Autism, Empathy, and Theory of Mind Over Time: Does Gender Make a Difference?

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Abstract

Individuals with autism spectrum disorder (ASD) typically display difficulties with theory of mind (ToM), which is the ability to attribute and recognize mental states in oneself and in others, and to use this information to infer and predict behaviours. Given that ToM is an essential requirement for empathy, it is hypothesized that difficulties with empathy and ToM underpin many of the social and communication difficulties observed in autism. However, research is lacking concerning possible sex differences in the cognitive profiles of males and females with autism, and how ToM and empathy may change over time. Thus, the proposed study will investigate possible sex differences in ToM and empathy over time (i.e., 10-years) with a sample of autistic and neurotypical children. Four hundred children (M_{age} = 5.0) will be recruited and will be evenly split by gender (male vs. female) and by neurodevelopmental status (i.e., autistic vs. neurotypical). Participants will undergo ToM and empathy tasks, and will complete an empathy questionnaire over the course of three sessions (i.e., every five years). The main hypothesis is that autistic females will exhibit a significant increase in cognitive empathy over time, and their ToM deficits will decrease over time, as compared to autistic males. This study will provide vital information concerning the developmental trajectories of ToM and empathy for autistic individuals, and will help address whether or not ToM deficits can decrease over time.

Keywords: ASD, female autism phenotype, empathy, theory of mind, sex differences

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Possessing a theory of mind (ToM), such that one can understand other people's mental states, is important for developing social skills and is a key component of the development of empathy (Baron-Cohen, 2002). This is because an intact ToM allows people to understand and interpret their own mental states and the states of others, resulting in an ability to predict and explain behaviour (Mazza et al., 2006). Given that social impairment is considered an underlying deficit of autism, it is not surprising that a long-standing assumption is that people with autism lack a ToM. Indeed, research indicates that approximately 80% of autistic persons fail to attribute a false belief in a common ToM task (Baron-Cohen, Leslie, & Frith, 1985). However, some autistic participants with normal verbal IQ perform indistinctly from controls in ToM tasks, even when tested with more complex tasks (e.g., second-order tasks, such as recognizing that one can hold false beliefs about someone else's belief) (Happé, 1994).

The fact that some autistic persons are able to pass ToM tasks has been interpreted as proof of their possessing a ToM (Baron-Cohen, 1989). Given this, it has been suggested that children with autism display the same progressive order of ToM development as typically developing children, but are merely delayed in their age of acquisition (Kimbi, 2014). For example, children with ASD have been shown to pass false-belief tasks at age 9, rather than at age 4, like neurotypical children tend to do (Broekhof et al., 2015). This finding implies that autistic persons may exhibit a different developmental pattern in acquiring ToM, as compared to typically developing persons (Pino et al., 2017; Yirmiya et al., 1996).

It has also been suggested that the social impairments in autism that are thought to be caused by a ToM deficit may be caused by a different cognitive impairment (Happé, 1994). For example, the social-affective theory suggests that ToM deficits are caused by a distortion in

recognizing and responding to emotions (Mazza et al., 2014; Pileggi et al., 2015). This is important because, in order to appropriately recognize and respond to emotions, a person must have intact affective empathy (i.e., appropriately respond to the affective state of another person) and cognitive empathy (i.e., be able to understand and predict others' behaviour). Given that ToM appears to be an essential requirement for empathy (Declerck & Bogaert, 2008), it is not difficult to envision how empathy and ToM difficulties may both underlie many of the social and communication deficits observed in autism (Montgomery et al., 2016).

In the following sections, I will discuss research related to autism, ToM, and empathy. In particular, I will elucidate differences in the male and female presentations of autism, and how these differences may impact ToM development. I will then discuss the empathy imbalance hypothesis (EIH) of autism and its relationship to both the female autism phenotype and to ToM. Finally, I will end with my overarching research questions, hypotheses, study method, proposed analyses, limitations, and implications.

Autism Spectrum Disorder and the Female Autism Phenotype

Autism Spectrum Disorder (ASD) is a life-long neuro-developmental disorder characterized by impairments in social interaction and communication, restricted areas of interest, and highly repetitive behaviours (American Psychiatric Association, 2013). ASD rests on a continuum, with low-functioning autism on one end, and high-functioning autism on the other end (American Psychiatric Association, 2013). For the remainder of this paper, I will use the terms ASD and autism to apply to traits traditionally associated with the high-functioning range of behaviours.

Recently, researchers have begun to investigate sex-related differences along the autism spectrum, especially within the high-functioning range of behaviours. Within this range, the

male-to-female ratio of diagnoses varies considerably, reaching 5.7:1-11:1 (Baird et al., 2006). One explanation for this disparity is that females with higher intellectual ability exhibit different autism traits – termed the female autism phenotype – than those observed in males, causing more delays in diagnosing females (Lai et al., 2015).

Although a clear depiction of this phenotype has not yet developed within the literature (Howe et al., 2015), the phenotype appears to be comprised of the following characteristics: Improvement in reciprocal expression in conversations, assimilation of verbal and nonverbal behaviours, improved imagination, better adjusting behaviours per situation, better capability of learning facial expressions and eye contact, and an augmented intellectual grasp of the rules surrounding socializing, emotions, and relationships (Lai et al., 2015; Head et al., 2014; Hiller, Young, & Weber, 2014; Lai et al., 2011; Dworzynski et al., 2012). Additionally, autistic females appear to possess greater empathizing ability (Auyeung et al., 2009). Given these differences, one would expect a different developmental trajectory to emerge for empathy – and possibly for ToM ability – in autistic females, as compared to autistic males.

Theory of Mind

In its most basic form, theory of mind (ToM) is the ability to attribute and recognize mental states in oneself and in others, and to use this information to infer and predict behaviours (Pedreño, Pousa, Navarro, Pamias, & Obiols, 2017). Developmentally speaking, during age two and three years, typically developing children begin to use mental and emotional state words (Izard & Harris, 1995), and their speed of emotion recognition improves throughout childhood (De Sonneville et al., 2002). Over time, they begin to recognize more refined mental and emotional states, which continue to develop into adolescence and adulthood (Vicari, Reilly, Pasqualetti, Vizzotto, Caltagirone, 2000).

Research indicates that both children and adults with autism have difficulty with first-order false beliefs (i.e., recognizing that another person holds a belief that is incorrect), which are typically understood by 4-year-old neurotypical children (Baron-Cohen, Leslie, & Frith, 1985; Happé, 1995). Autistic persons also have difficulty with second-order false beliefs, which are typically understood by neurotypical children at 6 years old (Baron-Cohen, 1989). Such ToM deficits suggest there is a cognitive explanation for the social-communication problems that are characteristic of autism (Lai, Lombardo, Auyeung, Chakrabarti, Baron-Cohen, 2015). One of the most profound consequences of a ToM deficit is that persons with this deficit will have difficulty imagining the world from the perspective of other people, and will have trouble tracking the mental states of others during real-life interactions (Baron-Cohen et al., 2015).

Currently, few studies have examined sex differences in ToM development in typically developing children, and even fewer (if any) have specifically examined sex differences in autistic children. Of the extant literature, typically developing children age 6-8 years continue to show progression of performance with ToM tasks at this age. In addition, typicaly developing girls show a significant advantage over boys in ToM performance (Calero, Salles, Semelman, & Sigman, 2013). Whether this ToM advantage also extends to autistic females warrants further investigation.

There is a longstanding belief that mastering a false-belief task provides evidence of a mature ToM, but more recently researchers have posited that ToM ability encompasses much more than that (Blijd-Hoogewys, van Geert, Serra, & Minderaa, 2008). For example, ToM likely encompasses the understanding of desires and emotions of others (Astington, 2001). Hence, research has shifted its focus from specific false belief understanding to a more developmental view of how children develop various ToM components over time (Steele et al., 2003). For

example, investigating how children shift from understanding first-order beliefs to understanding second-order beliefs (Blijd-Hoogewys et al., 2008). One way to study the various constituents of ToM more comprehensively is to incorporate tasks that focus on core ToM components (e.g., desires, beliefs), and on other aspects, including recognizing emotions, perception of knowledge, and the difference between physical and mental entities (Blijd-Hoogewys, et al., 2008). Doing so should result in a more comprehensive test of ToM ability.

Baron-Cohen (1995) coined the term "mindblindness" to describe the ToM deficits typically observed in autism. He regarded mindblindness as a core deficit in autism, but this conclusion has been criticized in the literature. For example, one criticism is that ToM deficits are not exclusive to autism. Not only that, but doing well on standard ToM tests appears to be determined by linguistic ability (e.g., Gernsbacher & Frymiare, 2005). However, research is mixed, given that a study examining ToM with a nonverbal method in children with autism and children with a language impairment uncovered evidence of a cognitive empathy deficit in the autism group, suggesting that a ToM deficit in autism still exists, despite the use of a nonverbal measure of ToM (Colle, Baron-Cohen, & Hill, 2007). Overall, these findings suggest that a ToM deficit is somehow connected to autism, although the exact link is currently unknown. Further research is required to better clarify this link.

One way to clarify such a link would be to examine developmental changes in ToM over time in autistic and neurotypical samples. Although there is currently little known about the "mechanisms underpinning changes in symptom severity across development" (Livingston & Happé, 2017, p. 729), Livingston and Happé (2017) introduced a theoretical model to address this question. They posit that when behaviours in a condition improve, such that symptoms are reduced, this improvement is due to one of two reasons. Either the core underlying abnormalities

did improve over time, or, equally possible, the perceived improvement is due to a false appearance of improvement – termed 'compensation'. In cases of delayed maturation, where the development of a cognitive ability is delayed, (e.g., theory of mind in autistic children), they suggest that the underlying ability should, at some point, "become neurotypical"; however, its late emergence "may leave 'scars' because a critical window has been missed in development" (Livingston & Happé, 2017, p. 731). It is worth noting that an individual who is compensating for cognitive deficits may not necessarily be exhibiting a milder form of their condition; on the contrary, severe and persistent deficits may still be present (Livingston & Happé, 2017).

In Livingston and Happé's (2017) model, an individual may move, theoretically, from compensation (i.e., shallow or deep) to genuine remediation or delayed maturation. A ToM deficit is used to illustrate this model, but the authors indicate that any underlying cognitive ability and neurodevelopmental disorder could be substituted. It must also be noted that at this time, the model is entirely theoretical; empirical investigation is necessary to determine the validity and strength of the model. Nevertheless, the model proposes that in the shallow compensation stage, a clear ToM deficit is observed when measured with sensitive ToM tasks, but individuals may be able to solve some ToM tasks through logical reasoning. In the deep compensation stage, there is no clear ToM deficit because compensation has now extended to the cognitive level and good performance on ToM tasks may come at a cost to slow response time. In the next stage, genuine remediation, there is no ToM deficit on implicit or explicit ToM tasks, and the ToM deficit has genuinely resolved itself. In this stage, the authors suggest that ToM tasks should be just as effortful for autistic individuals as they are for neurotypicals.

Finally, in the last stage, delayed maturation, there is no obvious ToM deficit, but ToM ability may have matured too late to have much of an impact on the overall system. Persons in

this stage may still be able to attribute mental states, but will not be as quick as typically developing persons and will not be able to integrate multiple cues. The authors conclude that longitudinal studies should be conducted to establish whether ToM acquisition for autistic individuals follows the same order as neurotypicals, or whether autistic individuals experience a considerably large delay in ToM acquisition. Given this theoretical basis, the proposed study seeks to investigate the developmental trajectory of ToM ability, via a 10-year longitudinal study, using a sample of neurotypical and autistic 5-year-old children.

Empathy

Empathy is defined as a feeling and understanding of others' emotions that is essential for caring for others (Stern & Cassidy, 2018). More eloquently put, empathy is "the capacity to comprehend the minds of others, to feel emotions outside our own, and to respond with concern, kindness, and care to others' suffering" (Stern & Cassidy, 2018, p. 1). Interestingly, research suggests that autistic persons score significantly lower than typically developing persons on empathy questionnaires, for both self-report and parent-report measures of empathy (Baron-Cohen, et al., 2014; Auyeung, et al., 2009; Baron-Cohen & Wheelwright, 2009). Given this, it is reasonable, and necessary, to investigate whether an empathy deficit can explain the ToM deficiencies typically observed in autistic individuals.

With this in mind, the empathy imbalance hypothesis (EIH) suggests that autism is characterized by a deficit in cognitive empathy and an overabundance of emotional or affective empathy (Smith, 2009). Cognitive empathy is the ability to understand and predict others' behaviour (Smith, 2009). Given this definition, some have claimed that cognitive empathy is therefore synonymous with ToM (e.g., Baron-Cohen, 2015; Blair, 2005). In contrast to cognitive empathy, affective empathy constitutes the emotional response a person experiences that "stems

from and parallels" the affective state of another person (Smith, 2009, p. 274). As an illustration of the EIH, in the real-world many autistic persons have reported not realizing they have upset someone, which is an indication of impaired cognitive empathy. At the same time, they feel remorse when this social blunder is pointed out to them, which is a sign of intact affective empathy (Baron-Cohen & Wheelwright, 2004; Mazza, et al., 2014). While autistic persons appear to have difficulty with certain ToM tasks (e.g., false belief tests, second-order beliefs, irony, metaphors, white lies, double bluffs), these tasks are associated with aspects of cognitive empathy that typically developing people acquire intuitively (Baron-Cohen, 2000; Smith, 2009).

Although it is commonly stated that autistic persons lack empathy (eg., Yirmiya, Sigman, Kasari, & Mudy, 1992), others have recently suggested the exact opposite (e.g., Smith, 2009). That is, autistic persons, in order to cope with their empathy imbalance (i.e., excessive affective empathy and lack of cognitive empathy), may develop certain cognitive-behavioural styles to prevent "empathic over-arousal, personal distress, and confusion" (Smith, 2009, p. 279). In typical development, cognitive empathy is used to "regulate and resolve" (p. 495) affective empathy responses (Smith, 2009). However, those with autism may choose to narrow their attention (e.g., try to ignore empathetic feelings) in order to regulate their augmented affective empathy, resulting in a façade that makes it appear as if they lack empathy.

In previous research, the multifaceted empathy task (MET), which is a computerized empathy task, has been used to measure cognitive and affective empathy in autistic persons and controls. One study found that autistic persons displayed intact affective empathy, but reduced cognitive empathy (Dziobek et al., 2008). Another study found that children with autism displayed significantly more affective empathy than typically developing children (Capps, Kasari, Yirmiya, & Sigman, 1993). Finally, youth (age 9-17 years) with ASD exhibited less

cognitive empathy than controls, but still scored within the average range on affective empathy (Rueda, Fernandez-Berrocal & Baron-Cohen, 2015).

Interestingly, in terms of sex differences, research indicates that autistic females typically score significantly higher than autistic males in empathy tasks (Sucksmith, Allison, Baron-Cohen, Chakrabarti, Hoekstra, 2013). Although Mazza et al. (2014) found that adolescents with ASD showed deficits with cognitive and negative affective empathy, but not for positive affective empathy, as compared to neurotypicals, it is important to note that 73% of the autistic participants in this study were male. Thus, it is possible that results would be different for autistic females, given certain characteristics of the female autism phenotype (e.g., increased global empathy ability and ToM advantage in typically developing girls). Nevertheless, such findings lead credence to the empathy imbalance hypothesis (EIH), which suggests that difficulties with ToM in autistic persons may be due – at least in part – to a limited capacity for cognitive empathy and an overabundance of affective empathy.

Baron-Cohen et al. (2015) remarked that, if the mindblindness hypothesis of autism is correct, the following empathy scores should be observed: *typically developing female > typically developing male > people with autism*. In other words, the mindblindness theory does not predict sex differences to emerge between males and females with autism. In contrast, the EIH allows for the possibility that gender differences could emerge on both affective and cognitive empathy for autistic participants, which is in agreement with what the female autism phenotype would predict. As can be seen from this brief review of the literature, there is still much to uncover regarding the proposed links between autism, empathy, and theory of mind.

Proposed Study

The proposed study seeks to address the following gaps in the literature. Firstly, many studies examining the link between ToM and autism lack adequate female representation. For example, many studies have included only 10-20% of female participants with ASD (e.g., Rueda et al., 2015). Secondly, there are few, if any, longitudinal studies examining the developmental trajectory of ToM and empathy in autistic children. Thirdly, given that Livingston and Happé's (2017) theoretical model lacks empirical testing, the proposed study will investigate the strength of this model using empirical and longitudinal methods to examine the developmental trajectory of ToM ability over time. Fourthly, the EIH allows for the possibility that autistic females, as opposed to autistic males, may exhibit different levels of affective and cognitive empathy, which suggests that autistic females may also exhibit better ToM than autistic males, if the EIH hypothesis is accurate. In contrast, Baron-Cohen's mindblindness hypothesis does not allow sex differences to emerge for autistic individuals on levels of empathy or ToM. Lastly, given the proposed female autism phenotype, it is important to investigate the developmental trajectory of empathy and ToM over time in autistic females, and whether it differs from the developmental trajectory of autistic males. With these gaps in mind, my overarching research questions are as follows: What is the developmental trajectory of ToM deficits in an autistic sample? Can these deficits decrease over time? Is the developmental trajectory different for autistic females?

Based on the aforementioned literature, I have four hypotheses. Firstly, on average, the experimental condition (collapsed across gender) will exhibit significantly greater ToM deficits at baseline and over time (i.e., from session 1 to session 3), such that the control condition will score higher on the multifacted empathy task (MET), ToM task, and cognitive and affective empathy scales, as compared to the experimental condition. However, when separated by gender,

only male participants with ASD will significantly differ from neurotypical participants (both male and female) on the MET task, ToM task, and cognitive and affective empathy over time. Secondly, autistic females will exhibit significantly greater affective and cognitive empathy scores at baseline as compared to autistic males, but will show a significant increase in cognitive empathy over time, as compared to autistic males. Thirdly, ToM deficits will significantly decrease over time, but only in the autistic female participants, as compared to the autistic males. Lastly, if the empathy imbalance hypothesis of autism is accurate, ToM scores should be negatively correlated with affective empathy scores, and positively correlated with cognitive empathy scores at session 3.

Method

Participants

It is important to note that longitudinal research can be particularly cumbersome, as participants can drop out of the study at any time. Attrition rates are particularly elevated for long-term research studies. For example, Gustavson, Soest, Karevold, and Roysamb (2012) reported that after 15 years, 56% of participants ($N = 913$) dropped out of a longitudinal study examining the developmental trajectory of children and their families in the general population. Furthermore, there are additional considerations to be made specifically for children with ASD. For example, in one psychophysiology study, attrition rates for young children with autism were higher than attrition rates observed in non-autistic children (e.g., 11.4% versus 4.7%, respectively) (Ruysschaert et al., 2014).

Given such concerns over the issue of attrition and adequate sample size, I conducted a power analysis with G*Power software to determine an acceptable sample size for my proposed study. Previously, Fischer, O'Rourke, and Thornton (2016) reported a moderate effect size

(*Cohen's f* = 0.375) for the Strange Stories method of assessing ToM. Although my proposed study will use the same ToM measure, Fischer et al. (2016) assessed ToM ability in neurotypical young adults (M_{age} = 19.80 years), rather than children. Thus, I calculated my analysis with a moderate effect size (*Cohen's f* = .250), in order to ensure adequate power for my specific sample (i.e., autistic and neurotypical children). The analysis specified a minimum sample size of 279 participants for an Analysis of Covariance (ANCOVA) test, with four groups (i.e., male vs. female; autistic vs. neurotypical) and .95 power. Given that the proposed study will occur over a period of 10 years – and will include children with ASD – I will account for attrition rates by recruiting a maximum number of 400 participants (M_{age} = 5.0), with the goal of retaining a minimum sample size of 70 participants per group, which should maintain adequate power and pass assumptions of normality.

In terms of recruitment, the control group will be recruited from elementary schools in Southern Ontario (n = 100 neurotypical females; n = 100 neurotypical males). The experimental group will be recruited from a variety of community organizations specializing in autism services in Southern Ontario (e.g., Autism Ontario, Woodview Mental Health and Autism Services, Waterloo Region Family Network, etc.) (n = 100 autistic females; n = 100 autistic males). The groups will be split by gender and by neurodevelopmental status (i.e., neurotypical vs. autistic), resulting in 4 groups with 100 participants in each group.

Regarding inclusion criteria, participants who wish to participate must be five years of age, as ToM typically develops around the age of four or five in neurotypical children (Callaghan et al., 2005; Happé & Frith, 2014). In order to participate, participants in the experimental condition must already have a primary diagnosis of ASD, Level 1 (no language impairment) (American Psychological Association, 2013), and must not be diagnosed with additional

neurodevelopmental conditions (e.g., pervasive developmental disorder, learning disabilities, etc.), which could otherwise distort the results. Finally, siblings will not be permitted to participate – unless the siblings are both neurotypical or both autistic – as the broad autism phenotype indicates that, in the case of the neurotypical group, neurotypical family members of an autistic child typically exhibit greater autism traits, as compared to the general population (Losh, Childress, Lam, & Piven, 2008). In other words, it is important to keep the conditions as distinct from each other as possible.

Participants and their parents will be asked to attend three study sessions over the course of 10 years. In each session, parents will complete measures that assess their child's level of autism characteristics. The participants (i.e., children) will be asked to complete tasks and scales that measure empathy and ToM ability. To ensure that the empathy task is an accurate representation of empathy, participants will complete the Basic Empathy Scale, which will act as a check for convergent validity. Participants whose scores on the empathy scale do not correspond with scores on the multifaceted empathy task (MET) will be excluded from further analyses. Scales are attached as Appendices. After completing each session, participants and their parents will be debriefed and provided with compensation for participating in that session. For each session, the parent will receive $75 in compensation for participating, and the child will receive a $25 Walmart gift card.

Materials

Autism Spectrum Quotient (Child Version) (AQ-10 Child). All parents will be asked to complete the AQ-10 Child scale (Allison, Auyeung, Baron-Cohen, 2012) on behalf of their children who are participating in the study. The AQ-10 Child scale is comprised of 10 items that can be used to assess children, age 4-11 years, who are suspected of having high-functioning

autism. The scale assesses social skills, attention switching, attention to detail, communication, and imagination, all of which are behaviour characteristics traditionally associated with an ASD, Level 1 impairment. The AQ-10 Child scale is a condensed version of the 50-item AQ Child scale, and has been shown to have good reliability: $\alpha = .97$ (Auyeung, Baron-Cohen, Wheelwright, & Allison, 2008). Parents will be asked to rate statements on a 4-point Likert scale from *Definitely Agree* to *Definitely Disagree*. Example items include: *"S/he doesn't know how to keep a conversation going with his/her peers"* and *"S/he finds it hard to make new friends".* Typically, a cut-off score of 6 or above indicates the presence of elevated autistic traits, such that a specialist diagnostic assessment is recommended for the child. See Appendix A.

Autism Spectrum Quotient (Adolescent Version) (AQ-10 Adolescent). The AQ-10 Adolescent scale is the adolescent version of the AQ-10 Child scale (Allison et al., 2012). Like the AQ-10 Child version, the AQ-10 Adolescent scale is comprised of 10 items that assess social skills, attention switching, attention to detail, communication, and imagination. Unfortunately, no reliability information is currently available for this version of the scale. Nevertheless, parents will be asked to complete the AQ-10 Adolescent scale on behalf of their children, age 12-15 years who are suspected of having autism. Parents will rate statements on a 4-point Likert scale, from *Definitely Agree* to *Definitely Disagree.* Example items include: *"S/he finds it difficult to imagine what it would be like to be someone else"* and *"S/he frequently finds that s/he doesn't know how to keep a conversation going".* As before, a cut-off score of 6 or above indicates the presence of elevated autism traits. See Appendix B.

Questionnaire for Autism Spectrum Conditions (Q-ASC). The Q-ASC is a 61-item scale, designed to measure the perceptions of parents of children between the ages of 5-19 years who are suspected of having ASD, Level 1 impairment (Ormond et al., 2017). This scale is

included because it was created specifically for the purpose of detecting distinct autism profiles in males and females, making it a valuable tool to assess autism characteristics typically associated with the female autism phenotype (Ormond et al., 2017). This is important because many of the diagnostic tools used to assess autism are biased towards males (Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015). The Q-ASC assesses play, friendships and social situations, abilities and interests, and it includes a sensory profile and medical history. For questions 1-57, parents or caregivers will rate statements on a 4-point Likert scale, from *Definitely Agree* to *Definitely Disagree*, and will then answer yes or no for the remaining questions. Example items include: "*Do some social situations make him or her mute?"* and "*Is s/he distracted by certain smells or avoidant of certain tastes that are a part of a typical diet?"* Currently, no information is available concerning reliability, validity, or score cut-offs for this scale, but the authors state that higher scores indicate greater levels of autism traits, and more information will be released in upcoming publications. See Appendix C.

Controlling for supports. In addition to completing the above two scales, parents will be asked whether their child is currently receiving therapy (or other supports) to address behavioural issues. If the child is in the autism condition, the question will be tailored to problem behaviours associated with the child's ASD diagnosis. That is, parents will be asked: *"Is your child currently receiving any additional supports (e.g., therapy, interventions, etc.) for the purpose of addressing problem behaviours associated with his/her autism diagnosis?"* If the child is in the control condition, the question will be more general: *"Is your child currently receiving any additional supports (e.g., therapy, interventions, etc.) for the purpose of addressing problem behaviours?* This item will be used as a dichotomous (yes/no) covariate to control for the impact of therapy on all variables for both conditions.

Basic Empathy Scale (BES). The BES is a 20-item scale, designed to measure both cognitive and affective empathy in adolescents (i.e., around 15 years of age) (Joliffe & Farrington, 2005). The scale separates affective and cognitive empathy into two distinct subscales, both of which have been shown to have adequate reliability: $\alpha = .85$ and $\alpha = .79$, respectively (Joliffe & Farrington, 2005). For each item, participants will rate statements on a 5-point Likert scale, from *Totally disagree* to *Totally agree*. Sample items include: *"When someone is feeling 'down' I can usually understand how they feel"* and *"I often get swept up in my friends' feelings"*. See Appendix D.

Basic Empathy Scale - Child (BES-C). The BES-C is adapted from the adult version of the BES, which was originally developed for French schoolchildren (Bensalah, Stefaniak, Carre, & Besche-Richard, 2016). The BES-C contains 20 items that were modified so that they would be more easily understood by younger participants (i.e., aged 6-12 years). Research indicates that the overall scale has adequate reliability: $\alpha = .73$ (Bensalah et al., 2016). For each item, participants will rate statements on a 5-point scale. To ensure adequate understanding of response options, the scale includes smiling faces. Two smiling faces side-by-side indicate that the two faces agree, which is equivalent to *Totally agree* in the adult version of the BES. In contrast, a smiling face associated with a sad face indicates disagreement, which is equivalent to *Totally disagree* on the adult version of the scale. Research suggests that certain items in this scale should be specific to the gender of the participant in order to aid understanding and responsiveness (Findlay, Girardi, & Coplan, 2006); thus, for the proposed study, two gender-specific versions of the scale will be implemented. Example items include: *"I can understand the happiness a female friend feels when everything's going right for her"* and "*I often feel the same way as my classmates: happy when they're happy and sad when they're sad"*. See Appendix E.

Social Desirability Scale (SDS). The SDS (Bensalah et al., 2016) is adapted from the lie subscale of the Self-Esteem Inventory (Coopersmith, 1985). The SDS has been used in previous research with young children, as a means of measuring social desirability (e.g., Bensalah et al., 2016). For the purposes of the proposed study, the SDS will be used as a filler task in order to control for possible priming effects, as outlined in the procedure section below. The SDS contains 8 items that participants rate as either true or false. Scores of 5 or more indicate that the child may be exhibiting social desirability in their responses. Although the reliability for the SDS subscale is currently unknown, the Self-Esteem Inventory, from which the SDS is adapted from, has been shown to have adequate reliability: $\alpha = .70$ (Tatar, Saltukoglu, & Ozmen, 2018). Sample items include: "*I always speak the truth"* and *"I never feel happy"*. See Appendix F.

Multifaceted Empathy Test (MET). The MET (Dziobek et al., 2008; Kirchner et al., 2011) is a computerized task, consisting of 40 stimuli photographs. The MET was designed to measure cognitive and affective empathy, and to address shortcomings of other empathy measures that do not typically account for context. The MET has predominantly been used in its original German language, but was recently translated and psychometrically validated in English (Foell, Brislin, Drislane, Dziobek, Patrick, 2018). The stimuli photographs contain images of distressed people in different contexts and are supplemented with one target word and three distractor words (Dziobek et al., 2008). The images portray persons of varying genders, ages, ethnicities, and socio-economic statuses (e.g., man raising his arms proudly on a soccer field). Half of the images depict positive emotions (e.g., happiness, positive surprise), and the other half depict negative emotions (e.g., sadness, anger, disappointment). The images are to be presented twice, in order to measure affective and cognitive empathy separately, and are to be presented

randomly for each participant to reduce possible order effects. An example image of the MET is provided in Appendix G.

In my proposed study, I will assess affective empathy with the MET by asking participants to rate how strongly they experience the feelings of the person in the photo on a 9-point Likert scale (i.e., 1 = *"not at all"* to 9 = *"very strongly"*). To assess cognitive empathy, participants will be asked to infer the emotional state of the person in the image by selecting the target emotion out of a set of four options (with only one response being correct). The pictures will be displayed until a response is provided, and participants will be given in-depth instructions and be able to practice with various example items until they are comfortable with the process.

Cronbach's alpha for the English version of the affective empathy scale has been assessed by examining positive and negative valence on the affective empathy subscale separately, resulting in the following alphas: $\alpha = .93$, $\alpha = .94$, respectively. However, Cronbach's alpha for the English version of the cognitive empathy subscale (not separated by positive or negative valences) resulted in lower reliability: $\alpha = .49$ (Foell et al., 2018). Foell and colleagues (2018) suggest that the lower alpha for the cognitive empathy subscale may be overly conservative, as a factor-based greatest lower bound (glb) reliability analysis yielded a reliability estimate of .75, indicating adequate reliability.

In the proposed study, the difficulty of the stimuli photographs will be modified according to the age of the participants in each study session. For example, participants in the first session – who are expected to be five years of age – will be given modified stimuli photographs in order to make it comparatively easier to detect the target emotion (e.g., a crying face to show sadness). See Appendix H for an example of this modification. The stimuli photographs will become increasingly more complex and will be more difficult to determine the

target emotion over the course of the 10-year study. The underlying logic used to strengthen this design decision is the idea that if the MET task for 5-year-old participants (in session 1) is too difficult, the measure may create a floor effect in both conditions. Additionally, if the MET task is too easy for the now 15-year-old participants in session 3, the measure may create a ceiling effect. Thus, it will be important to ensure that the measure is not too difficult – nor too easy – for the participants as they age.

Theory of mind task. Participants will complete a ToM task designed to elicit a response that demonstrates the ability to infer the mental state of others (Happé, 1994). The proposed study will employ a ToM task that utilizes 24 short vignettes, termed Strange Stories. This task has been used with neurotypical participants (age range: 6.6 to 9.7 years; 15 to 24 years), and with autistic persons (age range: 8.9 to 45.1 years) (Happé, 1994), thus making it a useful tool for longitudinal research with autistic and neurotypical persons.

The vignettes focus on everyday events and situations, and are grouped into 12 story-types: lie, white lie, joke, pretend, misunderstanding, persuade, appearance/reality, figure of speech, sarcasm, forget, double bluff, and contrary emotions. There are six additional control stories that do not involve mental states, but involve unforeseen outcomes (e.g., power outage causes a meal to be undercooked) (Happé, 1994). Each vignette is presented with a picture and two questions; the comprehension question: “Was it true what X said?,” and the justification question: “Why did X say that?” (Happé, 1994). The comprehension question is used as a means of confirming that the participant fully understands the story. If the participant answers the comprehension question incorrectly, the story will be read to him/her again until adequate comprehension has been achieved. The justification question is scored as correct or incorrect. If the justification involves factual errors about the story, or includes inappropriate inferences, then

it will be scored as incorrect. This scoring method will yield a maximum score of 24 (i.e., all justifications are correct) and a minimum score of zero (i.e., no justifications are correct). See Appendix I for vignette examples. In order to assess progression in ToM ability over time, it is expected that autistic participants will have more difficulty with the stories than controls at session 1, but should have less difficulty with the stories as they age (i.e., progress to session 3), if their ToM deficits are actually decreasing over time.

Procedure

Session 1: Baseline measures. All sessions will begin once ethical requirements have been met, and informed consent has been obtained from the participants and from their parents. During the baseline session, parents will complete the AQ-10 (Child version), Q-ASC, and question about therapy/supports. If any participants in the control group exhibit elevated autism traits (i.e., a score of 6 or above on the AQ-10), they will be removed from the study and will be referred to a clinic for a diagnostic assessment. The parents of the children in the experimental group will also complete the AQ-10 (Child version) and Q-ASC scales. Although participants in the experimental group are required to already have a diagnosis of ASD, they will be assessed in order to measure change in autism traits over time. With support from the child's parent and a trained research assistant, participants from both conditions will complete the child version of the Basic Empathy Scale (BES-C), the Social Desirability Scale (SES), and then the MET and ToM tasks. Although this study is not concerned with social desirability, asking participants to complete the SES as a filler task will help ensure that participants are not primed to feeling empathetic when completing the MET task. After completing the first session, parents and participants will be debriefed, compensated for their participation, and will be reminded of the upcoming sessions.

Session 2: Five years after baseline. The procedure for the second session is nearly identical to the first, with one minor change being the addition of the modified MET task (MET-PA: Pre-Adolescent). As before, all parents will complete the AQ-10 (Child version) and Q-ASC scales on behalf of their children, and participants will complete the BES-C, SES, MET-PA, and ToM task. The parents will continue to fill out the autism scales in order to ensure that participants in the control condition remain under the autism cut-off score, and to ensure that participants in the autism condition are over the cut-off score. After completing this session, the parents and participants will be debriefed, compensated for their participation, and will be reminded of the final, upcoming session.

Session 3: Ten years after baseline. The procedure for the last session is similar to the first two sessions, with a few minor differences. For this session, parents will complete the AQ-10 (Adolescent version) and Q-ASC scales. The participants – now aged 15 years – will complete the adult version of the BES, the SES, the original MET task, and the ToM task. After completing the last session, participants and their parents will receive their final debriefing and will be provided with compensation for their participation.

Proposed Analysis

To examine my first hypothesis, namely that on average, the experimental condition will exhibit greater ToM deficits, as compared to the control condition, I will conduct a mixed ANCOVA (collapsed by gender) with developmental status (ASD vs. neurotypical) and ToM scores (baseline, session 2, session 3), controlling for the effect of therapy/supports. In addition, I will conduct four additional mixed ANCOVAs (separated by gender) to examine differences over time in affective empathy, cognitive empathy, and MET scores for cognitive and affective

empathy: gender (male vs. female) x developmental status (neurotypical vs. ASD) x dependent measure at baseline, session 2, and session 3, controlling for the effect of therapy/supports.

To examine my second hypothesis, namely that autistic females will exhibit significantly higher affective and cognitive empathy scores at baseline, with cognitive empathy increasing over time, as compared to males, I will conduct four mixed ANCOVAs: one with gender (autistic males vs. autistic females) and cognitive empathy scores from the BES scale (baseline, session 2, and session 3), and the other with gender (autistic males vs. autistic females) and affective empathy scores (baseline, session 2, and session 3), all of which will be controlled for the effect of therapy/treatment. The last two analyses will be the same, except using cognitive and affective empathy scores from the MET. In addition, I will run post-hocs on all analyses to further examine group differences.

To examine my third hypothesis, namely that ToM deficits will decrease over time only in female autistic participants, I will conduct a mixed ANCOVA, with gender of autistic participants (male vs. female) and ToM scores from baseline, session 2, and session 3, controlling for the effect of therapy/supports. I will run post-hocs to further examine group differences. Finally, I will conduct bivariate correlations to examine the accuracy of the empathy imbalance hypothesis (EIG) and to investigate a possible link between the EIH and the female autism phenotype.

Expected Results.

For my first hypothesis, I expect that the experimental condition (collapsed by gender) will exhibit greater ToM deficits, such that the control condition will score higher on the MET task (for both cognitive and affective empathy), ToM task, and cognitive and affective empathy as measured by the BES, as compared to the experimental condition, over time (see *Figure 1* for

an example of expected results for ToM). However, I expect that when conducting additional mixed ANCOVAs, separated by gender, only male participants with ASD will significantly differ from neurotypical participants on measures of empathy and ToM over time (see *Figure 2* for an example of expected results for ToM).

For my second hypothesis, I expect that autistic females will exhibit a significant increase in cognitive empathy over time (using scores from the MET and BES), as compared to autistic males, but not a significant increase in affective empathy over time because their affective empathy scores should already be more elevated at baseline, as compared to autistic males (see *Figure 3* and *Figure 4* for an example of expected results*)*. For my third hypothesis, I expect that ToM deficits should decrease over time, but only in autistic female participants, as compared to autistic males (see *Figure 5*).

Finally, if the empathy imbalance hypothesis (EIH) is accurate, ToM should be positively correlated with cognitive empathy (because both are believed to measure similar constructs), and negatively correlated with affective empathy (because EIH predicts an empathy imbalance in people with ASD). Given the existence of the proposed female autism phenotype, I expect that autistic females should exhibit a significantly stronger positive correlation between cognitive empathy and ToM, and a significantly stronger negative correlation between affective empathy and ToM, as compared to autistic males, when using scores from session 3.

Discussion

Limitations

While every effort has been made to ensure that the proposed study has as few limitations as possible, there are some concerns that must be addressed. Firstly, given that many females with autism are typically diagnosed much later in life than autistic males (e.g., Begeer et al.,

2013), it will likely be difficult to recruit 100 females who are diagnosed with autism at 5 years of age. If this occurs, the lack of female representation would need to be addressed (e.g., perhaps increase the age for all participants at baseline from five years to seven years, etc.).

Secondly, while the particular ToM task chosen for this study has been previously used with neurotypical and autistic samples, a floor effect could occur in the autism condition and/or a ceiling effect in the control condition. This is to say, if the task is too difficult for the autistic children to complete, then it is likely that no change will be observed over time, even if ToM ability is, in reality, developing over time. Yet, if the task is too easy for the control condition, then it is likely that no change will be observed (in the opposite direction). Interestingly, Happé (1994) observed that, for the ToM task, out of 24 possible correct justifications, the autism group (aged 8.9 to 42 years) answered 11.1 of the stories correctly (range: 3-19 correct answers), as compared to the neurotypical child group (age 6 to 10 years) who answered 16.7 of the stories correctly (range: 10-22 correct answers) , and the neurotypical adult group (age 15 to 24 years) who answered 22.5 of the stories correctly (range: 18-24 correct answers). Although it is concerning that, in Happé's (1994) study, autistic children and adults were collapsed into the same autism group, based on the range of correct answers in Happé's (1994) study, I believe this task is appropriate for the proposed study because it has been used with neurotypical and autistic children, adolescents, and adults. These demographics make the task a useful tool for examining change in ToM development over time in autistic and typically developing children. Of course, it is still possible that floor and ceiling effects could emerge, but I believe this is a remote possibility.

Lastly, there are a couple additional limitations worthy of mention: firstly, the cost to implement the study, and secondly, the length of time required to complete it. Given the 10-year

length, many unforeseen circumstances could arise within this time-frame. For example, funding could run out at any time, and numerous participants could drop out over the 10-years. There is also the possibility that participants who were once in the control condition could, over time, be diagnosed with ASD, making them ineligible to continue with the study.

Implications

The proposed study seeks to address various gaps in the literature, particularly those pertaining to the female autism phenotype, and the lack of longitudinal research on theory of mind (ToM). I proposed that autistic participants (collapsed by gender), on average, would exhibit greater ToM deficits, as compared to the control condition. However, when separated by gender, I expected that autistic females would, on average, score higher on cognitive empathy over time, and difficulties with ToM would decrease over time, as compared to autistic males. I also suggested that, if the empathy imbalance hypothesis (EIH) of autism is accurate, ToM scores should be negatively correlated with affective empathy scores, and positively correlated with cognitive empathy scores at session 3. In addition, given the female autism phenotype, a different pattern of results should emerge for autistic females, as compared to autistic males.

If my predictions are supported, it suggests there are different developmental trajectories for ToM and empathy, not only for autistic individuals in general, but also for autistic males and females. In fact, such findings would illuminate possible sex differences in the cognitive profiles of autistic and non-autistic individuals. Indeed, there is a need for additional information concerning the development of ToM over time, for both neurotypical and autistic children.

In addition, if it is found that autistic females do exhibit a deficit – even if only mildly – in cognitive empathy, but show an overabundance of affective empathy, this finding would both extend and support the EIH hypothesis. Indeed, such a finding would reveal the inadequacy of

the mindblindness theory of autism. As it currently stands, additional research would need to be conducted in order to appropriately modify the mindblindness theory of autism so that it encompasses the very real gender differences in the presentation and symptomatology of autism.

Furthermore, if it is found that ToM deficits do decrease over time, this finding would support Livingston and Happés (2017) developmental model. Such a finding would imply that ToM ability is more malleable than previously thought, or, at the very least, is not completely static, developmentally speaking. If this is the case, it hints at the possibility of designing and implementing interventions aimed at increasing ToM ability over time, which would be particularly beneficial for neurodevelopmental conditions, like autism. Indeed, if empathy, ToM, and social ability are indeed linked in some way, one could entertain the idea that increasing one component (e.g., ToM) may increase another (e.g., social ability).

Undoubtedly, if it is the case that ToM continues to develop over time, it will be vital that we persist in our investigation of it, so that we may acquire "better information about progressions that characterize lifespan trajectories of understanding, and how humans understand both ordinary and extraordinary minds" (Wellman, 2018, p. 137). If Livingston and Happé (2017) are correct in suggesting that some individuals may have the fortitude to move from compensation to remediation, then that is all the more reason to investigate cognitive abilities, like ToM and empathy, in a longitudinal fashion. Only then, will we come to understand how, and most importantly, why, such cognitive capacities change over time.

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Figure 1

Example of Expected Results for Hypothesis 1, Relating to Theory of Mind

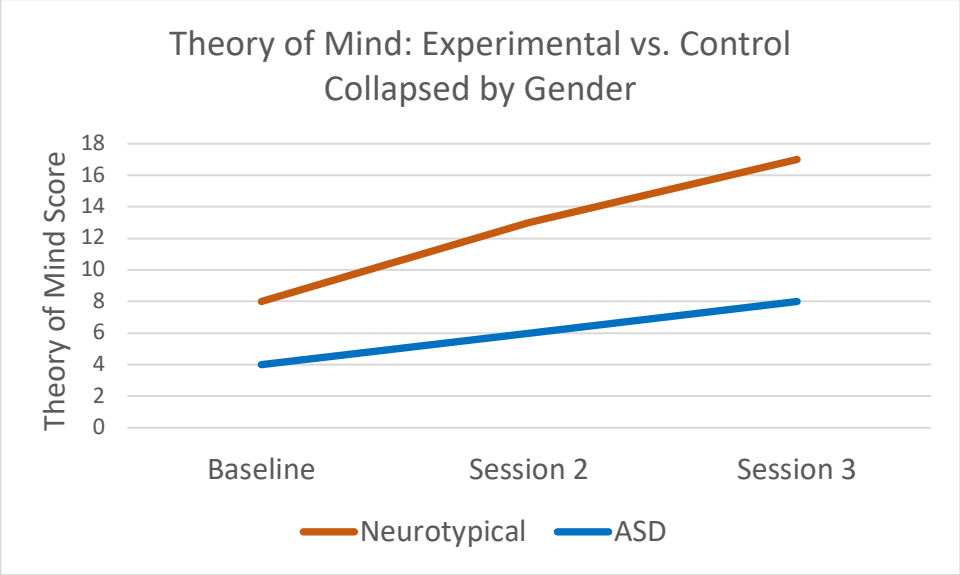


Figure 2

Example of Expected Results for Hypothesis 1, Split by Gender

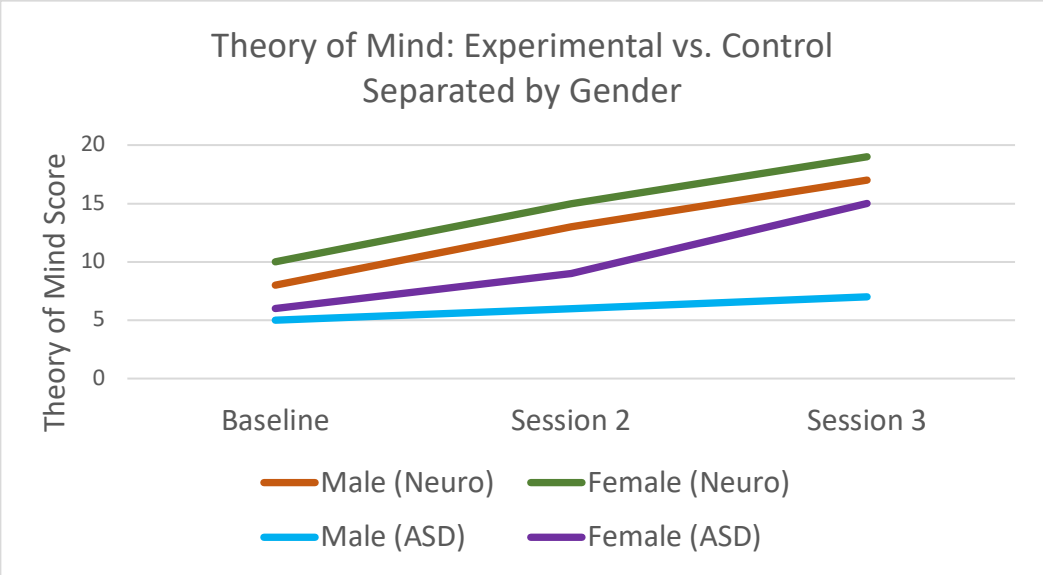


Figure 3

Example of Expected Results for Hypothesis 2, Relating to Cognitive Empathy

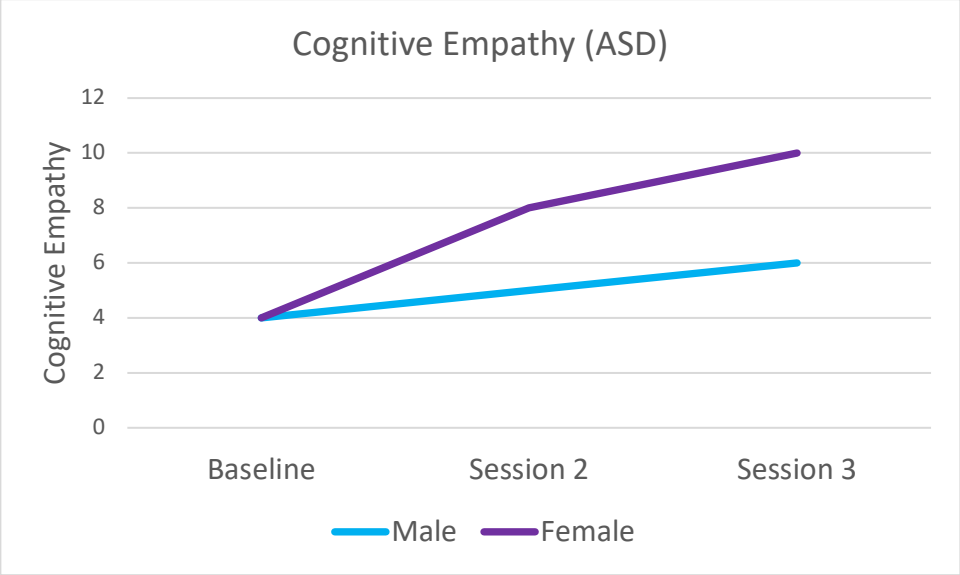


Figure 4

Example of Expected Results for Hypothesis 2, Relating to Affective Empathy

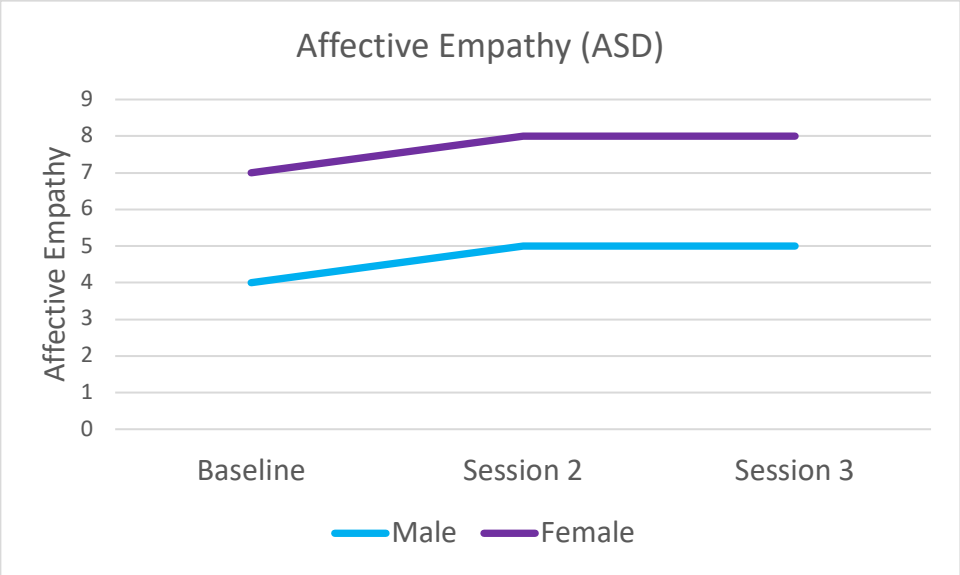
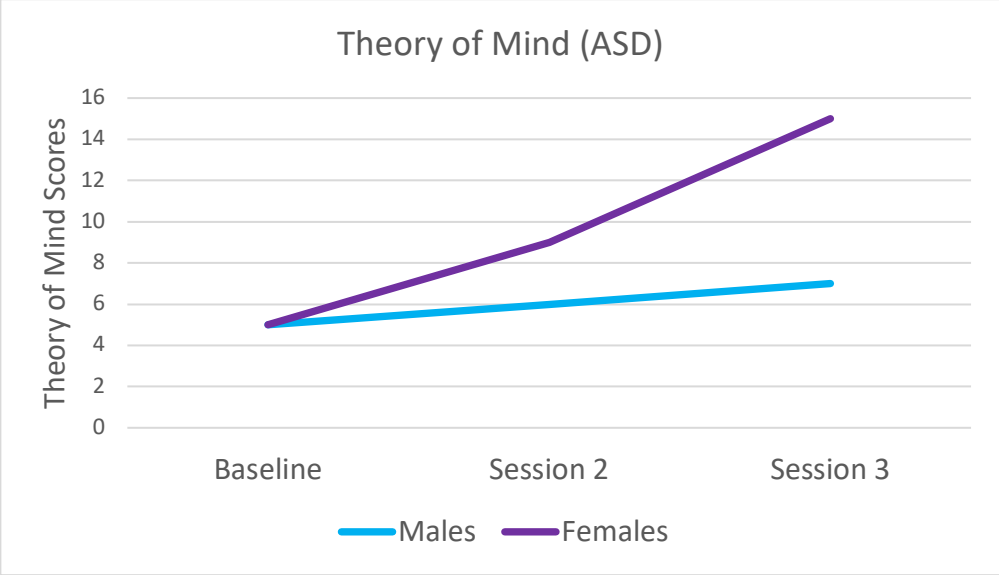


Figure 5

Example of Expected Results for Hypothesis 3



Appendix A

Autism Spectrum Quotient – Child Version (AQ-10 Child)

NHS National Institute for Health Research

AQ-10 (Child Version)

Autism Spectrum Quotient (AQ)

A quick referral guide for parents to complete about a child aged 4-11 years with suspected autism who does not have a learning disability.

Please tick one option per question only:		**Definitely Agree**	**Slightly Agree**	**Slightly Disagree**	**Definitely Disagree**
1	S/he often notices small sounds when others do not				
2	S/he usually concentrates more on the whole picture, rather than the small details				
3	In a social group, s/he can easily keep track of several different people's conversations				
4	S/he finds it easy to go back and forth between different activities				
5	S/he doesn't know how to keep a conversation going with his/her peers				
6	S/he is good at social chit-chat				
7	When s/he is read a story, s/he finds it difficult to work out the character's intentions or feelings				
8	When s/he was in preschool, s/he used to enjoy playing games involving pretending with other children				
9	S/he finds it easy to work out what someone is thinking or feeling just by looking at their face				
10	S/he finds it hard to make new friends				

SCORING: Only 1 point can be scored for each question. *Score 1 point for Definitely or Slightly Agree on each of items 1, 5, 7 and 10. Score 1 point for Definitely or Slightly Disagree on each of items 2, 3, 4, 6, 8 and 9.* If the individual scores **more than 6 out of 10**, consider referring them for a specialist diagnostic assessment.
USE: This is the child version of the test recommended in the NICE clinical guideline CG142. www.nice.org.uk/CG142

Key reference: Allison C, Auyeung B, and Baron-Cohen S, (2012) *Journal of the American Academy of Child and Adolescent Psychiatry* 51(2):202-12.

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Appendix B

Autism Spectrum Quotient – Adolescent Version (AQ-10 Adolescent)

NHS National Institute for Health Research

AQ-10 (Adolescent Version)

Autism Spectrum Quotient (AQ)

A quick referral guide for parents to complete about a teenager aged 12-15 years old with suspected autism who does not have a learning disability.

Please tick one option per question only:		**Definitely Agree**	**Slightly Agree**	**Slightly Disagree**	**Definitely Disagree**
1	S/he notices patterns in things all the time				
2	S/he usually concentrates more on the whole picture, rather than the small details				
3	In a social group, s/he can easily keep track of several different people's conversations				
4	If there is an interruption, s/he can switch back to what s/he was doing very quickly				
5	S/he frequently finds that s/he doesn't know how to keep a conversation going				
6	S/he is good at social chit-chat				
7	When s/he was younger, s/he used to enjoy playing games involving pretending with other children				
8	S/he finds it difficult to imagine what it would be like to be someone else				
9	S/he finds social situations easy				
10	S/he finds it hard to make new friends				

SCORING: Only 1 point can be scored for each question. *Score 1 point for Definitely or Slightly Agree on each of items 1, 5, 8 and 10. Score 1 point for Definitely or Slightly Disagree on each of items 2, 3, 4, 6, 7 and 9.* If the individual scores **more than 6 out of 10**, consider referring them for a specialist diagnostic assessment.

USE: This is the adolescent version of the test recommended in the NICE clinical guideline CG142. www.nice.org.uk/CG142

Key reference: Allison C, Auyeung B, and Baron-Cohen S, (2012) *Journal of the American Academy of Child and Adolescent Psychiatry* 51(2):202-12.

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Appendix C

Questionnaire for Autism Spectrum Conditions (Q-ASC)

Q-ASC

QUESTIONNAIRE FOR AUTISM SPECTRUM CONDITIONS

Age 5-19

NAME: _____AGE: _____ (years)

DOB: ____/____/____ GENDER: _____ Date of completion: ____ /____/_____

Has your child been diagnosed with Autism Spectrum Disorder? YES | NO

If yes, please specify:

Asperger's Syndrome ( ) Autism Spectrum Disorder ( ) Autism ( ) PDDNOS ( )

Other: _____ Year of ASD diagnosis: _____

Who conferred the diagnosis? (please tick):

Paediatrician ( ) Psychiatrist ( ) Psychologist ( ) Other:_____

Has your child received another diagnosis? YES | NO

If yes, please specify: _____

_____ Year of diagnoses: _____

Does your child attend a Special School? (please circle): YES | NO

The following screening questionnaire is designed to identify behaviors and abilities in young people aged 5 to 19 years that could be associated with the characteristics of Autism Spectrum Conditions (ASC, frequently defined as ASD – Autism Spectrum Disorders). Below is a list of questions and statements. Please read each question and statement very carefully and rate how strongly you agree or disagree with it by circling your answer.

SECTION A | Play **If the question describes your child's behavior when s/he was younger, please answer retrospectively.**				
1. Does or did s/he prefer to play with girls' toys?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree

					Not Applicable
2. Does or did s/he prefer to play with boys' toys?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
3. Does or did s/he play with the family pet/s?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
4. Does or did s/he have imaginary friends or imaginary animals?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
5. Was or is his/her play as imaginative as other children's?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
6. Does or did s/he create his/her own complex 'setups' with toys?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
7. Does or did s/he dominate when playing or talking with others?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
8. Does or did s/he role-play the teacher or other adults in his/her solitary games?	Definitely disagree	Slightly disagree	Slightly agree	Definitely Agree	

SECTION B **Friendships and Social Situations**				
9. Is s/he shy in social situations?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
10. Does s/he have many friends?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
11. Does s/he prefer to play with younger children?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
12. Does s/he prefer single, close friendships?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
13. Does s/he enjoy playing with others?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
14. Does s/he enjoy talking with others?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
15. Does s/he enjoy playing with the same gender?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
16. Does s/he enjoy playing or talking with the opposite gender?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
17. Is s/he attracted to girls or boys with strong personalities who tell him/her what to do?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
18. Does s/he avidly observe others playing or socialising?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
19. Does s/he copy or clone him/herself on others?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
20. Does s/he adopt a different persona in different situations?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
21. Is s/he well-behaved at school?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
22. Is s/he well-behaved at home?	Definitely disagree	Slightly disagree	Slightly agree	Definitely Agree

23. Does s/he apologise when s/he makes a social error?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
24. Does s/he say they know what to do in a social situation when s/he is actually confused?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
25. Does s/he have a facial 'mask' that hides his/her social confusion?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
26. Do some social situations make him or her mute?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
27. Does s/he socialise quite well for a while, but subsequently feels exhausted?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	**Not Applicable**
28. Does his/her facial expression sometimes not match his/her mood, or the situation?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	
29. If age appropriate, does s/he understand the art of flirting and dating?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree	**Not Applicable**

SECTION C
Abilities and interests

30. Did or does s/he enjoy fantasy worlds?	Definitely Disagree	Slightly disagree	Slightly agree	Definitely agree
31. Is s/he interested in fiction?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
32. Is s/he talented in art?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
33. Is s/he talented in mathematics?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
34. Is s/he talented in music?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree

35. Does s/he write fiction?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
36. Is s/he talented in languages?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
37. Is s/he interested in looking feminine?	Definitely Disagree	Slightly disagree	Slightly agree	Definitely agree
38. Is s/he interested in looking masculine?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
39. Is s/he interested in looking gender neutral?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
40. Does s/he stand out as different from peers in terms of clothing?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
41. Are his/her interests advanced for their age (e.g. opera)?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
42. Are his/her interests immature for their age?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
43. Is s/he interested in nature?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
44. Does or did s/he have a special interest in friendship?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
45. Does s/he have a special interest/s related to food?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
46. Does s/he have an immature voice?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
47. Does s/he avoid complying with requests from an adult?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
48. Is s/he emotional and her reactions out of proportion?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
49. Is s/he confused about his/her sexual orientation?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree

SECTION D **Sensory profile**				
50. Does s/he express distress during grooming (e.g. fights or cries during fingernail cutting, haircutting, combing) or when s/he is touched (e.g. someone touches his/her feet)?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
51. Is s/he bothered by bright lights or certain kind of lights (e.g. fluorescent light)?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
52. Is s/he distressed by certain smells or avoidant of certain tastes that are a part of a typical diet?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
53. Does s/he have poor endurance and tire easily?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
54. Does s/he seek certain sensations (e.g. jumps, swings, spins, cannot sit still, fidgets, masturbates, leaves clothing twisted on body)?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
55. Does s/he avoid certain sensations (e.g. distressed when his/her feet leave the ground, fear of heights, dislikes activities where his/her head is upside down)?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
56. Is s/he easily distracted and cannot focus his or her attention if there is a lot of noise around?	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree
57. Does s/he like to carry an object (e.g. a favorite toy, a piece of cloth) which s/he touches or rubs to calm	Definitely disagree	Slightly disagree	Slightly agree	Definitely agree

themselves.				

E. Medical history		
58. Has s/he ever presented symptoms typical for **depression** (e.g. feeling sad, hopeless, trouble sleeping, changes in appetite – either loss or gain in weight, suicidal thoughts and attempts etc.)?	YES	NO
59. Has s/he ever presented symptoms typical for **anxiety** (e.g. dizziness, feeling lightheaded, frequent urination, feeling cold or blushing, body aches etc.)?	YES	NO
60. Has s/he ever presented symptoms typical for **panic attacks** (e.g. sense of terror, or impending doom or death, feeling dizzy, sweaty or having chills, chest pains, breathing difficulties etc.)?	YES	NO
61. Has s/he ever been diagnosed with **eating disorder** (i.e. anorexia or bulimia) or presented symptoms typical for eating disorders (e.g. an intense fear of gaining weight, excessive exercise and dieting, preoccupation with food and/or calories, provoking vomiting, excessive laxative use etc.)	YES	NO

Appendix D

Basic Empathy Scale – Adult Version (BES)

1) My friends' emotions don't affect me much
2) After being with a friend who is sad about something, I usually feel sad
3) I can understand my friend's happiness when she/he does well at something
4) I get frightened when I watch characters in a good scary movie
5) I get caught up in other people's feelings easily
6) I find it hard to know when my friends are frightened
7) I don't become sad when I see other people crying
8) Other people's feelings don't bother me at all
9) When someone is feeling 'down' I can usually understand how they feel
10) I can usually work out when my friends are scared
11) I often become sad when watching sad things on TV or in films
12) I can often understand how people are feeling even before they tell me
13) Seeing a person who has been angered has no effect on my feelings
14) I can usually work out when people are cheerful
15) I tend to feel scared when I am with friends who are afraid
16) I can usually realize quickly when a friend is angry
17) I often get swept up in my friends' feelings
18) My friend's unhappiness doesn't make me feel anything
19) I am not usually aware of my friends' feelings
20) I have trouble figuring out when my friends are happy

Appendix E

Basic Empathy Scale – Child Version (BES-C)

1) The happiness of my friends doesn't necessarily make me feel happy
2) When I've been with a friend who's sad, I feel sad
3) I can understand the happiness a female friend feels when everything's going right for her
4) When a girl or a boy is afraid in a film, I'm afraid, too
5) I generally feel happy when others are happy
6) I find it hard to know when my friends are scared
7) I'm not sad when I see someone who's sad
8) Other people's problems don't bother me at all
9) When someone feels sad, I can understand them
10) I can usually tell when my friends are scared
11) I often feel sad when I see sad things or watch sad films
12) I can often understand how people feel even when they don't tell me
13) When I see someone who's angry I'm not scared
14) I generally know when people are happy
15) I tend to be afraid when I'm with friends who are afraid
16) It generally doesn't take me long to realize a friend is angry
17) I often feel the same way as my classmates: happy when they're happy and sad when they're feeling sad
18) I don't feel anything when I see that one of my friends is sad
19) I don't generally pay any attention to my friends' worries
20) I find it hard to understand when my friends are happy

Appendix F

Social Desirability Scale (SDS)

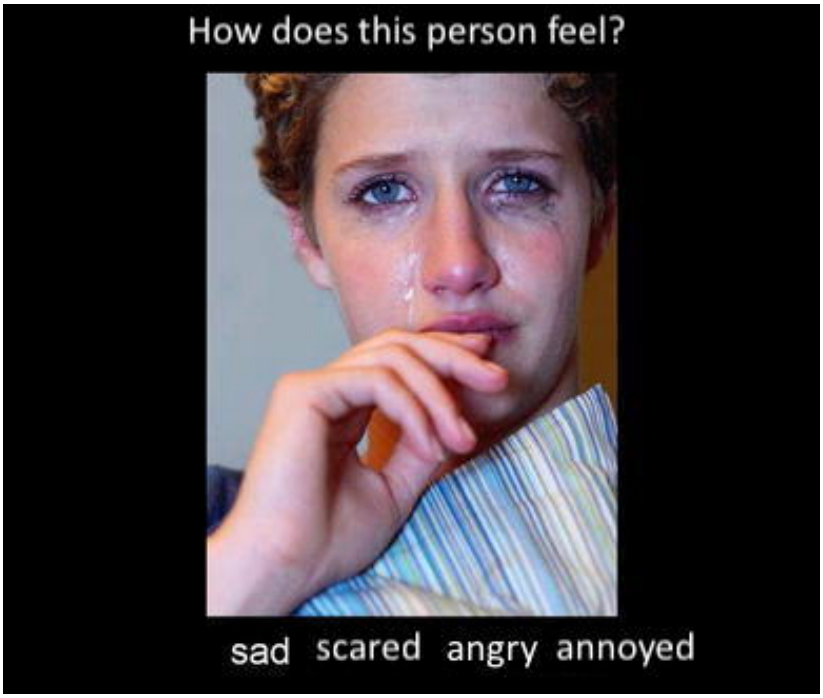
1) I never feel worried
2) I always do what I'm supposed to
3) I never feel happy
4) I like all the people I know
5) People never criticize me
6) I never feel cowed in the presence of an adult
7) I always speak the truth
8) I always know what to say to other people

Appendix G

Multifaceted Empathy Test (MET) – Example

Appendix H

Multifaceted Empathy Test – Child (MET-C) – Modification Example



Appendix I

Theory of Mind (ToM) – Vignette Examples

APPENDIX

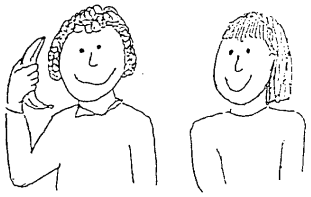
Examples of Strange Stories[3]

Story Type: Pretend

Katie and Emma are playing in the house. Emma picks up a banana from the fruit bowl and holds it up to her ear. She says to Katie, "Look! This banana is a telephone!"

Is it true what Emma says?

Why does Emma say this?



Story Type: Joke

Today James is going to Claire's house for the first time. He is going over for tea, and he is looking forward to seeing Claire's dog, which she talks about all the time. James likes dogs very much. When James arrives at Claire's house Claire runs to open the door, and her dog jumps up to greet James. Claire's dog is huge, it's almost as big as James! When James sees Claire's huge dog he says, "Claire, you haven't got a dog at all. You've got an elephant!"

Is it true, what James says?

Why does James say this?

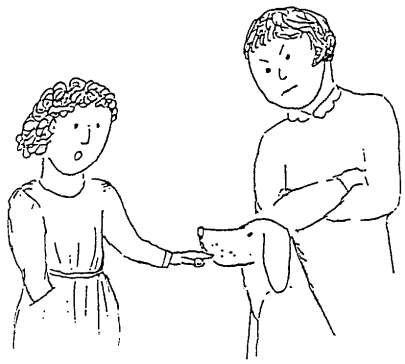
[3]The full set of test stories can be obtained from the author.

Story Type: Lie

One day, while she is playing in the house, Anna accidentally knocks over and breaks her mother's favorite crystal vase. Oh dear, when mother finds out she will be very cross! So when Anna's mother comes home and sees the broken vase and asks Anna what happened, Anna says, "The dog knocked it over, it wasn't my fault!"

Was it true, what Anna told her mother?

Why did she say this?



Story Type: White Lie

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."

Is it true, what Helen said?

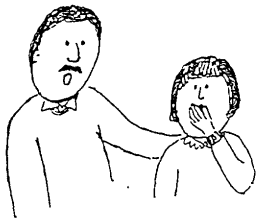
Why did she say that to her parents?

Story Type: Figure of Speech

Emma has a cough. All through lunch she coughs and coughs and coughs. Father says, "Poor Emma, you must have a frog in your throat!"

Is it true, what Father says to Emma?

Why does he say that?



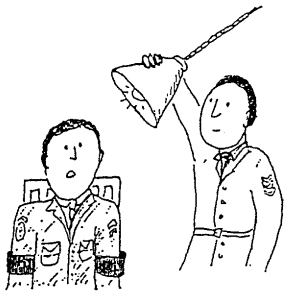
Story Type: Double Bluff

During the war, the Red army captured 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 asks him where his tanks are, he says, "They are in the mountains."

Is it true what the prisoner said?

Where will the other army look for his tanks?

Why did the prisoner say what he said?

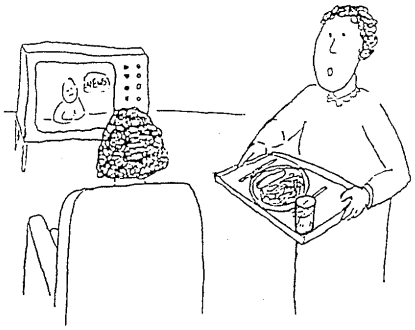


Story Type: Irony

Ann's mother has spent a long time cooking Ann's favorite meal; fish and chips. But when she brings it in to Ann, she is watching TV, and she doesn't even look up, or say thank you. Ann's mother is cross and says, "Well that's very nice, isn't it! That's what I call politeness!"

Is it true, what Ann's mother says?

Why does Ann's mother say this?



Story Type: Persuasion

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 Jane 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!"

Was it true, what Mrs. Smith said?

Why did Mrs. Smith say this to Jane?

Control Physical Story Example

Sally is in the garden. She is sowing seeds, so that next year she will have lots of vegetables in her garden. She sows seeds for carrots, lettuces and peas. She sows the seeds well, but when she goes inside after sowing them, the birds fly down and eat up all Sally's seeds! Poor Sally, not one of her seeds is left!
Q: Is it true that Sally sowed seeds for turnips and swedes?
Q: Why will Sally not have any vegetables in her garden?

Examples of Subjects' Answers to the "Why" Question

Answers Rated as Mental State Justifications

Because he doesn't like the dentist
She's cross
He's lying
Said it to fool her
She's just pretending
He's making a joke
To make them happy
It's just an expression people use
She thought it was a telephone
He knows they won't believe him
She doesn't want to upset them

Answers Rated as Physical State Justifications

So he won't have to go to the dentist
So she won't get spanked
That's where it is
Because it looks like a telephone
In order to sell the kittens
Because the dog is big
Because she won the competition