Blair, Granger & Razza, 2005). The model therefore brings together current understanding of the influences on ToM ability and suggests avenues of future research with regard to ToM use. It is possible that by investigating these factors in relation to ToM performance, a greater understanding of the relationships between ToM and emotional and behavioural difficulties can be developed.

Figure 1

A model of individual use of ToM[1]
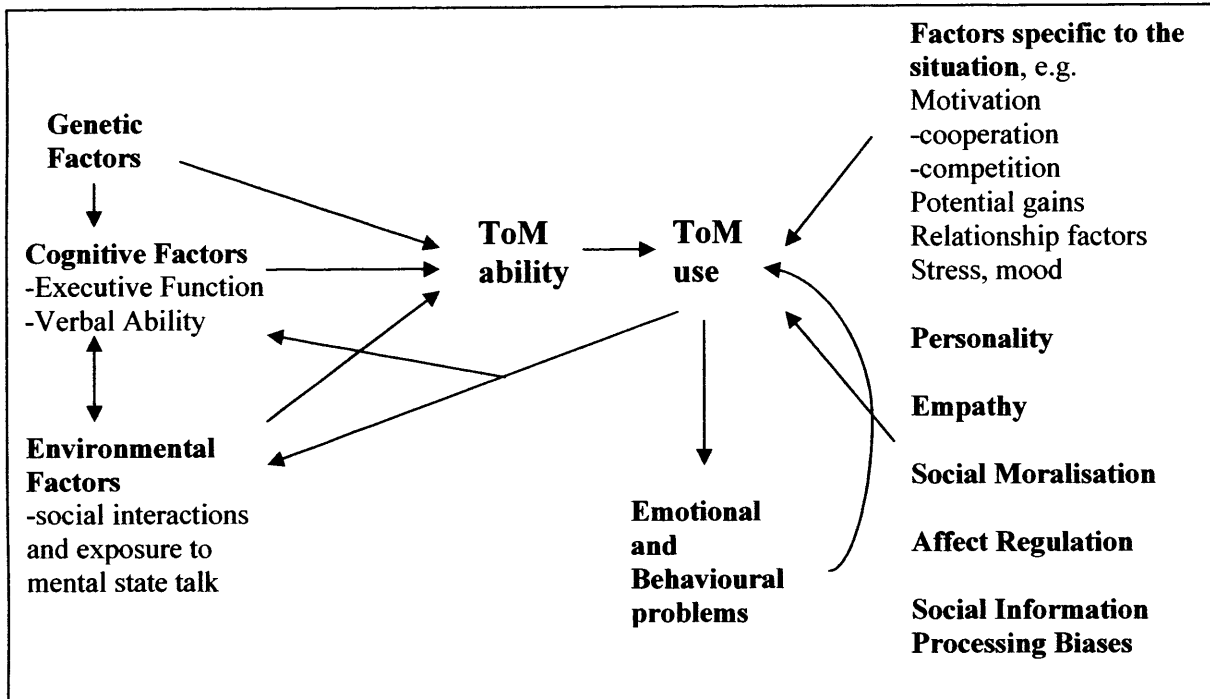
The implications of finding out more about ToM use in childhood and the associations with emotional and behavioural problems are hugely important and bear relevance for working clinically with such children. Assessment approaches, therapy and preventative strategies using ToM are implemented clinically, for example Short Term Mentalizing and Relational Therapy (SMART; Fearon et al., 2006) and in tackling bullying in schools (Twemlow & Fonagy, 2006). Identifying factors which affect this important ability may help the development of strategies to improve the lives of many children and their families.

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[1] The diagram depicts how ToM may mediate a relationship between genetic and environmental factors and emotional and behavioural difficulties. It is assumed that there are many other factors contributing to the development of such problems even though these are not depicted.

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PART 2

EMPIRICAL PAPER

STRESS, THEORY OF MIND AND EMOTIONAL AND BEHAVIOURAL DIFFICULTIES IN PRE-ADOLESCENT CHILDREN

Abstract

This study examined the effects of a social stressor on Theory of Mind (ToM)

performance as mediated by cortisol reactivity. An experimental between groups design

was used, in which 9 - 11 year old children were randomly allocated to either a social

stress (N = 50) or control condition (N = 27). The stress intervention consisted of the

Trier Social Stress Test for Children (TSST-C; Buske-Kirschbaum, 1997) whilst the

control intervention involved a series of functionally similar tasks that did not involve

social stress. Physiological reactivity was measured at two time points (pre and post

intervention) as indicated by salivary cortisol concentration. ToM performance was

assessed using the Strange Stories task (from Happe, 1994) and the Eyes Test (Baron-

Cohen et al., 2001) immediately following the intervention. There were no differences in

salivary cortisol between the stressed and control groups post-intervention. The salivary

cortisol means followed diurnal variation in both groups and decreased. No group

difference in ToM performance was found. However in the stressed group, post- TSST-

C cortisol was an independent predictor of ToM performance on the Strange Stories

task. Cortisol reactivity and ToM performance were also examined in relation to

problem scores on the Child Behaviour Checklist (Achenbach, 2001), but no

associations were found. The results are discussed within the context of the study's

limitations and the potential implications of a relationship between stress and ToM are

considered. Further research is required investigating the effects of stress on ToM and

the links to emotional and behavioural difficulties.

Introduction

Recent research has shown much interest in individual differences in Theory of Mind (ToM), the factors which influence these differences and the resulting consequences. In addition, research is starting to look at factors which affect the application of ToM in a given situation. Stress is known to affect a variety of cognitive processes and is predicted here to affect ToM performance. The rationale for the present study will be presented by briefly reviewing ToM literature, the effects of stress on cognition, individual differences in stress physiology and how stress and ToM may relate to emotional and behavioural difficulties.

Theory of Mind (ToM)

ToM is the understanding of the self and others by reference to mental states (thoughts, beliefs and feelings) and is critical in predicting emotions and behaviour (Frith, Morton and Leslie, 1991). It is a remarkable and high-level capacity which is automatic and an almost exclusively human ability. Classically, the acquisition of ToM is observed experimentally in 4 year old children who begin to pass false-belief tasks, for example, deceptive container tasks (e.g. Perner, Leekham & Wimmer, 1987). These tasks demonstrate a child's understanding that someone else may hold a different belief to their own or that they themselves may hold different beliefs at different times. The development of ToM can, however, be argued to begin well before this age and it clearly continues to develop throughout childhood, into adolescence and adulthood. Some evidence has been gained that suggests a genetic influence (Hughes & Cutting, 1999), although in a larger study Hughes et al. (2005) found a negligible genetic influence on 5-year-old's mentalization skills. Certainly, environmental effects are substantial and it is

thought that there are bi-directional relationships between social experiences and ToM skills (see Hughes & Leekham, 2004 for a review). ToM has been associated with attachment security (Fonagy, 2001) and maternal sensitivity to the child's mental state (Meins, Fernyhough, Fradley & Tuckey, 2001). Other factors such as number of siblings (e.g. Peterson, 2001), cultural differences (e.g. Vinden, 1996) and socio-economic status (Hughes et al., 2005) have been associated with variation in ToM. A common factor to these environmental influences may be exposure to mental state talk (Symons, 2004). ToM development and ability is linked to other cognitive abilities, namely verbal ability and executive function. Impairments in ToM have been linked to autism (Baron-Cohen et al., 1985) and more recently, there has been interest in individual differences in ToM and how these may relate to other emotional and behavioural difficulties in children. For example, research has been carried out with children with conduct disorder (Happe & Frith, 1996), attention deficit hyperactivity disorder (ADHD; Charman, Carroll & Sturge, 2001; Perner, Kain & Barchfield, 2002; Sodian & Hulsken, 2005), those rejected by their peers (e.g. Badenes, Estevan & Bacete, 2000), children with anxiety (e.g. Cutting & Dunn, 2002) and those involved in bullying (e.g. Sutton, Smith and Swettenham, 1999). Some evidence has been gained to suggest that children with emotional and behavioural problems may differ in ToM ability and their application of it. This is further supported by research with adult clinical populations (e.g. Bateman & Fonagy, 2004; Langdon & Coltheart, 1999). However, much research is compromised by difficulties intrinsic to measuring ToM skills as experimental ToM tasks may not reflect everyday use. ToM is used in the context of relationships, which requires the consideration of competition, co-operation and potential gains. It is likely that previous experiences, personality factors and empathy all play a considerable role in an

individual's use of ToM in any given situation. Some research has been carried out

looking at intra-individual differences (e.g. O'Conner & Hirsch, 1999) and this is

thought to be a key area for research so that we can begin to understand more about

everyday use of ToM (Keenan, 2003). It is expected that other factors affect an

individual's use of ToM at a given time. Stress is a likely candidate for this.

Acute stress, cognition and theory of mind

It is well known that stress is influential in children's development and can cause both

immediate and long term effects. It is plausible that chronic stress could affect ToM

development (see Fonagy, 1999) and that acute stress could affect the application of

ToM at a given time. Stress is known to affect other cognitive processes; at low levels

stress can have an enhancing effect on cognition, but greater or uncontrollable stress

effectively takes the prefrontal cortex (PFC) offline as survival mode takes over

(Arnsten, 1998).

The hypothalamic-pituitary-adrenocortical (HPA) system is the core neuroendocrine

system of the stress response and it produces the glucocorticoid hormone cortisol.

Cortisol mediates a range of basal metabolic and stress-sensitive processes in the body

(Watamura, Donzella, Kertes, & Gunnar, 2004). HPA reactivity to stress is adaptive; an

increase in cortisol mobilizes the organism's resources to meet challenges when needed,

but a negative feedback loop ensures cortisol down-regulation when challenges have

been met (Erickson, Drevets, & Schulkin, 2003). The HPA response affects frontal

processes and is known to affect a variety of cognitive functions. The effects of

glucocorticoids on cognition follow an inverted U-shaped curve (Lupien & McEwen

1997), and whilst very high levels have an adverse effect on cognition, very low levels are also associated with impairments. It follows that a medium level of glucocorticoids result in optimum performance, hence a moderate increase in cortisol has an enhancing effect on cognitive processes.

The effect of stress on executive function (EF) is of particular interest as ToM and EF are empirically linked. Two studies have looked at the relationship between cortisol levels and EF in children, and both studies found that higher cortisol levels were associated with better EF performance (Blair, Granger & Razza, 2005; Davis, Bruce & Gunner, 2003). However, large increases in cortisol have been shown to impair EF in animal studies and in pharmacological studies with adults. For example, the experimental administration of exogenous glucocorticoids has been found to interfere with frontal process such as inhibitory control, attention regulation and planning (Young, Sahakian, Robbins & Cowen, 1999). Psychological stress has been shown to impair attentional inhibition in adults (Skosnik, Chatterton, Swisher & Park, 2000). Although, Skosnik et al. (2000) did not find a group increase in cortisol levels after a stressor, they found that cortisol levels after the stressor were associated with attentional inhibition. Additionally, the effects of stress on memory retrieval, a related cognitive process, have been researched much more intensely and it has been shown that induced stress can raise cortisol levels and have an adverse effect on memory retrieval (e.g. Kuhlmann, Piel & Wolf, 2005). Furthermore, teacher ratings of inattention in children with ADHD have been associated with noradrenaline, another marker of stress (Anderson et al., 2000).

The effect of stress on social cognition has been given less attention and only one study

has looked at the effect of stress on ToM. Blair et al. (2005) looked at the effects of

cortisol reactivity on EF and ToM in four and five year old children. A moderate

increase in cortisol was positively associated with measures of EF and self-regulation,

but not with emotion knowledge or false-belief understanding. Further research is

warranted using more advanced measures of ToM, capable of detecting individual

differences as false-belief tasks can only be scored as right or wrong. Good examples of

ToM tasks that yield a range of scores are the Eyes Test (Baron-Cohen, 2001) and the

Strange Stories (Happe, 1994). In addition, stress was induced by the child working with

an unknown adult and it may be advantageous to use a more robust stress induction

procedure.

One reason to expect an effect of stress on ToM performance is that there are empirical

links between ToM and EF (e.g. Carlson & Moses, 2001; Carlson, Moses & Claxton,

2003; Ozonoff et al., 1991). Indeed, there is a developmental shift in both ToM and EF

around 4 years of age and at this age ToM and EF are correlated (Hughes, 1998).

Opposing theories have suggested that executive control is necessary for ToM and that

ToM is necessary for executive control. It has also been suggested that there is

interdependency between the two skills (see Perner & Lang, 1999, for a review). There

is evidence that stress can enhance or impair executive function and it is hypothesised

that there will be a similar effect on ToM. However, it should be noted that there is some

evidence that suggests dissociability between ToM and EF in children with ADHD (e.g.

Perner & Lang, 2002) and those who are deaf (see Peterson, 2003). Therefore, it is

possible that stress could affect EF and ToM independently.

A second reason to expect an effect of stress on ToM performance comes from literature

on mentalization, a term which can be used interchangeably with ToM. Relationships

between affect regulation, capacity to maintain focused attention and understanding

mental states in one's self and others, are argued to be central features for working

'closely and collaboratively with other minds' (Fonagy and Target, 2002). It is argued

by these authors that stress and the ability to regulate emotions have consequences for

mentalization ability. Mentalization is said to act as a 'buffer' when other's reactions are

unexpected, allowing auxiliary hypotheses to be created as a way of explaining

behaviour. It is hypothesised that under stress the ability to make these hypotheses fails,

hence implicating the impairment of mentalization type processes (Fonagy, 1999).

It may be that acute stress affects ToM/ mentalization due to compromised EF abilities,

for example attention control or it is possible that this occurs through a domain specific

mechanism. Functional magnetic resonance imaging (fMRI) studies are starting to

isolate specific brain areas involved in ToM. Many studies have consistently found

activation of the anterior paracingulate cortex, the superior temporal sulci and the

temporal poles bilaterally during tasks of theory of mind (see Gallagher & Frith, 2003).

Recently, Vollm et al. (2005) found activation in the medial prefrontal cortex,

temporoparietal junction and temporal poles to be common to both ToM and empathy.

They also found increased activation for ToM stimuli, compared to empathy stimuli in

the lateral orbitofrontal cortex, middle frontal gyrus, cuneus and superior temporal

gyrus. Many of these areas are likely to be stress sensitive; the prefrontal cortex (PFC) is

often described as being 'offline' in times of stress (e.g. Arnsten, 1998) and

glucocorticoids affect the functioning of the PFC, including the anterior cingulate cortex (e.g. Karreman & Mogahaddam, 1996).

Early experiences, chronic stress and stress physiology

A number of studies have shown individual differences in cortisol levels and cortisol reactivity. It seems that early experiences may influence these differences. For example, sensitive and responsive care-giving in which a child is helped to regulate emotions and stress will result in HPA development which responds to stress appropriately and which is able to regulate itself efficiently. For example, it has been shown that children with secure attachments have lower cortisol reactivity to a novel situation (e.g. Van Bakel & Riksen-Walraven, 2004). In contrast, hyper- or hypo- cortisol activity have been documented in a variety of high-risk and clinical populations, including those who have suffered maltreatment, post traumatic stress disorder and institutional rearing (Gunnar & Donzella, 2002). Chronic activation of the HPA axis has been shown to adversely affect the development of brain structures and neural systems known to be important for the regulation of the stress response (Francis, Caldji, Champagne, Plotsky, & Meaney, 1999). For reasons that are not well understood, the resulting effect can be either very high or very low levels of cortisol.

Those with higher cortisol levels and reactivity are likely to be more vulnerable to the effects of stress on cognition. Indeed, Fonagy (2006, pp. 87) suggested that individuals who have suffered from trauma or abuse have lower thresholds for the switching off of mentalization due to stress. It is also possible that those with lower cortisol levels and hypo- reactivity will not benefit from the positive effects of mild stress on cognition.

Links to emotional and behavioural difficulties

As discussed previously, there are theoretical and some empirical links between ToM

and emotional and behavioural difficulties. There are also theoretical and empirical links

between stress and emotional and behavioural difficulties. Indeed, chronically elevated

stress levels are known to be associated with problems of physical and mental health

(McEwen, 1998). Prolonged elevation of cortisol levels can cause low mood, depression,

and cognitive impairment (Schmidt, Fox, Goldberg, Smith & Schulkin, 1999;

Wolkowitz et al., 1990). Robust findings indicate elevated HPA axis in adults with

depression and this has also been found in children (Luby et al., 2003). Similar results

have been found in other clinical populations, for example adolescents with conduct

disorder (McBurnett, Lahey, Rathouz & Loeber, 2000). However, less is known about

how these three variables relate together. Does ToM play a mediating role between

stress and emotional and behavioural difficulties?

Stress, ToM and emotional and behavioural difficulties

There are theoretical and empirical grounds to hypothesise that ToM function may be

affected by physiological arousal and stress. Therefore, this study investigated the

effects of a social stressor on ToM performance. An adapted version of The Trier Social

Stress Test for Children (TSST-C; Buske-Kirschbaum, 1997) was used in order to

induce a stress response in a group of children. The TSST-C has been shown to induce

physiological stress responses in children, including an increase in salivary free cortisol

(Buske-Kirschbaum et al., 1997; Buske-Kirschbaum et al., 2003; Dorn et al., 2003;

Kudielka, Buske-Kirschbaum, Hellhammer & Kirschbaum, 2003). Salivary cortisol

levels within the *stressed* group and performance on two ToM tasks immediately

following the stressor are compared to a *control* group. To the authors knowledge, a between groups design using the TSST-C and a control group has not been carried out before. Additionally, individual differences in cortisol levels following the stressor are analysed in relation to ToM performance in the *stressed* group.

Hypotheses

It is predicted that the TSST-C will negatively affect performance on the ToM tasks. This is consistent with theory from the mentalisation literature which indicates that stress impairs mentalisation (Fonagy, 1999). It is also based upon empirical evidence that psychosocial stress can affect cortisol levels in association with impairment in frontal processes (e.g. Kuhlmann et al., 2005; Skosnik et al., 2000). It is therefore hypothesised that:

1. There will be a significant difference in ToM performance between a *stressed* group and a *control* group. It is predicted that the *stressed* group will not perform as well on the ToM tasks as the controls.

2. Stress reactivity (as measured by salivary cortisol) will be correlated with performance on the ToM tasks. It is predicted that higher cortisol levels after the stressor will be associated with lower ToM scores.

However, it is worth noting that the direction of the effect on ToM performance is contingent on the levels of the stressor. Based on the inverted U-shaped curve, it is conceivable that the effect may be in the opposite direction and that small increases in cortisol levels may be associated with higher ToM scores.

The relationship between stress reactivity, ToM performance and emotional and behavioural difficulties is also investigated. Investigation of these hypotheses is exploratory as there is not conclusive evidence to support predictions. It is hypothesised that ToM performance is affected by stress and that ToM performance mediates a relationship between stress reactivity and emotional and behavioural difficulties. It is therefore hypothesised that:

3. Stress reactivity (as measured by salivary cortisol) will be related to emotional and behavioural difficulties.

4. Performance on the ToM tasks will be related to ratings of emotional and behavioural difficulties.

5. ToM performance will mediate the relationship between stress reactivity and emotional and behavioural difficulties (this will depend upon the relationships in hypotheses 3 and 4 being found).

Method

Overview

A stress response was induced in 50 children using an adapted version of the TSST-C, (Buske-Kirschbaum et al., 1997) and was measured by cortisol determination of saliva samples (-pre and -post TSST-C) and subjective rating (Visual Analogue Scale; VAS). ToM performance during the experimental manipulation was measured using the Strange Stories (Happe, 1994) and the Eyes Test (Baron-Cohen, 2001). A control group of 27 children was used. Demographics were collected and parents completed the Child

Behaviour Checklist (CBCL; Achenbach, 2001). The research was carried out as part of

a joint project (see Fairbairn, J. *Stress, cortisol and executive function in pre-adolescent*

school children).

Participants

77^2 (44 female and 33 male) children were recruited from nine inner city London

primary schools. All children in Year 5 (a total of 379) from these schools were invited

to take part and a short presentation was made to each class. All children taking part in

the research were entered into a raffle to win a family cinema ticket. The mean age of

the participants was 10 years and 1 month (range: 9; 4 – 11; 1). Demographic

information was returned by 66 of the children and, for the majority was completed by

mothers (82%). Of the children who returned forms, 67% (N = 44) lived with at least

two adults and 79% (N = 52) lived with at least one sibling. Fifty two respondents

completed information about household income: 36.5% (N = 19) of families reported an

income of less than £10,000 per annum, 50% (N = 26) reported between £10,000-

£40,000 and 13.5% (N = 17) reported more than £40,000. 29.5% (N = 18) respondents

reported being unemployed, 37.7% (N = 23) reported one adult in the household being

employed and 32.8% (N = 20) reported two adults being employed. The ethnicities of

the participants are shown in Table 1.

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[2] In terms of statistical power: Kuhlman et al. (2005) found a significant difference in cortisol levels
between conditions (TSST and control) in a repeated measures design with 19 participants. It was decided
that this should be the minimum number in each group. Few studies are relevant when considering
correlational analyses between cortisol levels and ToM in the stressed group, however Skosnik et al.
(2000) found a correlation of .47 between cortisol levels 20 minutes after a stressor and attentional
inhibition. Therefore a medium to large effect size was expected and this study was designed to detect an
effect size of .4 and above with 80% power at alpha = .05; this required 51 participants in the stressed
group.

Table 1

The ethnicity of participants

Ethnicity	N (%)
White UK	19 (24.7%)
White other	5 (6.5%)
Black or Black British – Caribbean	6 (7.8%)
Black or Black British – African	7 (9.1%)
Asian or Asian British – Indian	1 (1.3%)
Asian or Asian British – Bangladeshi	15 (19.5%)
Asian or Asian British – other	3 (3.9%)
Mixed	7 (9.1%)
Other	2 (2.6%)
Missing data	12 (15.6%)

The children were randomly allocated to either the *stressed* or *control* group by the researchers who were blind to information about them. Two children were dispatched by their teacher at any given time and they were consecutively allocated to either the *stressed* or *control* condition. In order to maintain a 2:1 ratio (of *stressed*: *control* participants), a cycle was used: two *stressed* conditions followed by two sets of one *stressed* and one *control* condition. The mean age and gender for each group is shown in Table 2.

Table 2

Age and gender of participants in each group

	Stressed		Control	
	N	Mean age (years; months)	N	Mean age (years; months)
Males	23	10; 2	10	10; 1
Females	27	10; 0	17	10; 1
Total	50	10; 1	27	10; 1

Ethics

Ethical approval was gained from UCL Research Ethics Committee (see Appendix B). Informed consent was gained from the children and their parents/ guardians (see Appendix C). The ethical concern about inducing a stress response was considered throughout testing. At the beginning of the testing session, the children were reminded that some tasks would be difficult and they were asked if they still wanted to take part. They were informed that they could withdraw from the study at any time. During the testing session, the children's reported stress was closely monitored using a visual analogue scale. After large increases in stress, the children were asked if they still wanted to carry on. The children were debriefed at the end, given specific praise about what they had done well and invited to play a fun game before returning to class.

Design

A between groups design was used. The two groups were *stressed* (N = 50) and *control*

(N = 27). A larger proportion of children were assigned to the *stressed* group so that

regression analysis could be carried out within this group.

Measures

Theory of mind performance:

1. The Strange Stories

A revised version of the Strange Stories test (Happe, 1994; Happe, Winner & Brownell,

1999; Brent, Rios, Happe & Charman, 2004) was used. The test consisted of eight

theory of mind (ToM) stories and five physical control (PC) stories. The ToM stories

assessed participant's understanding of lies, white lies, double bluff, persuasion and

misunderstanding. Correct performance required the ability to identify the underlying

intention of the character. The PC stories assessed the participant's understanding of a

physical or practical reason for a character's behaviour. The PC stories were included so

that non-ToM task performance of the SS-ToM stories, for example verbal competence,

could be controlled for during analysis. Each story and question was read aloud to the

participant and the story sheet was left in front of them to minimise memory loading (see

Appendix D for verbal instructions). The order of presentation was counterbalanced;

either the PC or ToM stories were read first. Each child's answers were recorded

verbatim at the time of testing. The stories were rated on a 0 - 2 point scale as full and

explicitly correct (2), partial or implicitly correct (1), or incorrect (0) according to

criteria used in previous research. (For examples of stories, answers and scoring see

Appendix E). A subset of 15 answer sheets were rated by a second rater. Kendall's Tau

correlation coefficients were calculated for each question. The range of co-efficients for 10 of the stories was .76-1.00. For three of the stories there was not enough variance to compute reliability, but overall Pearson's r correlation coefficients for the calculated total scores of the PC stories (.87) and ToM stories (.79) was considered satisfactory.

2. The Eyes Test

A version of the Eyes Test for children and adolescents (Baron-Cohen et al., 2001) was used which has normative data for children between 6 - 12 years old (Baron-Cohen, Jolliffe, Mortimore & Robertson, 1997). It consists of black and white photographs of male's and female's eyes. Participants were required to choose out of four options which word best describes what the person in each photograph is thinking or feeling (for example, hate, surprised, kind or cross). (See Appendix D for verbal instructions and Appendix F for an example). There is one practice item and 28 test items. Correct answers are scored as 1 and the maximum score is 28.

Brent et al. (2004) found significant differences, with large effect sizes, between typically developing children and children with autistic spectrum disorder on the SS-ToM and Eyes Test, but not the SS-PC. Gender differences have also been found on versions of the Eyes Test, with males typically scoring lower then females (e.g. Baron-Cohen, Joliffe, Mortimore & Robertson, 1997).

Child Behaviour Checklist (CBCL)

The CBCL is a questionnaire designed to quantify children's problems and competencies in a standardized way (Achenbach, 2001). The CBCL rated by parents for 6-18 year olds

was used. Parents were asked to complete items relating to problem behaviours, indicating whether and how often a specific behavior has occurred on a 3-point scale (0-2). Factor analysis has derived syndrome scales and second factor analysis has grouped these scales together into broader bands, labelled 'Internalising' (*anxious/ depressed, withdrawn/depressed* and *somatic complaints*) and 'Externalising' (*rule-breaking behaviour* and *aggressive behaviour*). Internalising, externalising and total problem scores were computed and converted into T-scores using an Assessment Data Management Program (Achenbach, 2003). Normative data are available for the various syndrome scores, separately for boys and girls at ages 6-11. The reliability and validity of the parent version of the CBCL have been demonstrated in many studies in North America and other cultures (see Achenbach, 2001).

SAT score for reading

Current Standardised Assessment Test (SAT) scores of reading ability were obtained from the teacher of each child. Optional SATs and teacher assessments are undertaken routinely throughout Key Stage 2, including Year 5. Children's attainment is assessed and monitored using SAT scores. The majority of children in Key Stage 2 are expected to work at levels 2 – 5; by age 11 (the end of Key Stage 2) children are expected to reach level 4 (National Curriculum Online, 2007). Within each level there are three bands that ascend c, b, a. Participants scores ranged from 1a to 5b and the median score was 4c. For analysis, these scores were converted to a numerical scale ranging from 1-15.

Cortisol determination

Participants used a polypropylene straw and ultra pure polypropylene Salicap® to produce two samples of saliva. These samples were frozen (below -20°C) and then sent to IBL Hamburg where competitive chemiluminescence immunoassay (ILA) was used to determine cortisol levels. This was measured in ug/dL. IBL-Hamburg cortisol in saliva ILA has high analytical sensitivity (0.16 ng/mL), good specificity, precision and linearity (IBL Hamburg, 2006).

Visual Analogue Scale (VAS)

Participants rated their mood on a 10 point VAS at five time points during the procedure (see Appendix G). On the scale, 1 was labelled as 'Very calm and relaxed' (and was depicted with a smiley face) and 10 was labelled 'Very stressed and not at all relaxed' (and was depicted with a worried face).

Procedure

The children were randomly assigned to the *stressed* or *control* group and to one of two researchers. Each child was seen for approximately one hour. All testing sessions were carried out in the afternoon due to diurnal variation in cortisol; it was planned for the sessions to start at 13.15 and 14.15. Due to factors outside of the author's control this was not always possible, but all subjects started testing between 13.00 - 13.30 or 14.00 - 14.30. Typically, two children took part at the same time (one with each researcher). They were collected from their classroom or playground and asked to have a sip of water.

After a brief introduction, the children were asked to spit some saliva into the Salicap® (Pre-TSST-C cortisol level) and to rate their mood (VAS Time 1).

An adapted version of the TSST-C (Buske-Kirschbaum et al., 1997) was given to the *stressed* group. A recent meta-analysis (Dickerson and Kemeny, 2004) identified that social-evaluative threat in combination with uncontrollability is associated with the largest cortisol increases in laboratory experiments. The TSST-C is designed to incorporate both of these factors. The test involves telling a story and mental arithmetic in front of adults. The test was adapted by shortening it, only one adult witnessed the child's performance, no video equipment was used and an anticipatory stressor was also included. Recently, HPA activation has been shown to correlate with anticipatory stress appraisal (Gaab, Rohleder, Nater & Ehlert, 2005) and this was included to maintain physiological arousal during the procedure. To the author's knowledge, the TSST-C has not been used before in a between group design, alongside a control group although the adult version of the test has been conducted using a repeated measures design (e.g. Kuhlman, Piel & Wolf, 2005). A protocol was designed to keep the procedures for the *stressed* and *control* group very similar, the difference being the influence of social stress on the experimental group. The *control* group completed the same tasks, but did not have to perform these tasks in front of the researcher. In addition, they were not given the anticipatory stressor.

A description of the procedure is given here (see Appendix D for a transcript). The researcher informed the children that they should listen carefully to a story so that they

could make up an ending for it. In the *stressed* group it was emphasised that this would be in front of the researcher, that the child would need to stand up and that the story had to be really good and 'better than the other children's'. In contrast, the children in the *control* group were told that they would need to think about their story, but would not need to tell the researcher at all. The *stressed* group were given two minutes to *prepare* their story, whilst the *control* group were asked to *think* about their story in this time. The *stressed* group were then asked to stand up and tell their story out loud. They were asked to keep telling their story for three minutes and were prompted to continue if they stopped at any time. In contrast, the *control* group was asked to draw or write down some of their story, but were told that the researcher would not be looking at their work. Immediately afterwards both groups were asked to do some mental arithmetic for three minutes, counting backwards from 758 in 7's; a task recommended for children aged between 9 to 11 years (Buske-Kirschbaum et al., 1997). The *stressed* group were told to remain standing and were asked to complete the arithmetic out loud, as fast and as accurately as possible. On every mistake they were asked to start again. The *control* group were told that it was another thinking task, for them to do inside their heads and that they would not need to share their answers. When the task finished the children in the *stressed* group were told that they should not forget their story and that they would be asked some more about their story, or asked to do some more maths at the end of the testing session. They were reminded of this between each of the following ToM and EF tasks. Both groups of children were asked to rate their mood (VAS Time 2).

The children then completed the two ToM tasks and an EF task (not reported here). The order of presentation of the tasks was counterbalanced within the *stressed* and *control*

groups and between researchers within each group. Twenty minutes after the end of the TSST-C (usually between the second and third task) the child was asked for a second saliva sample and to rate their mood (VAS Time 3). Previous research shows that it takes approximately twenty minutes for cortisol levels to peak post-stressor (e.g. Buske-Kirschbaum et al., 2003). They then continued with the tasks.

After all three tasks had been completed, the child was asked to rate how they were feeling (VAS Time 4). Children in the *stressed* group were asked if they would like to say anything else about their story. They were then told that they would not be asked any further questions about their story or any further maths. All the children were praised for their efforts and it was acknowledged that some of the tasks were supposed to be hard. Every child was given an example of something they did well. The children were then invited to play a short game, before returning to class. After this game, the children rated their mood (VAS Time 5) to ensure that they were not left feeling distressed. Further praise and thanks were given to the children and they were given the opportunity to ask any questions.

Data Analysis

ANOVAs and t-tests were used to look at group differences in salivary cortisol and performance on the ToM tasks. In order to examine individual differences, correlations were carried out between the measures of cortisol and performance on the ToM tasks in the *stressed* group only and followed up where applicable using regression analysis. To test the hypotheses that emotional and behavioural difficulties would be associated with both cortisol and ToM, correlations were performed. It was also hypothesised that ToM

would mediate a relationship between stress and emotional and behavioural difficulties. For this to be the case there would need to be a significant effect of cortisol on problem scores and ToM would need to act as a mediator, adding significant independent variance to that already accounted for by the cortisol variables (Baron & Kenny, 1986), hence it was anticipated that regression analysis would be carried out if the relevant, significant correlations were found.

Results

Overview

Prior to analysis of the data, information on missing data and normality of the variables is included. Before investigating group differences in ToM performance, the groups are examined in terms of demographics, salivary cortisol (pre-TSST-C and post-TSST-C) and subjective ratings of stress (VAS). The descriptive data for the ToM tasks are then presented and group differences are analysed. In order to investigate individual differences in the *stressed* group, correlations and regression analyses are carried out. Finally, data from the CBCL problem scales are presented and the ability to predict these scores from salivary cortisol and ToM performance in the *stressed* group is investigated.

Missing data

Data are missing for Strange Stories – physical condition (1 participant), CBCL scores (18 participants), ethnicity (12 participants), income (25 participants) and SAT score (1 participant).

Data screening

The data were inspected for normality and outliers before any analysis proceeded. Tests of skew and kurtosis indicated that the cortisol data and Eyes data (*control* group only) were not normally distributed. The cortisol data both pre- and post- TSST-C were positively skewed in both the *stressed* and *control* groups and so a square root transformation was applied. For one case in the *stressed* group, the transformed post-TSST-C data was 4.37 standard deviations from the mean and when a 'change in cortisol' variable was created, this case had a value that was 4.02 standard deviations from the mean. There was no clear cut strategy for reducing the data for this case and so the cortisol data for this case was removed. The Eyes data had an outlier in the *control* group ($z = 3.39$) and this was reduced to within one unit of the nearest value. The transformed data were used for analysis using parametric tests.

Preliminary analysis

A preliminary analysis of the two groups was carried out to determine if there were any confounding differences between the two groups prior to looking at differences in cortisol, ToM scores and CBCL scores. The two groups, *stressed* and *control,* were not significantly different in terms of SAT scores, age, gender, ethnicity or income (see Table 3).

Table 3

Descriptive statistics for the stressed and control groups

	Stressed Mean (SD)	*Control* Mean (SD)	•
SATs (N = 76)	9.72 (2.34)	9.46 (2.45)	$t_{(73)} = .45, p = .65$
Age (N = 77)	121.38 (4.23)	120.85 (4.59)	$t_{(75)} = .51, p = .61$
	N	N	
Gender (N = 77)			
-males	23	10	$X^2_{(1)} = .58, p = .45$
-females	27	17	
Ethnicity (N = 65)			
-white	17	7	$X^2_{(1)} = .98, p = .32$
-non-white	24	17	
Income (N = 52)			
-<£20,000	18	11	$X^2_{(1)} = .16, p = .69$
->£20,000	13	10	

The two groups showed differences in their subjective ratings of stress during the procedure. Figure 1 shows the estimated marginal means as measured by the VAS. A repeated measures ANOVA looking at the 5 time points showed a main effect of time $(F_{(1,75)} = 13.30, p < .01)$, group $(F_{(1,75)} = 6.98, p = .01)$ and a significant interaction $(F_{(1,75)} = 19.96, p < .01)$. Post hoc analysis showed that there was a main effect of time in both groups.

Figure 1

VAS ratings throughout the testing sessions
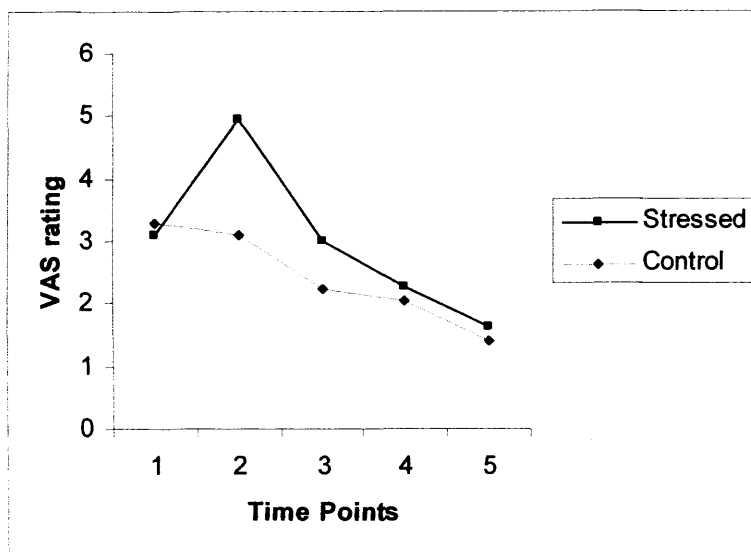
However, in the *control* group there were no significant difference between times 1 and

2 whereas in the *stressed* group there was; VAS rating at time 2 (x = 4.94) was

significantly higher than at time 1 (x = 3.10). Times 1 and 2 are of particular interest as

they show subjective ratings of stress before and immediately after the TSST-C.

Pairwise comparisons, using Bonferroni adjustments, indicated significant differences

between the groups at time 2 ($F_{(1, 74)}$ = 20.35, p < .01) and time 3 ($F_{(1, 74)}$ = 4.57, p = .04),

but not at time 1 ($F_{(1, 74)}$ = .28, p = .60), time 4 ($F_{(1, 74)}$ = .38, p = .54) and time 5 ($F_{(1, 74)}$ =

1.06, p = .31).

Analysis of salivary cortisol

The transformed cortisol data were then analysed to determine if there were any

differences between the two groups, in other words to determine if there was a group

effect of the TSST-C. Descriptive data for the non-transformed salivary cortisol data are shown in Table 4. A repeated measures ANOVA showed a main effect of time (pre- vs post- TSST-C) ($F_{(1, 74)}$ = 4.93, p = .03); cortisol levels were greater pre-TSST-C (x = .25) than post-TSST-C (x = .22). There was no significant difference between the *stressed* and *control* groups ($F_{(1, 74)}$ = .11, p = .75) and no interaction with time point ($F_{(1, 74)}$ = 1.12, p = .29).

Table 4

Descriptive statistics for original salivary cortisol data in the stressed and control groups.

	Stressed Mean (SD) (N = 49)	*Control* Mean (SD) (N = 27)
Pre-TSST-C Cortisol (μg/dL)	.24 (.13)	.26 (.12)
Post-TSST-C Cortisol (μg/dL)	.23 (.13)	.21 (.09)

The potential influences of demographic variables were then examined. A series of repeated measures ANOVAs showed that there were no significant interacting effects with time or group of the following dichotomous variables: gender, ethnicity (white and non-white), income (below £20,000 and above £20,000) or hour of testing (1 O'Clock and 2 O'Clock). However, a main effect of hour of testing was found ($F_{(1, 72)}$ = 11.82, p < 0.01); the 2 O'Clock group (x = .42) had lower mean cortisol than the 1 O'Clock group (x = .50). An interaction was found between which researcher conducted the session and time ($F_{(1, 72)}$ = 4.76, p = .03), indicating that there was a steeper decline overall in cortisol of participants working with one researcher. Age was also entered as a

covariate and a significant interaction with time was found ($F_{(1, 73)} = 5.71$, $p = .02$). This suggested that younger participants did not have as large a decrease in cortisol levels as older participants did. In fact there was a three way interaction between time point, age and group ($F_{(1,72)} = 6.53$, $p = .01$) and this indicated that younger children in the stressed group had higher cortisol levels at post-TSST-C measure, but not in the control group. This indicates that the *stressed* condition was more effective at inducing stress in younger children than in the older children.

No significant correlations were found between the VAS ratings and cortisol data (pre-TSST-C, post-TSST-C and percentage change) in the *stressed* group or the *control* group.

Investigation of group differences in theory of mind performance

In order to test the hypothesis that stress affects ToM performance, group differences in ToM were investigated. The mean scores and standard deviations are given for total scores of the Strange Stories – physical control (SS-PC), Strange Stories – Theory of Mind (SS-ToM) and the Eyes Test in Table 5.

Table 5

Descriptive statistics for ToM measures

	Stressed Mean (SD) (N = 50)	*Control* Mean (SD) (N = 27)
Eyes (max = 28)	17.96 (2.72)	17.59 (2.10)
SS – PC[a] (max = 10)	5.26 (2.19)	5.46 (1.79)
SS – ToM[b] (max = 16)	11.70 (2.27)	11.56 (2.67)[c]

[a] SS-PC – Strange Stories Physical Control score

[b] SS-ToM – Strange Stories Theory of Mind score

[c] N = 26

Using independent samples t-tests, no significant group differences were found for SS-PC ($t_{(74)}$ = -.40, p = .69), SS-ToM ($t_{(75)}$ = .25, p = .80) or Eyes ($t_{(75)}$ = .61, p = .54). Percentage correct scores were calculated for both SS story types. A repeated measures ANOVA indicated an effect of story type ($F_{(1,74)}$ = 71.15, p < .01). Mean percentage correct on the PC stories was lower (53.6%) than the ToM stories (72.7%). However, there was no interaction of this with group ($F_{(1,74)}$ = .38, p = .54).

The order of presentation of the tasks was examined in order to determine if this had an effect on performance. Two way ANOVAs looking at the effect of order of presentation and group showed no significant differences for the Eyes, SS-ToM or SS-PC tasks and no interactions.

A series of univariate analyses of variance looking separately at Eyes, SS-ToM and SS-PC showed that there were no significant main or interacting effects of gender, ethnicity, income or researcher. An effect of hour of testing was found on SS-PC scores ($F_{(1,72)} =$ 5.35, p = .02). Those being tested at 1 O'Clock (x = 5.69) tended to perform higher on this task than those tested at 2 O'Clock (x = 4.71). Hour of testing had an interacting effect with group on SS-ToM ($F_{(1,73)} = 4.30$, p = .04). Simple main effects showed that the control group performed significantly worse in the 2 O'Clock testing slot (x = 10.33) than in the 1 O'Clock testing slot (x = 12.53), but there was no significant difference in the stressed group.

Predicting ToM performance in the stressed group

The heterogeneity of the cortisol responses after the TSST-C are of interest, even though a significant mean group difference in cortisol levels between the *stressed* and *control* group was not found. Potential relationships between cortisol levels and ToM performance were therefore investigated within the *stressed* group. Pearson r correlations were carried out between the measures of ToM, cortisol, age, and SAT scores and are presented in Table 6 for descriptive purposes. It should be noted that significant results should be interpreted with caution as the probability of Type 1 errors is higher when many correlations are carried out.

Table 6

Correlations among variables in the stressed group

	SS-ToM[b]	SS-PC[a]	Eyes	Age	SATS	Pre-TSST-C cortisol
SS-PC[a]	.51**					
Eyes total	.29*	.02				
Age	.09	.28	-.08			
SATS	.20	.45**	.10	.14		
Pre-TSST-C cortisol	-.15	.03	.00	.29*	-.08	
Post-TSST-C cortisol	-.32*	.08	.02	-.18	.15	.48**

* significant at p = 0.05

** significant at p = 0.01

[a] SS-PC – Strange Stories Physical Control score

[b] SS-ToM – Strange Stories Theory of Mind score

It should be noted that the correlation between SS-ToM and post-TSST-C cortisol (see Table 6) is increased when SS-PC is controlled for in a partial correlation ($r = -.41$, $p < .01$). This may represent more clearly the association between post-TSST-C and the mentalizing component of the Strange Stories task.

In order to investigate the relationship between SS-ToM and salivary cortisol further, regression analysis was carried out, controlling for SS-PC, SAT score and hour of testing. Overall, the regression was significant ($F_{(5, 47)} = 4.91$, $p < .01$). Pre-TSST-C cortisol, post-TSST-C cortisol, SS-PC, SAT score and hour of testing accounted for

36.9% of the variance in SS-ToM scores (see Table 7). The independent effect of post-TSST-C cortisol was significant; it was indicated that lower cortisol post-TSST-C was associated with higher SS-ToM scores (β = -.42, p = .01).

Table 7

Regression equation predicting SS-ToM scores (n = 47), R^2 = .37

	B	SE	β
Pre-TSST-C cortisol	.69	2.58	.04
Post-TSST-C cortisol	-7.05**	2.48	-.42
SS-PC	.48**	.14	.48
SAT score	.04	.13	.04
Hour of testing	-.26	.62	-.06

** significant at p < .01

Predicting CBCL problem scores from salivary cortisol and ToM performance

It was hypothesised that ToM would be related to problem behaviour scores and that furthermore, ToM would mediate a relationship between salivary cortisol and problem behaviour scores. Prior to testing these hypotheses, the mean scores and standard deviations for computed T scores for the CBCL problem scales in both the *stressed* and *control* groups are shown in Table 8. It should be noted that there were no significant group differences (as expected; participants were randomly allocated to the groups).

Table 8

Descriptive data for problem scores

	Stressed Mean (SD) (N = 39)	*Control* Mean (SD) (N = 20)
Internalising (T score)	52.92 (11.66)	56.75 (10.19)
Externalising (T score)	51.00 (11.34)	52.75 (10.22)
Total (T score)	51.36 (11.37)	55.90 (10.06)

The relationship between baseline salivary cortisol and problem behaviour scores was then examined. With the hour of testing controlled for, partial correlations (N = 59) indicated a trend between pre-TSST-C cortisol and internalising problems ($r = -.23$, $p = .09$), and pre-TSST-C and externalising problems ($r = -.23$, $p = .08$) problem scores, although neither was a significant correlation at $p < .05$.

In order to test the hypotheses considering the relationships between emotional and behavioural difficulties, cortisol reactivity and ToM, data from the *stressed* group were examined. Within this group, no significant gender differences were found for either of the problem scores. The correlations between the problem scores, salivary cortisol, ToM performance, age and SAT scores are presented in Table 9. The analyses are exploratory and caution should be taken in interpreting significant findings when many correlations are carried out. Significant correlations were not found between cortisol and emotional and behavioural difficulties or between ToM and emotional and behavioural difficulties. It was hypothesised that ToM would mediate a relationship between stress and

emotional and behavioural difficulties. However, as significant correlations were not

found between problem scores, cortisol and ToM, further analysis was not warranted.

Table 9

Correlations between problem scores and other variables in the stressed group (n = 39)

	Internalising	Externalising	Total
Pre-TSST-C cortisol	-.25	-.20	-.24
Post-TSST-C cortisol	-.09	-.27	-.21
SS-ToM[b]	-.03	-.05	-.04
SS-PC[a]	-.35*	-.31	-.38*
Eyes	-.03	-.06	-.10
Age	-.11	-.17	-.25
SATS	-.29	-.21	-.31
Internalising		.63**	.84**
Externalising			.89**

* significant at $p = 0.05$

** significant at $p = 0.01$

[a] SS-PC – Strange Stories Physical Control score

[b] SS-ToM – Strange Stories Theory of Mind score

Discussion

This is the first experimental design, to the author's knowledge, to look at group

differences in ToM performance in children exposed to a social stressor and controls,

with examination of the underlying physiology of the stress response. The primary aim

was to investigate whether social stress affects ToM performance. It was hypothesised that the effects of stress on ToM would be mediated by activation of the HPA axis (as measured by an increase in salivary cortisol). Therefore, it was hypothesised that the social stressor would create a group difference in salivary cortisol and ToM performance. It was also considered that social stress may affect ToM independently of cortisol levels.

There was not a significant difference in cortisol levels between a group exposed to the adapted version of the TSST-C and controls. There are several hypotheses which could explain this: the adapted TSST-C was not stressful enough, the control condition was stressful and/ or the statistical tests lacked the power to find a difference between the two groups. In terms of power, it may have been beneficial to have a larger number of participants in the control group. However, it should be noted that Kuhlmann et al. (2005) found a significant difference in salivary cortisol between conditions (TSST and control) in a within subject design with 19 adults.

A significant group difference in ToM performance was not found on either the Strange Stories or Eyes Test. This result may not be surprising given that a significant group difference in salivary cortisol was not found. It also indicates that the social stressor did not significantly impair performance indirectly either (i.e. independently of cortisol). One possible conclusion from these results is that social stress does not affect ToM. However, a number of limitations need to be taken into account before interpreting the finding. Firstly, the groups may not have performed differently on the ToM tasks because they did not differ in terms of physiological stress. Importantly, the *stressed*

condition may not have been physiologically stressful enough to induce changes in cognitive performance. Secondly, the measures of ToM may not have been sensitive enough to detect a difference and thirdly, the sample size may not have been big enough to detect a group difference.

It is possible that the TSST-C was not physiologically stressful enough. Indeed, the mean salivary cortisol level in the *stressed* group did not increase after the stress, but followed diurnal variation and decreased. Mean increases in salivary cortisol have been observed in other studies using the TSST-C (e.g. Kudielka, Buske-Kirschbaum, Hellhamer & Kirschbaum, 2003; Buske-Kirschbaum et al., 1997). The discrepancy in findings may be because the adaptations to the TSST-C reduced the stressful component of the tasks. The story and mathematics tasks were shorter than suggested in the original TSST-C and video-equipment was not used. It is of great importance, however, that VAS ratings suggest that most children did find the task stressful compared to the *control* group. It is ethically questionable whether it would have been acceptable to have exposed participants to the tasks for longer or to have heightened their anxiety with technological equipment. It is consistent with other research that significant correlations were not found between VAS ratings and salivary cortisol levels (e.g. Buske-Kirschbaum et al., 2003). The VAS ratings may suggest that the participants did have physiological stress responses, but that the measurement of this was limited.

It is possible that the latency of the cortisol release was longer than twenty minutes and therefore not observed. Other research has suggested that twenty minutes is reflective of peak cortisol after a stressor, however it is possible that by using only two time points of

cortisol measurement important information about the individual's stress reactivity was missed. Analysis of cortisol at, for example, five time points would have allowed cortisol change to be assessed in much greater detail. Further still, additional time points would have allowed down regulation of cortisol to be measured. It has been argued that both HPA reactivity and regulation are important for assessing individual differences in stress physiology (Ramsey & Lewis, 2003). There are of course many other ways to measure stress reactivity, for example α-amylase in saliva, heart rate monitoring or blood cortisol levels. Using more than one method would have been advantageous and may have enabled the detection of group differences in stress physiology.

An additional reason that may account for the lack of increased cortisol in the *stressed* group is that blunted cortisol responses have been found in some groups of children, including those with atopic disease (Buske-Kirschbaum et al., 2003). It is a limitation that this was not controlled for within this study as it is known that one in ten children have asthma in the UK (Asthma UK, 2007) and prevalence can be even higher in lower socio-economic groups. It is possible that this could account for the lack of increase.

It should also be noted that other research has not found increases in cortisol levels after psychological stressors with typically developing children (e.g. Luby et al., 2003; Fernald & Grantham-McGregor, 1998). In addition, Skosnik et al. (2000) did not find a salivary cortisol difference between conditions in a within subject design with adults.

A related issue is whether all of the ToM tasks were carried out under the umbrella of a stress response. The children's ratings of subjective stress levelled off possibly before

both of the ToM tasks were completed. A group difference remained at VAS time 3, when the second saliva sample was taken. However, by time 4 (at the end of the last task) the groups both rated similar, very low levels of stress. It is likely that in many cases, ToM tasks completed last in the series of presentation were not under the umbrella of feeling subjectively stressed; without physiological evidence it is difficult to feel confident that stress featured at all when these tasks were completed.

In terms of the ToM tasks used, the research may be limited by the sensitivity of the measures in detecting differences in mentalizing performance. The ToM tasks were selected for their advantages over other currently available measures. However, the tasks can be criticised as it is unclear what skills are required for each task, for example as well as mentalizing skills, the Strange Stories task clearly requires good comprehension skills. Additionally, other skills such as working memory, language, IQ and visual processing may be used and it is possible that these skills are differentially affected by stress.

It is of great interest that within the *stressed* group salivary cortisol was correlated with ToM performance on the Strange Stories (SS) task, although not the Eyes Test. When baseline cortisol, SAT scores, SS-Physical Control (SS-PC) and hour of day were controlled for, higher cortisol levels after the adapted TSST-C were associated with poorer performance on the SS-ToM task. Interestingly, the straight correlation between salivary cortisol and SS-ToM was strengthened when performance on the SS-PC stories was controlled for in a partial correlation. This correlation may be a better representation of the relationship between cortisol and the mentalizing aspect of the SS-ToM task.

When SS-PC is controlled for, the unique relationship between ToM and salivary cortisol levels can be seen as the 'noise' variance from the performance aspect of the task is removed. This was to be expected as the SS-PC condition was included to control for task performance for the SS-ToM stories. The results suggest that the individual differences in ToM performance are associated with individual responses to the stressor as ToM performance was only correlated to the post-TSST-C cortisol and not the baseline measure. At first glance, this appears inconsistent with the finding that there was not an increase in mean cortisol in the stressed group. However, this may be explained by individual differences in stress reactivity; even though the overall group mean did not increase, some children's cortisol did increase and other's decreased.

In the absence of a group effect, the contribution of individual differences in ToM and stress related ToM performance cannot be clearly differentiated. In other words, the correlation may represent a relationship between cortisol and ToM performance independent of stress induction. Furthermore, the direction of the correlational relationship cannot be assumed; it is possible that children who found the tasks challenging had a resulting increase in cortisol. However, this is unlikely as previous research has indicated a lag time of 20 minutes for the physiological response to stress to be expressed in salivary cortisol, indicating that the cortisol collected at this time represents stress reactivity at the end of the TSST-C. A plausible explanation is that children who are better at ToM have less physiological reactivity to social stress. Alternatively, the result may suggest that raised levels of cortisol impair ToM performance. This interpretation is consistent with findings from other research that cortisol levels affect cognitive performance. Indeed, Skosnik et al. (2000) found that

adults with higher concentrations of salivary cortisol twenty minutes after mild psychological stress induction had greater reductions in attentional inhibition. The association between cortisol and ToM is consistent with the knowledge that prefrontal cortex (PFC) function is affected by stress. Taking the PFC 'offline' at times of stress may have evolved for survival purposes, but it has been argued elsewhere that this is maladaptive in human society when PFC functions, such as working memory, behavioural inhibition and concentration are imperative (Arnsten & Goldman-Rakic, 1998). The results of the current finding may suggest that aspects of ToM could be added to this list. The finding is also consistent with theories about mentalization which suggest that stress affects ToM.

It should be noted that the association found is inconsistent with the study by Blair et al. (2005) which did not find an association between salivary cortisol levels and false belief performance. However, this may be because the study differed in terms of age of participants, stress induction procedure and ToM tasks. Additionally, the finding is not consistent with the idea that moderate increases in stress improve cognitive performance and only very large increases impair performance. Indeed, one interpretation of the lack of group difference in cortisol levels is that physiological responses to stress were not induced in the children in the *stressed* group. This interpretation would suggest that cortisol levels were not raised sufficiently to impair ToM performance in any of the children. It is possible, therefore, that the result is due to a type 1 error.

Of interest, a relationship was not found between cortisol and the Eyes Test. This may suggest that the relationship found between cortisol and SS-ToM was spurious.

However, an alternative explanation is that the SS and the Eyes Test measure different aspects of mentalizing and that stress differentially affects these aspects. It should be noted that the two ToM tasks were significantly correlated, suggesting that they measure related concepts, but this has not always been found (e.g. Brent, Rios, Happe & Charman, 2004). The Eyes Test was not correlated with the SS-PC stories and this may suggest that the correlation between the Eyes Test and SS-ToM is due to factors specific to mentalizing. However, the mentalizing demands of the SS-ToM and Eyes Test seem to be quite different; the SS-ToM measures social-cognitive aspects and the Eyes Test measures affective aspects. Evidence from fMRI studies on ToM and empathy suggests that whilst they rely on common networks for making inferences about mental states, ToM does not recruit networks involved in emotional processing (Vollm et al., 2006). However, Baron-Cohen et al. (1999) found activation of the amygdala during the Eyes Test and there is face validity that this task would involve emotional processing. Whilst stress can impair the PFC, the amygdala is not impaired and is in fact highly important at times of stress. This may be able to account for the discrepancy.

It was also hypothesised that internalising and externalising behaviours would be associated with ToM performance and that ToM would mediate a relationship between stress physiology and problem scores. However, significant correlations were not found between cortisol levels after the stressor, ToM performance and problem scores. A trend was suggested between baseline salivary cortisol and internalising and externalising problems, however correlations were not significant. Perhaps surprisingly, both trends indicated that lower cortisol levels were associated with higher scores on the problem scales. Other research has found this for externalising problems (e.g. Gunnar &

Vasquez, 2001), but this was not expected for internalising problems, which are typically associated with higher baseline cortisol levels (e.g. Luby et al., 2003). Research investigating the relationships between ToM and behaviour difficulties has found inconsistent results and so the current findings in relation to emotional and behavioural difficulties are not unusual. Associations between problem behaviour scores and ToM ability have been found in other community settings (e.g. Hughes et al., 1998; Hughes & Ensor, 2006) and in fact, Badenes, Estevan & Bacete (2000) found that total scores for a set of Strange Stories correlated negatively with aggressive and socially withdrawn behaviour. However, other research (e.g. Cassidy, Werner, Rourke & Zubernis, 2003; Sutton, Reeves & Keogh, 2000) has not found these associations. However, there are a number of limitations of the current study that may explain why associations were not found. Firstly, a community sample was used and very few participants scored in the borderline or clinical range for problem scores. Secondly, the experimental ToM tasks may not be able to capture the difficulties that children with emotional and behavioural difficulties have with everyday ToM. Thirdly, potential relationships between ToM and CBCL scores in a community sample may have small effect sizes; with a sample of 38[3] it is more than likely that the statistical tests did not have enough power to detect differences. Finally, the measurement of behaviour difficulties was limited: the CBCL was completed only by parents and the design would have been improved upon with teacher ratings and/ or observation.

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[3] Number in stressed group with completed CBCLs

Clinical Implications and Future Research

In light of the limitations, the results need to be interpreted cautiously. Nevertheless, it is worth considering further the association found between salivary cortisol and performance on the SS-ToM task. This may be the first experimental design to find evidence that cortisol levels are associated with ToM performance, linking stress to mentalization. The result may suggest that superior ToM ability is associated with lower stress reactivity or that aspects of mentalizing are very sensitive to changes in stress physiology.

The consequences of stress affecting, and indeed impeding aspects of ToM are universal, but may be extremely negative for some individuals. Clearly, there are many clinical implications. One example is the work carried out with families with high levels of stress. 'Cycles of non-mentalizing interactions' are theorised to occur (Fearon et al., 2006 pp. 208) in which stress impairs mentalization and lack of mentalization in social interactions causes stress. Short Term Mentalization and Relational Therapy (SMART; Fearon et al., 2006) is designed to target these cycles. In light of the implications, a much greater understanding of how stress can affect ToM is needed.

Further research is required with larger sample sizes, different stress induction procedures and with more naturalistic ToM tasks. One suggestion is the design of virtual reality tasks measuring ToM, in which the participant is required to make ToM decisions in a social context. This has advantages for measuring ToM, but may also be a better way to assess the effects of stress on ToM. It is possible that stress linked more directly to the ToM task is more influential on the social-cognitive processes required, and this

could be set up using virtual reality. In addition, a within subjects design may have added advantages in answering the research questions. There is theoretical and empirical research that suggests that stress and ToM are associated with emotional and behavioural difficulties and this should continue to be investigated. Again, future research would benefit from larger sample sizes and in addition, greater ranges of problem scores or greater severity of problem scores; indeed, a similar research protocol with a clinical sample of children would be extremely interesting.

Summary

The study did not detect group differences in ToM performance, but this may be due to a number of limitations. Crucially, a group difference in salivary cortisol levels was not found after the TSST-C/ control condition. However, an association between salivary cortisol post-TSST-C and SS-ToM performance was found and one interpretation is that some evidence has been gained linking stress to mentalization. Associations between ToM and emotional and behavioural difficulties were not found and ToM performance did not mediate a relationship between stress and emotional and behavioural difficulties. Due to limitations, the results should be interpreted with caution and further research is warranted looking at the effects of stress on ToM, and the relationship of this to emotional and behavioural difficulties.

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PART 3

CRITICAL APPRAISAL

Overview

The critical appraisal is divided into three parts. Firstly, the research implications of the current study are discussed and the limitations explored, including issues related to measurement and stress induction. Secondly, the clinical implications of stress affecting ToM performance are discussed and links are made with current clinical practice. This will be followed by a personal reflection of the research process, including the challenges and successes, with reference to the literature review, planning the research project, working in schools, working with 'stress', carrying out a joint project and my personal development. The appraisal ends with a summary of the research.

Research Implications

The current study did not find a group difference in ToM performance between those exposed to an adapted version of the TSST-C and controls. However, unexpectedly, a group difference in salivary cortisol levels was not found either. Nevertheless, some evidence was gained which may suggest a link between stress and mentalization; an association was found between post-TSST-C salivary cortisol and ToM performance on the Strange Stories task. The findings clearly warrant further research. The following section discusses the limitations of the current study and the difficulties intrinsic to research like this. It will outline the process of designing the research with consideration to stress induction in children, physiological stress measurement and ToM measurement.

Stress induction

Stress induction procedures, especially with children, are potentially contentious and require ethical deliberation. Many studies looking at the effects of cortisol on cognition have been with animals or within pharmacological studies with adults. Typically, in these experiments, high levels of physiological arousal can be induced, but there are obviously larger constraints in research involving the psychological stress of humans. Psychological stress procedures were developed for use with adults (e.g. Kirschbaum et al., 1993), with the advantage that these induce a natural variation of the stress response. These tasks have since been developed for use with children (e.g. TSST-C, Buske-Kirschbaum et al., 1997). Only a few studies have been carried out with children using this procedure, and to my knowledge, none have been carried out using a comparable control condition.

Planning a stress induction procedure for children required the balancing of ethical issues, acceptability of the task to teachers, parents and children, and creating a stress response that could be measured. Adaptations to the TSST-C included decreasing the length of time the children spent doing the stressful tasks and in addition, only one adult witnessed the story and no video camera was used. The reasoning behind reducing the length of time was twofold. Firstly, during informal piloting of the procedure (with fellow trainees) the suggested amount of time for each task seemed very long and this was particularly pertinent for the control condition, in which the tasks were completed as thinking tasks. We were conscious that the controls should not feel stressed and we did not want this solitary time to feel punitive, irritating or boring. In addition to this, it was important to keep the total testing time to an hour and this was exceeded with the inclusion of the full length of the TSST-C. We considered the initial testing sessions with children as a pilot phase and those in the stressed group did report feeling stressed after the adapted TSST-C. In addition, this seemed like the maximum amount of time that those in the control condition could tolerate without getting bored. A further adaptation we made to the stress test was the inclusion of an anticipatory stressor (reminding the children that they would need to do more story telling or mathematics at the end of the procedure) as HPA activation has been shown to correlate with anticipatory stress appraisal (Gaab, Rohleder, Nater & Ehlert, 2005). This was included to maintain physiological arousal during the time that the ToM tasks were completed. It is unclear what effect this had on the children. It is acknowledged that our adaptations to the procedure may have resulted in the test not producing the same effects as the original TSST-C.

Most children rated their stress levels as considerably higher after the TSST-C and visible signs of stress, such as fidgeting and worried looks were often observed. During debriefing at the end of the testing sessions, children were often relieved to hear that the TSST-C part of the procedure was supposed to be particularly hard and that they had done well at these challenging tasks. Some children expressed relief that they did not have to do more mathematics or story telling at the end of the procedure. It therefore appeared that the stress test did have its desired effects and a more stressful procedure may have been unethical. It should be noted that some other studies which have used psychosocial stress induction protocols have also not found an increase in cortisol levels after stress induction in typically developing children (e.g. Luby et al., 2003; Fernald & Grantham-McGregor, 1998).

In terms of my subjective appraisal of how stressed the children appeared, two things which were noticed may be of importance. Firstly, many children seemed stressed immediately after the TSST-C and at the beginning of the first task, but then seemed to recover quickly. It often seemed that the children relaxed after starting the ToM or EF tasks. Some children appeared to find these tasks boring and this may have affected cortisol levels. In terms of subjective stress, it seemed that the design of the experiment would benefit from fewer or just one task to complete immediately after the TSST-C. However, in terms of salivary cortisol being at its peak it could be argued that in order to associate salivary cortisol with task performance, the tasks should be completed 20 minutes after the end of the stressor. During testing, tasks were started between 1 and 25 minutes (approximately) after the end of the TSST-C and were counterbalanced for presentation order. Presentation order was not found to affect task performance, but it is

unclear how much performance was affected by concurrent stress, either as measured by subjective scales or salivary cortisol. Analysis at this level would not have been meaningful due to the small number in each group. However, it would be interesting for future research to explore this.

The second observation was the differential response towards the TSST-C task from the children. The TSST-C was very stressful for some children, but others seemed to enjoy it and enjoyed the challenge of it. For example one child said 'I love mental arithmetic', whereas other children looked extremely worried at the prospect. Indeed, after being reminded that there would be more mathematics at the end of the tasks, one boy said categorically, 'I don't want to do any more maths at the end.' An advantage of the TSST-C was the inclusion of both story telling and mathematics; children tended to find one or other of these more challenging. This supports the use of the TSST-C or other stress induction procedures in which more than one type of challenging task is included.

In comparing the groups' salivary cortisol, it is difficult to ascertain if the stressed condition was not stressful, or if the control condition was stressful or if there was a mixture of both. It is possible that some of the children did find the control condition stressful, possibly because they were working with an unfamiliar adult and possibly, by the nature of the task, the children may not have felt certain how they were doing (when answers were kept to themselves) or what was coming next. Alternatively, the children may not have been stressed, but bored by the tasks and lagging in concentration by the time they completed the ToM tasks.

I have considered that if I designed the protocol again, it may be beneficial to create a more structured and more relaxing control condition. For example giving the children a completely different task that they would enjoy, attempting to avoid stress or boredom. Additionally, there would be advantages to using a within-subjects design, so that all children complete ToM tasks under stressful and control conditions. The main advantage being that the two groups would be identical and pairwise comparisons could be made looking at an individual's performance in both conditions.

Measuring stress

Financial restrictions influenced the choice of measurement of physiological stress and furthermore, it was only possible to measure and determine cortisol concentrations in saliva at two time points for each child. This was disadvantageous as it would have been better to track cortisol up regulation and down regulation (see Ramsey & Lewis, 2003). Cortisol changes are often difficult to interpret and especially when only two time points are used. Measuring and tracking stress physiology is also enhanced if multi-methods are employed, for example blood plasma cortisol and heart rate monitoring. Procedures for measuring this physiology are advancing continuously and there has recently been much interest in using salivary alpha-amylase as a marker of stress. IBL Hamburg suggest that measuring this alongside salivary cortisol is an optimal way of looking at individual differences in stress physiology (IBL Hamburg, 2006).

Measuring ToM

The ToM tasks were selected because they are considered advanced tests of ToM and have been successfully used with similar age groups before (e.g. Brent et al, 2004). They

are advantageous over more classical second order false belief tasks because a range of scores is obtained and individual differences in performance can be analysed. The Strange Stories are argued to measure the understanding of internal mental states; the social cognitive aspect of mentalizing. The Eyes Test involves emotion recognition, measuring affective aspects of mentalizing and is argued to be free of general intelligence skills (Baron-Cohen et al., 1997). There are specific criticisms of the two tasks and more general criticisms about experimental ToM tasks.

As well as ToM ability, the Strange Stories require good comprehension skills. Indeed, it was observed that the Strange Stories felt very difficult for many of the children primarily because the stories are relatively long and complicated; some of the language was hard for some of the children to understand. In an adaptation from the original, the stories were read and left in view of the children in order to reduce memory loading (as in Brent et al., 2004), but it still seemed difficult for some children to recall all the details when producing their answers. The Eyes Test can be criticised as it only requires the representation of an agent's attitude (e.g. he's angry about something), but it does not require any content of the attitude (e.g. he's angry about the letter). Jarrold, Butler, Cottington & Jimenez (2000) argue that without the representation of both attitude and content, it is not a proper representation of how another represents the world and hence is not metarepresentation. ToM requires inferring the content of a belief and not just that they believe something (Jarrold, Butler, Cottington & Jimenez, 2000).

It remains debatable how generalisable performance on these tasks is to ToM use in everyday interactions. The use of ToM is likely to be affected by many factors,

including the relationship context of the interaction, motivation (e.g. competition), empathy and social moralisation. Arguably, experimental tasks of ToM may be interpreted as the participant's ToM ability when tested explicitly, but they may not tell us the full story about everyday abilities. Natural use of ToM can be described as fluid, whereas experimental tasks are concrete and inflexible and are more likely to assess crystallised ToM knowledge or competence. It is plausible that stress is more likely to affect the fluid nature of ToM. Therefore, it could be argued, that in order to assess the effects of stress on ToM, more naturalistic ToM tasks are needed and I have suggested the idea of using virtual reality or computer games to create these tasks.

Measuring language

It was not possible to complete formal measures of language ability. This would have required an additional meeting with each child which was not feasible. However, this limited my ability to control for language when analyzing the ToM tasks and I relied upon SAT scores which were gathered from teachers. Although this was not ideal, this measure did give a good indication of the child's ability.

Intra-individual differences in ToM and the factors which influence these differences is a new and exciting line of research with many clinical implications. Stress is a likely candidate for affecting ToM ability in a given situation and the knowledge base about ToM ability and use would benefit greatly from further research using stress induction procedures. The limitations of the current study illustrate the difficulties intrinsic to this type of research and suggest many considerations for the planning of future research.

Clinical Implications: Stress and ToM/ Mentalization

The implications of stress affecting ToM are universal. It is possibly a phenomenon that we are all aware of in our own lives. For example, in an emotionally charged argument it is often extremely difficult to see another person's point of view. It is clear that some people are more easily aroused by stress and/ or may have lower thresholds for stress affecting their cognitive performance. In relating stress and ToM to emotional and behavioural difficulties, it seems plausible that many children and adults with these difficulties will be more prone to the effects of stress. Clinical observation of the effects of stress on ToM/ mentalization and theoretical accounts have prompted the development of interventions with these ideas at the foreground.

ToM/ mentalization based treatments have been developed recently, but it is arguable that mentalization ideas are not new per se, but a core component of all psychotherapies. For example Bjorgvinsson & Hart (2006) argue that Cognitive Behavioural Therapy (CBT) overlaps with mentalization concepts and indeed enhances mentalization capacity. Bateman & Fonagy (2004) suggested that mentalization is a bridging concept between therapies, in a similar way to the therapeutic alliance.

In terms of the effects of stress on ToM, most therapies involve learning how to cope with high level emotions, for example fear and anger. It also seems true that many therapies use a metaphorical 'pause button' (Allen, 2005) for reflection of these moments of high arousal (e.g. CBT: Bjorgvinsson & Hart, 2006; Dialectical Behaviour Therapy: Lewis, 2006). For example, in CBT, the therapist may ask the client to stop and think: 'What went through your mind before that happened?' Arguably, reflecting

on events in this way allows the person to mentalize explicitly and to reflect upon the consequences of their implicit mentalization at the time of arousal (Bjorgvinsson & Hart, 2006).

Specific mentalization based treatments have developed primarily in response to working with difficult-to-treat patients. They often incorporate psycho-education about explicit and implicit mentalization, encouraging the client to learn to stop, pause and then mentalize explicitly. Lewis (2006) explains to clients during skills training, the 'narrowing of thinking' associated with the fight or flight response to aversive situations, at the expense of mentalization. She illustrates this with situations when this is clearly adaptive, for example when faced with extreme threat, and times when this is less adaptive, for example in interpersonal situations which are clearly best resolved by mentalizing. Clients can be taught to identify the early stages of physiological arousal to avoid the 'mentalizing paradox' (Tobias, Haslam-Hopwood, Allen, Stein & Bleiberg, 2006); in the midst of physiological arousal one must be able to reflect that they have stopped mentalizing before making a conscious decision to mentalize. Other techniques are then taught, for example self-soothing techniques to enhance emotional regulation at these times. Another strand of treatment may be in helping clients to increase their stress tolerance, pushing the boundaries of the zone in which they are able to mentalize (Tobias et al., 2006).

Mentalization based treatments with families, for example, Short Term Mentalization and Relational Therapy (SMART; Fearon et al., 2006) also puts a great deal of emphasis on the effects of stress on mentalization. In families with high levels of stress, 'cycles of

non-mentalizing interactions' are often established, during which stress frequently impedes ToM (Fearon et al. 2006 pp. 208). In these cycles, strong emotions result in non-mentalizing responses to others which are unhelpful and unsupportive. Controlling behaviour is used as a 'second-line' strategy replacing the use of psychological means to influence others behaviours. Interactions are therefore hostile, coercive, undermining, frustrating, distressing and ultimately stressful which triggers non-mentalizing in others. A long term consequence of this may be that these interactions become predictable and possibly over-learned so much so that non-mentalizing occurs without the emotion to initiate it (Fearon et al. 2006).

The implications clearly suggest that further research is warranted in investigating the effects of stress on ToM and how this is associated with clinical problems in both children and adults.

Personal reflection

The Literature Review

It has been rewarding to research a topic in so much detail and I have enjoyed learning about the impact of individual differences in ToM. This helped me to situate the empirical research within a wider context and I have reflected upon the importance of research findings to date and future research. The potential implications of research within this field, have served to motivate me during the project when at times the task of completing it has been daunting. It has however been challenging at times to remember the wider context when submerged in trying to evaluate details. I have had to hone my

skills at broadening out and relating what I was learning at any given time to the overall picture.

Planning the research project

In planning the project, I was greatly aware of tensions between designing a protocol which would answer the research question, ethics and recruiting participants. These tensions were within the context of carrying out a joint project and working within primary schools. We needed to design a feasible experiment which schools, parents and children would consent to taking part in. We considered that it would be appropriate to work with each child on one occasion for a maximum of one hour and that questionnaire packs sent to parents should be as brief as possible. This influenced the choice of measures selected and the way in which we adapted the TSST-C.

Working in schools

Working within primary schools presented many challenges and these will be discussed, including recruiting participants and working with factors not within the researchers' control.

A strength of the study is that the children in the sample came from different ethnic backgrounds. Of the 65 children who returned forms, 63% were from black or ethnic minorities. Six of the schools we worked in were in Islington, a London borough in which 64% of primary school pupils are from black and ethnic minority backgrounds (CEA@Islington, 2005). In terms of ethnicity the sample therefore appears, at least at a

surface level, to be representative of Year 5 pupils in other schools in Islington and similar boroughs.

On commencing the project, I anticipated that recruitment could be difficult for two reasons. Firstly, we were going to ask the children to do something challenging/ stressful and secondly because we were asking for saliva samples. It is difficult to know how much these factors did influence parents' and children's willingness to take part, but one head-teacher did not agree to the school taking part in the study due to these very reasons. Two further obstacles to getting schools to take part were that London primary schools are inundated with requests from people wanting to carry out research and, more generally, the schools are very busy.

Although most children appeared interested in the experiment, only 20% of children that we gave presentations to actually took part. This may be due to a number of reasons: the ethical reasons stated above, the parents did not receive or read the letters, the parents could not speak English, the children did not want to take part. A methodological constraint on participation was that none of the information, questionnaires or measures were translated into other languages and therefore a pre-requirement was that children and parents needed to speak and read English. In addition to this, another factor was parent's willingness for their children to take part and/ or their willingness to fill in the questionnaire packs. The questionnaire pack was estimated to take about thirty minutes. (It included a demographic questionnaire, the CBCL and two measures for the other part of the joint project). It would be interesting to know more about the differences between children who took part, and those who did not. It is of interest that more girls

participated in the study than boys. Due to the small percentage of children from each school taking part, a larger number of schools than anticipated were required in order to recruit enough participants. This posed many challenges in organisation and a large amount of liaison with school representatives was essential.

It was important that we fitted into the school system and that we worked collaboratively with the teachers in terms of setting up when and where we could work with the children. The rooms we used varied in distractions and it is unclear if this could have influenced the stress induction procedure or the children's concentration during ToM tasks. Our desire to control for factors affecting cortisol levels was paramount to the design, but compromises (e.g. starting times of the procedure) had to be made in order to work in different schools. It may be that other variables were influencing the children's cortisol levels and reactivity. For example, children taking part in the 1 O'Clock slot typically came straight from playing in the play ground. Some of the children would have been exercising and some would not have. Although attempts were made to make sure these children had early lunches, this was not always possible. In addition, we were not always able to control how much prior warning children were given about taking part in the experimental procedure and this may have affected anticipatory anxiety in some of the children and not others. The influence of this anticipation or the immediate effects of being asked to work with a stranger may have differentially affected cortisol levels. Some children were excited and looking forward to the session and other children were nervous. Whilst these individual differences may be of interest, it may have also have been due to being the first or last child in the class to take part or the result of hearing from other children about the experimental procedure. An important

consideration is that atopic diseases were not controlled for. Atopic diseases, including

asthma have been shown to be associated with blunted cortisol reactivity and in addition,

medications used to control asthma also affect cortisol levels.

Working with stress

During the process of planning, carrying out and writing up the piece of research, I have

become increasingly familiar with the complications in measuring stress reactivity. It

was somewhat disappointing that we did not influence a group difference in salivary

cortisol after the TSST-C, but as a control group has not been used alongside a group

exposed to the TSST-C, it is difficult to interpret if this was a failing of the stress

induction procedure. Measuring *only* salivary cortisol and *only* at two time points can be

criticized greatly and it is very likely that we missed out on a wealth of information

about individual differences in stress reactivity. However, research of this type is

expensive and, perhaps, does not lend itself well to a research project of this size.

Complications arose from carrying out data collection in the school setting, whereby

many factors that could potentially influence cortisol levels were difficult to control for

(see above). Nevertheless, I think it has been of great benefit to include a physiological

measure and making links between the experience of a stressful situation and task

performance to underlying physiology has been very exciting. An enjoyable part of the

research was locating a laboratory to carry out the cortisol analysis and making contact

and connections with IBL Hamburg, Germany.

The ethical issue of stressing children was ever present in my mind. The protocol was

designed so that it was not hugely different from the challenging tasks that children are

often expected to complete in the classroom. However, it was in contrast to my role as a clinician to induce negative affect in the children and at times felt uncomfortable. I did feel, however, that debriefing the children at the end of the testing session worked extremely well in relieving any residual negative feelings about the TSST-C tasks. The children were pleased to hear that the tasks were meant to be hard and that they did well just to have a go at them.

Joint project

Carrying out a joint project with a fellow trainee has been extremely rewarding and enjoyable, however it also posed many challenges. Choosing research questions that lent themselves to being answered through a common experimental design ensured that we had the resources to analyze salivary cortisol as well as measuring subjective stress. This was a major advantage for the research project. Other advantages were in sharing ideas to design a joint protocol and sharing the difficulties that were encountered during recruitment. At times it was also a challenge to work jointly. In particular, coordinating our time was occasionally difficult and naturally we needed to compromise on some ideas. It also felt difficult not to have control over the project, especially within the context of balancing other demands of the training course. However, working through these challenges has in itself been rewarding and I feel I have learnt more about how I work and how I work with others. It is my understanding that Clinical Psychologists typically carry out research in conjunction with others and I have reflected that this has been an extremely valuable learning experience.

Personal development

I have had an academic and clinical interest in ToM for many years, since I first learnt about the concept during my undergraduate degree and simultaneously began some voluntary work with children with autism. However, whilst researching for this thesis I have been struck by the huge importance of this social ability and its interaction with so many clinical problems. I have become acutely aware of this within my own clinical work and in other learning opportunities. For example, in my current clinical work with children with severe mental health problems, I have often encountered the idea that some of the children and their families have rigidity in their communication and difficulty in expressing their thoughts and feelings. Indeed, it is often commented upon by other professionals that a goal of therapeutic work should be to enhance the family members' mentalization skills. A common feature of psychotherapy is to create an interpersonal context where the understanding of mental states becomes a focus (Bateman & Fonagy, 2004). I have become increasingly aware of dialogue about mental states within my clinical work and I believe that this has enhanced my clinical skills.

Summary

This thesis has outlined the literature on individual differences in ToM in relation to emotional and behavioural difficulties. Although, this type of research is in its infancy there is evidence to suggest that individual differences in ToM are associated with difficulties in childhood. There may be many factors, however, which influence an individual's use of ToM other than their explicit abilities. The empirical study investigated the influence of stress on the performance of 9 – 10 year old children on two ToM tasks. It was also hypothesized that ToM performance may mediate a

relationship between stress physiology and emotional and behavioural difficulties. A group difference in ToM performance between those exposed to the stressor and those in a control condition was not found. However, these groups did not differ in salivary cortisol levels either. Nevertheless, an association was found between a measure of salivary cortisol twenty minutes after the stressor and performance on one of the ToM tasks. Links to a measure of emotional and behavioural difficulties were not found. One interpretation of the results may suggest that higher salivary cortisol levels were associated with poorer performance on the ToM task. This is consistent with the idea that stress can impair ToM. Bearing in mind the limitations of the study, further research in this area is warranted.

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Appendix A: Individual contribution to the joint project

The empirical research was carried out as part of a joint project with James Fairbairn ('Stress, cortisol and executive functioning in pre-adolescent school children').

All written work has been planned and completed individually, including the research proposal, the literature review, the empirical paper and the critical appraisal. Reviewing current literature for these purposes has been carried out independently. The majority of the data analysis was carried out independently (initial examination of the cortisol variables was carried out together). The measures unique to this part of the project were selected and, after administration, scored independently.

The experimental protocol was developed jointly. This included discussions, research and joint working, whereby an equal share of work was completed by both trainees. Information sheets, consent forms and the transcript of the procedure were written together. Joint applications were made to the UCL Ethics Board and for research funds; the preparation of these was shared equally. The recruitment of participants was carried out jointly and equally. Both trainees contacted schools and liaised with head-teachers, teachers and other staff members. Both trainees gave short presentations to classes of children and both were actively involved in giving out and collecting in forms and questionnaire packs. Carrying out the experimental procedure with the children was shared; each trainee worked with approximately half the total number of participants. This included carrying out tasks with each child for each other's research project. Liaison and the practicalities of sending the saliva samples for analysis were shared. Data entry of common variables was shared.
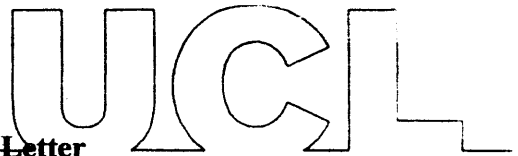
Dr Pasco Fearon and Dr Steven Butler
Sub-Department of Clinical Health Psychology
UCL
Gower Street
London

24 January 2006

Dear Dr Fearon and Dr Butler

Re: Notification of Ethical Approval

Re: Ethics Application: Social stress: effects on theory of mind and executive function in children

Further to the meeting of the UCL Research Ethics Committee on Thursday 19 January, I am pleased to inform you that the above research has been given ethical approval for the duration of the project.

Dr   lay member of the Committee, who reviewed the application, would relish the opportunity of accompanying the researchers to one of the designated primary schools in London to act as an observer. I do hope that this will be possible and I would be grateful if you could liaise with the Secretary of the Committee, Ms   , to discuss this matter further on tel: .

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://www.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events.
For non-serious adverse events you will need to inform Ms   , Ethics Committee Administrator   within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Reporting Serious Adverse Events
The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the

Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

Yours sincerely

Chair of the UCL Research Ethics Committee

Cc: James Fairbairn & Lucy Partridge, Sub-Department of Clinical Health Psychology, UCL

Appendix C: Letters and consent forms

Sub-Department of Clinical Health Psychology

UNIVERSITY COLLEGE LONDON

GOWER STREET   LONDON   WC1E 6BT

INFORMATION SHEET FOR PUPILS

Dear Pupil,

After our talk today we wanted to give you some more information about our project to take home and think about.

- *Why is this research happening?*

The study is about how children in Year 5 understand other people's feelings and actions, and their ability to concentrate when doing a computer task. We're looking at what makes these tasks easier or harder. We are especially interested in how these sorts of tasks can be more difficult when you are under a little bit of pressure or when the task is more challenging.

- *Why have I been chosen?*

You have been chosen because you are in Year 5 and all the children in your class have been invited to take part. We need about 60 children in your school and other schools to take part.

- *What will I have to do?*

There will be two groups of children and there is an equal chance you will be group 1 or group 2. We would like all the children to tell a short story and do some mental arithmetic for a few minutes. In one group these tasks will be more difficult. We would also like you to answer some questions about characters in some stories and pictures, and to do a task on a computer. There are no right or wrong answers.

We will also ask you to spit a small amount of saliva into a little pot so that we can send it off to a laboratory. At the laboratory they will look to see how much of a hormone called 'cortisol' is in it, which tells us how your body responds to challenges. Once we have got this measurement we will not keep the samples you give us (they will be destroyed).

Everyone taking part has the chance of winning tickets for their family to go to the cinema.

- *Do I have to take part?*

It's up to you! If you decide you don't want to we will not mind. You do not have to take part if you do not want to.

- *Will information I give be kept private?*

Yes. Each person will have a number so that your name will not be written on any of the questionnaires, answer sheets or on your saliva sample. We will carefully lock everything away and password protect any information on a computer.

- *What do I do now?*

Talk to your parent/guardian and if you decide that you want to be involved you need them to complete the consent sheet. If you and your parent/ guardian would like you to take part, please return all the forms to the school office. If you have any questions please let your teacher know.

Thank you for your help!

James and Lucy

Sub-Department of Clinical Health Psychology

UNIVERSITY COLLEGE LONDON

GOWER STREET LONDON WC1E 6BT

(To be completed by the child)

INFORMED CONSENT FORM

1. Have you read the information sheet?

               Yes   No

2. Have you had the chance to ask questions about the project and did you understand the answers to any questions?

               Yes   No

3. Do you think that you have been told enough about this project?

               Yes   No

4. Did you know that you can decide to <u>not</u> take part in this project at any time? You don't need to tell me why and this won't make a difference to things in school.

               Yes   No

5. Do you want to take part in the project?

               Yes   No

Name_____

Signature_____

Today's Date_____   Date of birth_____

Name of researcher_____

Signature of researcher_____ Date_____

Sub-Department of Clinical Health Psychology

UNIVERSITY COLLEGE LONDON

GOWER STREET LONDON WC1E 6BT

INFORMATION SHEET

Dear Parents/Guardians,

Our names are James Fairbairn and Lucy Partridge. We are Trainee Clinical Psychologists and are carrying out a study conducted by University College London and your child's school. We are writing to invite you and your child to take part in this study. The study is looking at factors involved in the development of behavioural and emotional difficulties in children and aims to help professionals to help children with these difficulties.

- ***What is the purpose of the research?***

Many things affect children's chance of developing behavioural and emotional problems, one important factor is how children perform under pressure. We are hoping to find out more about the link between performance under pressure and children's emotional and behavioural difficulties. We are particularly interested in how children are able to think flexibly, avoid distraction and think about other people's thoughts and feelings, when are faced with a mildly challenging task (like some of those which children experience within the classroom environment). The results of the study will help us understand young people's social understanding, concentration and behaviour better, and may help us to develop strategies to prevent behavioural and emotional problems in children.

- ***Why has my child been chosen?***

This school has been chosen because it takes both boys and girls and we have asked your child to be involved only because of their age, not because of anything to do with their behaviour. All children of your child's age within the school are being asked to participate. We hope to collect information from around sixty families who will have a wide range of opinions, all of which will be useful to the research.

- ***What will my son / daughter have to do if they take part?***

The children taking part will be randomly allocated into two different groups. In one group the children will be asked to carry out some challenging tasks in which they may feel they are being evaluated, such as giving a short speech and doing some mental arithmetic. In the second group, the children will complete less challenging tasks and will not feel evaluated. None of the tasks in either group will be more demanding than those regularly carried out within the school environment. Children in both groups will then be asked to complete questions about characters in some stories and pictures, and carry out a 10 minute computer task, involving tapping a button in response to changing

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pictures and positions. Most children enjoy tasks like these. The children will also be asked to give some samples of their saliva (by spitting in a pot) to measure the way their body responds to the tasks. These samples will be analysed to determine the amount of cortisol in them. Your child's teacher will also be asked to give some information on your child's language comprehension. The things that we would like to do would take about one hour in total, and would be carried out during the school day with the agreement of your child's teacher. Everyone taking part will be entered into a raffle, where they have the chance of winning a family trip to the cinema.

- *Will I need to do anything if I agree that my child can take part?*
Parents or guardians are asked to sign the attached consent form and return it to the class teacher. We will then send you some questionnaires, which should take about 30 minutes to complete and should also be returned to the class teacher. The questionnaires ask for brief background information about you, and about your child's feelings and behaviour as well as your opinions on being a parent.

- **Is the research confidential?**
Yes. All information collected will be used for research purposes only and an ID number used to keep answers confidential. Teachers will not see the forms the children and parents complete. Your child will also not see the answers you provide regarding their behaviour. The saliva collected from your child will be anonymous and only identifiable by a number. Once it has been analysed it will be destroyed.

- **Are there any risks from taking part?**
There is no reason to believe that taking part in this study would be harmful in any way. Your child will be asked to take part in a mildly stressful activity which is similar in many respects to the sorts of challenges that children face at school quite regularly (e.g. reading aloud, doing tests). However we will monitor children's feelings carefully, and if we thought they were finding the tasks unduly stressful, the session would be ceased immediately. All proposals for research with people are reviewed by an ethics committee before they can begin. This proposal has been examined by the UCL Committee on the Ethics of Non-NHS Human Research. If you do have any concerns, you are free to contact us at the address given below.

- **Who should I contact if I have any questions?**
Please contact James Fairbairn or Lucy Partridge if there is anything that is not clear or if you would like more information.

- **Do we have to take part?**
You and your child do not have to take place in this study if you do not wish to. You, or your child, may withdraw at any time without having to give a reason. Your child's decision to take part or not, will not affect their schooling or teaching in any way.

- **If you do choose to take part....**
Thank you very much, for your help. Please sign the consent form and return it to the school, together with your child's consent form.

Thank you for taking the time to read this information sheet.

Yours sincerely

James Fairbairn and Lucy Partridge
Trainee Clinical Psychologists
(address and contact details given)

Please note: The researchers have undergone a criminal records check.

Clinical Psychology Investigation of Factors Affecting Behaviour in Children

If, once you have read the information sheet, you would like your son/daughter to be involved in the research please complete this slip. If you do decide that you would like your child to take part in the study you can always change your mind and withdraw him/her from the study without giving a reason. This will not affect your child's schooling in any way.

Please complete this slip and return it to your child's class teacher.

I have read the information sheet and agree to my child taking part in this study.

Child's Name...

Child'd Date of Birth.....................................

Parent's Name in capital letters..

Parent's Signature..

Date ....

Appendix D: Transcript of the Procedure (verbal instructions)

Prior to testing, class teachers will be given a list of the children we will be testing on each day, so they can fore-warn the child in the morning before their testing session. Check children have had an early lunch. First child starting at 1pm.

In class room, both children (stress/non stress) will be picked up by the experimenter carrying out the "non-stressed" condition
Hello are you ready? We're going to .... to do the games and activities for our study, you'll be back in about an hour. Before we go, can you have a sip of water.

First room should contain; Blank and lined paper, pens and pencils, lap-top, 2 chairs, desk and tasks. Once in first room, experimenter who is carrying out the "non- stressed" condition should say to both children.
Thanks for returning all the forms. Today we wanted to do some games and activities with you, as part of the study which we spoke to you and your class about. As part of our study I'll ask you to spit some saliva into a little pot so that we can measure something in it called cortisol, which changes depending on how you are feeling.

We are seeing lots of children in your class and some from other schools the same age as you. Some of the tasks will be easy, but some you might find harder. Do you still want to carry on? Just to let you know, if you do want to stop at any time, then that is fine, just tell me, I won't mind at all, and you can stop. Also, if you have any questions, I can answer them all at the end. Is that Ok?

    ☺ First saliva sample collection, carried out by both experimenters
To start off with, I'd like you to spit some saliva into this pot, using this straw, try and make the pot half full. Thank you.

First visual scale by both experimenters (take children to areas where can't see each others choice on scale)
This is a scale representing how you are feeling. If this is feeling very happy (point to picture 5), this is ok (point to picture 3) and this is very worried or stressed (point to picture 1), can you point to the scale to show me how you are feeling now?

Thank you for doing that, we're now going to split up and James/Lucy is going to take X to the .....room and we're going to stay here. You'll see each other back in class in about an hour.

Stress condition

Throughout stress test, give adequate positive feedback, either facial or verbal.

Ok, firstly I'm going to tell you the beginning of a story, listen carefully because I'm going to ask you to make up the ending. I'm going to ask you to stand up and tell me

out loud your ending to the story. You need to listen carefully as I want you to make your story really good.

Yesterday my best friend Robert and I went home from school, suddenly we had the idea to visit Mr Gregg who lived in the big old house located in the dark forest near our town. Mr Gregg was a crazy old man and our parents didn't like the idea that we sometimes went visiting him. There was a rumour in town that there was a mystery about the old house. When we arrived at the house, we were surprised that the door was open. Suddenly we heard a strange noise, and cautiously we entered the dark hall.......

What do you think happens next? I want you to make it up. I'm going to give you 2 minutes to prepare your story. Then I will ask you to stand up and tell me your story. Try and make it as exciting as possible, see if you can make it better than all of the other children's.

Experimenter sits behind the desk and holds clip board, watching child prepare story for 2 minutes.

> If child asks you to repeat the story say
> *Try and remember the best you can, it doesn't matter if you can't remember all of the story I read you, but I want you to make up what may happen next*

> If child tries to make conversation with the experimenter (unless relating to distress/not wanting to continue), say....
> *It's important for the study that we don't talk through this bit, so please try to get on with the task quietly.*

After 2 minutes of preparation
The 2 minutes is up, can you stand up and tell me the rest of your story now. I would like you to keep telling the story for 3 minutes.

> If the child finishes before 3 minutes, use following prompts, until child is not able to continue.
> *Can you tell me a bit more about that? And what else might happen?*

Thank you for telling me your story. Don't forget about your story, as I am going to ask you some more about it at the end.

Mental arithmetic task
Now we are going to do some mental arithmetic. You're going to do this for 3 minutes. I would like you to subtract/take away 7 from 758, then continue take away 7 from each answer. For example 758 take away 7 is 751, then you would take away 7 from 751 and so on.... Try to do it as fast as you can and as accurately as possible. Off you go...
(if failing at any point ask to stop and start again at 758)
Continue for 3 minutes after starting.

If child stops or finds very difficult...
Just keep going and do your best

Answers: 758, 751, 744, 737, 730, 723, 716, 709, 702, 695, 688, 681, 674, 667.

Thankyou

☺ Second visual scale
Have another look at this scale, can you show me how you are feeling at the moment using the scale again.

Tasks

→ TAKE SECOND SALIVA SAMPLE AFTER 20 MINUTES

Stories

Nb counterbalancing – read either physical or ToM stories first.

Read each story to child, record answers verbatim.
We're going to look at some stories now. On each page you will find a short story to read. After you've read and understood the story, there will be a question. I'd like you to tell me the answer to this question. I'll read through the story and question with you.

Show practice question and ask question
Ok, lets carry on

As I said before, don't forget your story from the first task as I will be asking more about it at the end. I might also ask you to do some more maths at the end too.

→ Second saliva sample?

Eyes

Show practice item
In this folder I've got lots of pictures of people's eyes. Each picture has four words round it. I want you to look carefully at the picture and then chose the word that best describes what the person in the picture is thinking or feeling. Let's have a go with this one.

Point to words as they are read. Make sure child picks one of the options and given encouraging feedback without revealing whether they are right are wrong.
Now look at this person. Do you think he is feeling jealous, scared, relaxed or hate?

Ok, let's have a go at the rest of them. You might find some of them quite easy and some of them quite hard, so don't worry if it's not always easy to choose the best word. I'll read all the words for you so you don't need to worry about that. If you really can't choose the best word, you can have a guess.

Proceed with the test items in exactly the same way as the practice item.

> (Prompt)
> If taking a long time prompt with: *Which word do you think fits best?*

As I said before, don't forget your story as I will be asking more about it at the end. I might also ask you to do some more maths at the end too.

→ Second saliva sample?

Attention Network Task

Instructions given for computer task. Task takes approximately 17 minutes.

As I said before, don't forget your story as I will be asking more about it at the end. I might also ask you to do some more maths at the end too.

→ Second saliva sample?

→ Second saliva sample
20 minutes after stress test.
I would like you to spit some more saliva into this pot.

☺ Third visual scale: Immediately after second saliva sample
Can you please tell me how you are feeling at the moment using the scale again.

End of testing

☺ Fourth visual scale: Immediately after last task.
Can you please tell me how you are feeling at the moment using the scale again.

Can you remember the story you made up at the beginning? Is there anything else you would like to add to it?

I'm not going to ask you any more questions about it and I don't need to ask you any more maths questions.

You've done all the tasks that I wanted you to do and you've done really well. I know some of them were quite hard, but you did really well.
Give child one example of something they did well.

Shall we do something fun before you go back to class? Lets play a game of hangman!

☺ Final visual scale
Can you tell me how you are feeling again, using the scale?

Thank you for all your hard work today, I am very impressed. When we have finished seeing everyone in your class, we will come back and tell your whole class more about why we have asked you to do these games and activities today. You will be able to ask any questions then, but I was wondering if you had any questions you would like to ask me now?
Great, let's go back to class.

Control condition

I'm going to tell you the beginning of a story, listen carefully because I'd like you to make up an ending to the story. I'm not going to ask you tell me your story, but I'd just like you to have a think about it.

Yesterday my best friend Robert and I went home from school, suddenly we had the idea to visit Mr Gregg who lived in the big old house located in the dark forest near our town. Mr Gregg was a crazy old man and our parents didn't like the idea that we sometimes went visiting him. There was a rumour in town that there was a mystery about the old house. When we arrived at the house, we were surprised that the door was open. Suddenly we heard a strange noise, and cautiously we entered the dark hall.......

What do you think happens next? I'm going to give you for 2 minutes to prepare your ending to the story. It can be as exciting as you like. The story is for you to keep to yourself, you won't have to tell it to anyone. I'd just like you to think about it. Whilst you're doing that, I'll sit here and do some reading.

Experimenter stays in room, but does not pay attention to child, gets on with "own work".

If child asks what the point is say

It's just a thinking task/ a task for you to do some thinking

If child asks you to repeat story say
Try and remember the best you can, it doesn't matter if you can't remember all of the story I read you, but think to yourself about what may happen next. Remember, you won't have to tell anyone.

If child tries to start conversation (unless related to distress/ wanting to stop), say.....
Try and keep going through this bit without talking, as it is important for the study. Think of other things to add into your story. Maybe you could think of other people who could be in the story.

After 2 minutes
That's 2 minutes up. Like I said, you don't need to tell me your story, but I'd like you to either write some of your story down or draw a picture of something in your story. I'm not going to ask to see your writing or drawing, the exercise is just for you to do some thinking.
Give 3 minutes.

If child finishes before 3 minutes encourage them to continue.
Can you think of anything else you would want to write/draw about the story?

Mental arithmetic task
Now I would like you to do some arithmetic. It's just going to be in your head – you don't need to tell me the answers. You're going to do this for 3 minutes. I would like you to take away 7 from 758, then continue taking away 7 from each answer. For example 758 take away is 751, then you would take away 7 from 751 and so on.... Off you go...
(time 3 minutes)
How did you find that? It's quite difficult isn't it.

☺ Second visual scale
Have another look at this scale, can you show me how you are feeling at the moment using the scale again.
Great, are you feeling ok to carry on?

Tasks
Tasks were administered the same as in the stress condition. No reminders about further story or maths tasks were given between tasks as in the stress condition.
→ Second saliva sample
20 minutes after stress test.
I would like you to spit some more saliva into this pot.

☺ Third visual scale: Immediately after second saliva sample
Can you please tell me how you are feeling at the moment using the scale again.

End of testing

☺ Fourth visual scale: Immediately after last task.
Can you please tell me how you are feeling at the moment using the scale again.

You've done all the tasks that I wanted you to do and you've done really well. I know some of them were quite hard, but you did really well.
Give child one example of something they did well.

Shall we do something fun before you go back to class? Lets play a game of hangman!

☺ Final visual scale
Can you tell me how you are feeling again, using the scale?

Thank you for all your hard work today, I am very impressed. When we have finished seeing everyone in your class, we will come back and tell your whole class more about why we have asked you to do these games and activities today. You will be able to ask any questions then, but I was wondering if you had any questions you would like to ask me now?
Great, let's go back to class.

Appendix E: The Strange Stories (Happe, 1994): The Stories, Scoring and Examples of Answers

<u>**Strange Stories Task Instructions**</u>

Providing context-appropriate mental state explanations for story characters' non-literal utterances

Participants are read a number of stories and have to answer a simple justification question about each story. Eight of the stories involve mentalizing and participants have to answer the question correctly using mental state terms. Five of the stories are controls and do not require any mentalizing to answer them correctly.

There are 2 conditions in this task:
  8 = Theory of mind – stories to do with mental states
  5 = Control (physical) – stories to do with physical behaviour

<u>**The stories**</u>

Practice Story: On Christmas Eve Alice's mother takes her to the big department store in town. They go to look in the toy department. In the toy department Mr. Brown, Alice's next-door neighbour, is dressed up as Santa Claus, giving out sweets to all the children. Alice thinks she recognises Mr. Brown, so she runs up to him and asks, "Who are you?" Mr. Brown answers, "I'm Santa Claus!"

Q: Why does he say this?

11. Two enemy armies have been at war for a very long time. Each army has won several battles, but now either side could win. The two sides are equally strong. However, the Blue army is stronger than the Yellow army in foot soldiers and tanks. But the Yellow army is stronger than the Blue Army in aeroplanes. On the day of the final battle there is heavy fog over the mountains where the fighting is about to begin. Low clouds hang above the soldiers. By the end of the day the Blue army has won.

Q: Why did the Blue army win?

12. A burglar is about to break into a jewellery shop. He skillfully picks the lock on the shop door. Carefully he crawls under the electronic detector beam. If he breaks this

beam it will set off the alarm. Quietly he opens the door of the store-room and sees the gems glittering. As he reaches out, however, he steps on something soft. He hears a screech and something small and furry runs out past him, towards the shop door. Immediately the alarm sounds.

Q: Why did the alarm go off?

13. Mrs. Simpson works in a library. One day she receives a special book and has to decide where to put in the library. The library is very big, and has many different sections. The new book is about plants and their medical uses, and has lots of drawings in it. However, Mrs. Simpson does not put it with the books on plants. She does not put it with the books on medicine either. Instead, she carefully takes it into a separate room. In this room all the books are kept in special cases, and the temperature is kept constant.

Q: Why did she do this?

14. Old Mrs. Robinson is very frail. One day she slips on her icy door step and falls on her side. She gets up right away, although she feels quite bruised and shaken. The next day her leg feels very stiff and she can hardly walk. She makes her way to the doctors. As soon as the doctor hears about the fall, and sees her swollen side, he says, "Go immediately to casualty". At the casualty department they take an X-ray.

Q: Why did they take an X-ray?

15. John is going shopping. He buys a nice new desk lamp, for his study. He needs a light bulb for his new lamp. He goes from the furniture shop to the electrical shop. In the electrical shop he finds that there are two brands of light bulb of the right kind. Everbrite light bulbs cost less in single packs than Literite bulbs. However, only Literite bulbs come in multi-packs of six. John buys the multi-pack, even though he only needs one bulb.

Q: Why does John buy the Literite bulbs?

21. Simon is a big liar. Simon's brother Jim knows this, he knows that Simon never tells the truth! Now yesterday Simon stole Jim's ping-pong bat, and Jim knows Simon has hidden it somewhere, though he can't find it. He's very cross. So he finds Simon and he says, "Where is my ping-pong bat? You must have hidden it either in the cupboard or under your bed, because I've looked everywhere else. Where is it, in the cupboard or under your bed?" Simon tells him the bat is under his bed. Jim goes straight to the cupboard.

Q: Why will Jim look in the cupboard for the bat?

22. During the war, the Red army captures a member of the Blue army. They want him to tell them where his army's tanks are; they know they are either by the sea or in the mountains. They know that the prisoner will not want to tell them, he will want to save his army, and so he will certainly lie to them. The prisoner is very brave and very clever, he will not let them find his tanks. The tanks are really in the mountains. Now when the other side ask him where his tanks are, he says, "They are in the mountains".

Q: Why did the prisoner say that?

23. Brian is always hungry. Today at school it is his favorite meal - sausages and beans. He is a very greedy boy, and he would like to have more sausages than anybody else, even though his mother will have made him a lovely meal when he gets home! But everyone is allowed two sausages and no more. When it is Brian's turn to be served, he says, "Oh, please can I have four sausages, because I won't be having any dinner when I get home!"

Q: Why does Brian say this?

24. Jill wanted to buy a kitten, so she went to see Mrs. Smith, who had lots of kittens she didn't want. Now Mrs. Smith loved the kittens, and she wouldn't do anything to harm them, though she couldn't keep them all herself. When Jill visited she wasn't sure she wanted one of Mrs. Smith's kittens, since they were all males and she had wanted a female. But Mrs. Smith said, "If no one buys the kittens I'll just have to drown them!"

Q: Why did Mrs. Smith say that?

25. One day Aunt Jane came to visit Peter. Now Peter loves his aunt very much, but today she is wearing a new hat; a new hat which Peter thinks is very ugly indeed. Peter thinks his aunt looks silly in it, and much nicer in her old hat. But when Aunt Jane asks Peter, "How do you like my new hat?", Peter says, "Oh, its very nice".

Q: Why does he say that?

26. Helen waited all year for Christmas, because she knew at Christmas she could ask her parents for a rabbit. Helen wanted a rabbit more than anything in the world. At last Christmas Day arrived, and Helen ran to unwrap the big box her parents had given her. She felt sure it would contain a little rabbit in a cage. But when she opened it, with all the family standing round, she found her present was just a boring old set of encyclopedias, which Helen did not want at all! Still, when Helen's parents asked her how she liked her Christmas present, she said, "It's lovely, thank you. It's just what I wanted".

Q: Why did she say this?

27. Late one night old Mrs. Peabody is walking home. She doesn't like walking home alone in the dark because she is always afraid that someone will attack her and rob her. She really is a very nervous person! Suddenly, out of the shadows comes a man. He wants to ask Mrs. Peabody what time it is, so he walks towards her. When Mrs. Peabody sees the man coming towards her, she starts to tremble and says, "Take my purse, just don't hurt me please!"

Q: Why did she say that?

28. A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn't know the man is a

burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, "Hey, you! Stop!", the burglar turns round, sees the policeman and gives himself up. He puts his hands up and admits that he did the break-in at the local shop.

Q: Why did the burglar do that?

Scoring:

Answers are scored as follows (see below for examples):

- 2 = full and explicitly correct answer
- 1 = partial or implicit answer
- 0 = incorrect or don't know

Examples:

p1. Armies   'Why did the blue army win?'
2 = ref to both weather conditions and relative ground superiority, inability of other army's planes to be useful in fog (names of armies unimportant)
1 = ref either to weather OR to relative superiority on ground vs air.
0 = ref to irrelevant or incorrect info (e.g. they won cos they had better planes)

p2. Burglar   "Why did the alarm go off?
2 = ref to animal, which the burglar disturbed, setting off the alarm (n.b. type of animal unimportant, e.g. cat, mouse, rat all okay).
1 = ref to burglar setting off alarm, e.g. being startled by animal and so crossing the beam.
0 = ref to irrelevant or incorrect facts (e.g. the animal's screech set off the alarm).

p3. Librarian   'Why did she do this?
2 = ref of delicate condition of book due to age, value and may ref temp control on room
1 = general ref to special status of book, not further explained (e.g. to keep it safe)
0 = ref to other motivations not warranted by story (e.g. so she would always know where to find it. For her own convenience).

p4. Leg   "Why did they take an X-ray?"
2 = ref to possibility that she has fractured/broken her hip/leg (e.g. they want to see if she has broken anything).
1 = ref to general aim (e.g. to see what's wrong. Because of her fall).
0 = ref to irrelevant or incorrect factors (e.g. that's what doctor's do).

p5. Lightbulbs   'Why does John buy the literite bulbs?'
2 = ref to saving money (since multipacks are cheaper). NB may also, but needn't mention convenience of having more, or future need of more bulbs.

1 = ref to convenience of having more, or future need for more than one bulb (e.g. so wont have to keep going to the store) No mention of saving money.

0 = ref to irrelevant or incorrect facts (e.g. he likes the literite the best. He needs a whole lot of bulbs.

m1. Brothers   **'Why will Jim look in the cupboard for the bat?'**

2 = ref to Simon having lied, being a liar, Jim knowing Simon lies etc.

1 = ref to facts without explicit mention of lying - e.g. That's where it is really

0 = ref to general, story non-specific info e.g. things are usually left in cupboards.

m2. Armies   **"Why did the prisoner say that?"**

2 = ref to fact that other army will not believe and hence look in other place, to prisoner's realisation that that's what they'll do, or ref to double bluff.

1 = ref to outcome – to save the armies tanks, or simply lying (to mislead them, to lie)

0 = ref to motivation that misses the point of double bluff (e.g. because he was scared and wanted to tell the truth).

m3. Sausages   **"Why does Brian say this?"**

2 = ref to intention to mislead, persuasion, making them feel sorry for him.

1 = ref to outcome (to get more), simply trait (greedy), or simple desire (wants more sausages).

0 = ref to irrelevant facts (e.g. because his mum will have made him a lovely meal).

m4. Kittens   **"Why did Mrs. Smith say that?"**

2 = ref to persuasion, manipulating feelings, trying to induce pity/guilt, etc

1 = ref to outcome (to sell them).

0 = ref to general knowledge or dilemma without realisation that statement was not true (e.g. she couldn't keep all of them. It's kinder to kill them. She's a horrible woman, she hates cats).

m5. Hat   **'Why did she say that?'**

2 = ref to white lie or wanting to spare his aunt's feelings

1 = more general ref to trait (he's a nice boy) or relationship (he likes his aunt)

0 = ref to irrelevant or incorrect fact/feelings (e.g. he likes the hat. He wants to trick her)

m6. Rabbit   **'Why did she say this?'**

2 = ref to white lie or wanting to spare her parents feelings

1 = more general ref to trait (e.g. she's nice) or emotion (she things it's better than no present at all)

0 = ref to irrelevant or incorrect fact/feelings (she likes the books. She's a hypocrite!)

m7. Mrs Peabody   **'Why did she say that?'**

2 = ref to her belief that he was going to mug her, or her ignorance of his real intention

1 = ref to her trait (she's a nervous person) or state (she's scared), or intention (so he wouldn't hurt her) without suggestion that fear was unnecessary.

0 = factually incorrect/irrelevant answers (e.g. he would like to kill her if she didn't give the purse)

m8. Burglar   "Why did the burglar do that?"
2 = ref to burglar's ignorance of policeman's true intention/knowledge state (e.g. he didn't know the policeman just wanted to return his glove. He thought the policeman had seen him rob the shop).

1 = more general ref to burglar's state of mind (e.g. he had a guilty conscience) or outcome (He thought the police might shoot otherwise).

0 = ref to irrelevant facts/mental states (he just wanted to come clean. He was tired of running. The police had his glove).

Appendix F: The Eyes Test (Baron-Cohen, 2001): An Example

1. **Female**

   Correct answer = sure about something

surprised   sure about something

joking   happy

Appendix G: Visual Analogue Scale

1 2 3 4 5 6 7 8 9 10

Very calm
and relaxed

Very stressed and
not at all relaxed