

Verbal Irony Comprehension for Children and Adolescents with High-Functioning
Autism and Asperger's Syndrome in Computer-Mediated Communication

by

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Abstract

Children and adolescents with autism commonly struggle with social interactions. In particular, it has been found that children and adolescents with autism struggle with verbal irony in face-to-face interactions where there are many competing cues that require their attention (i.e., body language, facial expressions, intonation). This study made use of Bubble Dialogue (Cunningham et al., 1992), a form of computer-mediated communication, to examine how children and adolescents with high-functioning autism and Asperger's syndrome (HFA/AS) comprehended verbal irony when these competing cues were removed from social interactions. Speaker attribute information has been shown to be beneficial in aiding typically developing children with successful verbal irony comprehension. In this study, participants with HFA/AS and matched typically developing participants were presented with Bubble Dialogue scenarios where speaker attribute was manipulated such that speakers were labelled as a peer, an adult, or without a speaker attribute label. Participants were presented with scenarios where the speaker made either an ironic criticism or a literal compliment in order to assess whether or not the information about the speaker influenced their comprehension and interpretation of speaker belief, speaker intent and speaker humour. Participants with HFA/AS provided responses along similar themes to their typically developing counterparts for both literal compliments and ironic criticisms in each speaker attribute condition. Participants with HFA/AS performed similarly to typically developing participants on their interpretations of speaker belief, speaker intent, and speaker humour. These findings suggest that, within the context of computer-mediated communication, children with HFA/AS are able to perform as well as typically developing participants on measures of verbal irony comprehension.

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CHAPTER I

Verbal Irony Comprehension in Children and Adolescents with High-Functioning Autism and Asperger's Syndrome in Computer-Mediated Communication

What is Autism?

Autism is a pervasive developmental disorder characterized by deficits in language development, reciprocal social interactions, and stereotyped/repetitive behaviour (American Psychiatric Association [*DSM-IV-TR*], 2000). Included along the autism spectrum are high-functioning autism (HFA) and Asperger's syndrome (AS) which are often difficult to differentiate (Verté, Geurts, Roeyers, Oosterlaan, & Sergeant, 2006) and will therefore be treated as one group for the purposes of the present research. HFA is characterized by substantial impairments in social interactions and communication as well as restricted, repetitive and stereotypic patterns of behaviours, interests, and activities (Verté et al., 2006). AS is marked by impairments in social interaction, and restricted repetitive and stereotypic behaviour but is not associated with clinically significant delays in language development or cognitive development (*DSM-IV-TR*, 2000). HFA and AS are similar in that they are both characterized by impairments in social interactions and restricted, repetitive, and stereotypic patterns of behaviour but they differ in regards to language development. Individuals with AS tend to reach language milestones at the same age as typically developing individuals, such as using single non-echoed words by age 2 years and using communicative phrases by age 3 years (*DSM-IV-TR*, 2000).

Communication deficits make social interactions difficult for individuals with autism especially when speakers use verbal irony or what is commonly called sarcasm

(Happé, 1994). In verbal irony, the speaker's intended meaning is composed of beliefs and attitudes that are indirectly conveyed to the listener. The listener must disregard the literal meaning of the statement in favour of the intended meaning of the statement (Filippova & Astington, 2008). An ironic criticism is a positive statement that is used to convey a negative meaning (e.g. saying "*You're really good at basketball*" to someone who has just missed her last three shots). Here, the positive statement is incongruent with the negative context. A literal compliment, on the other hand, is a positive statement used to convey a positive meaning (e.g. saying "*You're really good at basketball*" to someone who has successfully made her last three shots). Verbal irony comprehension is a marker of social competence because it depends on crucial communication skills including consideration of the beliefs and intentions of others (Happé, 1994) and for this reason, theory of mind reasoning is a prerequisite for understanding verbal irony. This is because verbal irony comprehension requires the listener to consider the ironic speaker's beliefs as well as the speaker's intentions for the listener's interpretation. An inability to recognize the non-literal meaning behind a speaker's words can hinder the ability to form intimate relationships since verbal irony is used most often when the speaker and listener are friends or intimates (Eisterhold, Attardo, & Boxer, 2006). Helping children and adolescents with HFA/AS to be able to take part in social interactions involving the use of verbal irony comprehension will allow them to be "in on" these interactions and could therefore alleviate the social isolation that often occurs with these individuals.

Being able to correctly gauge what the ironic speaker means and why people use verbal irony would stop individuals with HFA or AS from having their thoughts and beliefs deliberately manipulated by others (Papp, 2006). In addition, enhancing verbal

irony comprehension skills in this group has the potential to make social situations less awkward.

Theories of Verbal Irony

Many theories have been developed over the years to explain how we come to understand verbal irony. Some of the theories that are most commonly encountered in the verbal irony literature include the traditional view (Grice, 1975), the echoic theories (Sperber & Wilson, 1981; Kreuz & Glucksberg, 1989), the pretense theories (Clark & Gerrig, 1984; Kumon-Nakamura, Glucksberg, & Brown, 1995), the indirect negation theory (Giora, 1995), and the tinge hypothesis (Dews, Kaplan, & Winner, 1995; Dews & Winner, 1995). These theories are relevant to the proposed research as they offer accounts for how verbal irony alters the way listeners interpret ironic language compared to literal language.

The traditional view of irony comprehension involves the cooperative principle (Grice, 1975). The cooperative principle states that irony use violates the maxim of quality or truth because the speaker says the opposite of what they really mean. The speaker is saying something that is not literally appropriate given the context of the situation.

The echoic theories of verbal irony comprehension also rely on the given context of the situation and can be broken down into the echoic mention theory (Sperber & Wilson, 1981) and the echoic reminder theory (Kreuz & Glucksberg, 1989). The echoic mention theory states that an ironic speaker directly mentions a comment previously made by another speaker that has ended up being inaccurate. The echoic reminder theory states that an ironic speaker can remind the listener of generally accepted beliefs and

social norms, or an antecedent event but the listener must perceive that the speaker is alluding to something that has occurred in order to recognize the verbal irony.

The pretense theory (Clark & Gerrig, 1984) of irony comprehension involves two layers, what is said and what is implied. According to this theory, irony first involves the listener's recognition that the speaker is expressing an attitude. The listener must then recognize that it is the implied meaning that the speaker intends for the listener to pick up on while the literal meaning is irrelevant in the given context.

The allusional pretense theory of discourse irony (Kumon-Nakamura et al., 1995) combines parts of the echoic theories and the pretense theory. It consists of two parts: allusion to violated expectations and pragmatic insincerity. According to this theory, in order for a remark to be comprehended by the listener as ironic, the speaker must allude to a norm, prediction, previously made statement, or expectation that is then violated by subsequent events. The second part of the theory, pragmatic insincerity, occurs when the speaker has violated at least one of four felicity conditions: (a) the propositional content of an utterance, (b) the status of both the speaker and the listener, (c) the sincerity of the psychological state expressed or implied by the utterance, and (d) the perception of the speaker's sincerity by the listener. The inconsistency between the speaker's statement and the intended meaning of the speaker's statement makes the statement pragmatically insincere.

The indirect negation theory (Giora, 1995) involves two parts. In this theory, irony is viewed as a form of negation that is missing an explicit indication of the negation. According to this theory, comprehending irony is a two-step process that involves consideration of both the implied and literal meanings and processing the

difference between the two meanings before settling on the correct (in this case, implied) meaning in the given situation.

The tinge hypothesis (Dews et al., 1995; Dews & Winner, 1995), like the indirect negation theory (Giora, 1995), does not disregard the literal meaning of the speaker's statement. It suggests that the listener's perception of an ironic criticism is automatically tinged by the literal meaning of the statement. According to this theory, the speaker is able to mask his/her intent because the literal meaning of the ironic statement is processed by the listener and mutes the speaker's intended criticism or praise. The theory indicates that ironic criticisms (e.g., saying "*You are a great driver.*" to someone who has just driven through a red light) are perceived as more polite than literal criticisms (e.g., "*You are a terrible driver.*" to someone who has just driven through a red light) because they are tinged with positivity by having a positive, albeit, non-literal wording.

Adults' Understanding of Verbal Irony

Research on adults' understanding of verbal irony has focused on the social functions of verbal irony (Jorgensen, 1996; Matthews, Hancock, & Dunham, 2006), speaker characteristics and the listener's perception of the speaker (Gibbs, 2000; Katz, Blasko, & Kazmerski, 2004; Katz & Pexman, 1997; Pexman & Olineck, 2002), responses to verbal irony (Attardo, 2001; Gibbs, 2000), and verbal irony use in computer-mediated communication (Hancock, 2004; Whalen, Pexman, & Gill, 2009). By examining research on verbal irony comprehension in adults, we can start at the end point of verbal irony comprehension development and trace our steps backwards to see what is considered abnormal in this developmental path.

Irony language is relatively common amongst adults because it serves particular social functions. In adult conversations amongst friends, 8% of conversational turns involve an ironic remark (Gibbs, 2000). Given the frequency of verbal irony use, it is important to understand its functions and why people use verbal irony. The most typical use of verbal irony is to complain to or criticize close friends or others with whom one has a close relationship (Jorgensen, 1996; Recchia, Howe, Ross, & Alexander, 2010). Verbal irony is also used to save face because without it, the listener of the statement will perceive the speaker to be thoughtless, insulting, unfair, and rude (Jorgensen, 1996). Verbal irony is often used by adults to convey humour (Matthews et al., 2006; Recchia et al., 2010).

If speakers use verbal irony to be polite, to complain, to criticize, or to convey humour, it is important to determine how listeners actually perceive ironic statements. Pexman and Olineck (2002) explored whether verbal irony comprehension depends on if the listener is judging speaker intent (mocking) or social impression (politeness). Adults perceived ironic criticisms as more polite but also more mocking and more sarcastic than direct criticisms. Similarly, Gibbs (2000) found that most adults perceived ironic remarks as mocking some person, object, or event as well as being both critical but also humorous. Slightly less than 50% of adults find ironic remarks to be both critical and mocking (Gibbs, 2000).

Both the nature of the speaker and the context in which a statement is made have an influence on whether or not the statement is interpreted as ironic. Accurate comprehension of the ironic statement likely depends in large part on a combination of social and cultural factors (Katz et al., 2004). One of these social factors is the

relationship between the speaker and the listener. Eisterhold et al. (2006) found that verbal irony use is more commonly directed from an authority figure (i.e., professor/teacher) to a non-authority figure (i.e., student) than vice versa and that when an authority figure makes an ironic statement, the non-authority figure is not expected to, nor does not willingly, provide a response to the ironic statement. It was also found that social distance between speaker and listener is also a factor. More ironic statements are made when there is less social distance between the speaker and the listener, such as being friends versus being strangers (Eisterhold et al., 2006). Adult interpretation of verbal irony can also be influenced by characteristics of the speaker, such as occupation. When a speaker was described as being in an occupation associated with high-irony use (e.g., comedian) versus occupations associated with low-irony use (e.g., doctor), the speaker occupation information affected adults' interpretations of the speaker's intent to appear sarcastic (Katz & Pexman, 1997).

Given the functions and perceptions of verbal irony, it is also relevant to examine how adults respond to ironic remarks. One such response is mode adoption, which involves the listener responding to the speaker's ironic remark with another ironic remark such that the use of verbal irony carries beyond one conversational turn (Attardo, 2001; Colston, 2000). About one-third of adults respond to verbal irony by mode adoption (Gibbs, 2000). Other means of responding include responding with literal remarks that either do or do not indicate understanding of the speaker's intended meaning, laughing, or ignoring the remark (Attardo, 2001). The frequencies with which adults use these response types are 23%, 4%, 13%, and 29%, respectively (Gibbs, 2000). In the proposed research, children and adolescents with HFA/AS will be presented with conversations

including ironic criticisms. Therefore, it is important to know the socially acceptable and frequently used means of responding to verbal irony for typically developing individuals in order to be able to properly gauge the responses made by individuals with HFA/AS.

While several studies have examined verbal irony comprehension among adults, only a handful of studies have focused on verbal irony in the use of computer-mediated communication (CMC). CMC is characterized by social interactions which take place via computer, such as instant messaging, emails, chat rooms, and social networking sites such as Facebook and Twitter. In a study examining the frequency of irony production in dyadic CMC and dyadic face-to-face communication (FTF), it was found that adults make more ironic remarks in CMC than in FTF situations (Hancock, 2004). In terms of irony comprehension, there was less evidence of comprehension in CMC than FTF conversations but the participants in CMC conversations rated their partners as more humorous than participants in FTF conversations. Whalen et al. (2009) examined the occurrence of non-literal language use among adults in e-mail and also found that instances of non-literal language use were quite high. Overall, it appears that non-literal language use is fairly prevalent in CMC and since children and adolescents are engaging in CMC more now than ever, irony comprehension will play a meaningful part in getting the most out of these social interactions.

CMC use is highly prevalent among children and adolescents. In fact, 93% of adolescents aged 12 to 17 years go online and 65% of adolescents use online social networking sites (Lenhart, 2009). Further demonstrating the importance of CMC in the lives of adolescents, 65% of adolescents communicate with their friends via email, 61% send messages through social networking sites, and 60% use instant messaging to get in

contact with friends (Lenhart, 2009). Given the widespread use of CMC, it is important to learn how our messages are coming across to recipients in this forum. This will be an especially relevant area for further exploration because if verbal irony can be accurately conveyed through CMC, children and adolescents with HFA/AS will have a valuable tool for becoming and remaining an active part of today's social world.

Children's Understanding of Verbal Irony

The present study examined verbal irony comprehension and interpretation according to the following conceptualization: speaker belief (whether or not the speaker meant what he or she said), speaker intent (whether or not the speaker was trying to be nice or mean), and speaker humour (whether or not the speaker was trying to be funny or serious). An example of one of the scenarios used in the present study was: "Christian is Shane's big brother. One day, Christian is helping Shane with his homework. Christian explains the homework to Shane. When Shane starts the assignment, he does not follow Christian's instructions." The experimenter, as Christian, made the following statement: "*You are a good listener.*" In assessing speaker belief the participant was asked, "When Christian said, '*You are a good listener*', did he think that Shane was a good listener or a bad listener?" As a measure of speaker intent, the participant was told, "Now point to one of these faces to show me how nice or how mean Christian was being when he said, '*You are a good listener.*'" As a measure of speaker humour, the participant was told, "Now point to one of these faces to show me how funny or how serious Christian was being when he said, '*You are a good listener.*'" Both speaker intent and speaker humour were measured using response scales made up of 6 different faces per scale (see Fig. 4 and Fig. 5).

The developmental trajectory of verbal irony comprehension proceeds as follows: children first identify the incongruity between the context and the statement then understanding of speaker belief develops followed by understanding of speaker intent and finally, the ability to identify aspects of the speaker's attitude, such as speaker humour (Filippova & Astington, 2008). It is also important to note that children need to have the chance to observe and experience how people use verbal irony as part of their comprehension development (Gibbs, 2000; Hancock et al., 2000; Pexman, 2008). Parents use verbal irony with their children but for varying reasons. Fathers tend to use verbal irony in a playful way and during positive interactions while mothers use verbal irony in a more indirect disciplinary and instructive manner (Recchia et al., 2010).

Research on children's verbal irony comprehension has been conducted across a variety of areas, including the recognition of allusion and pragmatic insincerity (Creusere, 2000), perceptions and comprehension of the social functions of verbal irony (Hancock, Dunham, & Purdy, 2000; Harris & Pexman, 2003; Pexman, Glenwright, Hala, Kowbel, & Jungen, 2006; Pexman, Glenwright, Krol, & James, 2005), and the developmental path of verbal irony comprehension (Climie & Pexman, 2008; Filippova & Astington, 2008; Pexman & Glenwright, 2007). Studies of children's verbal irony comprehension tend to involve the presentation of everyday scenarios where a conversation between two characters ends with one of the characters making an ironic statement. These scenarios are often presented as puppet shows, videotapes of people acting out the scenarios, audiotapes of scenarios, or stories accompanied by illustrations.

Children's verbal irony comprehension is most commonly assessed using their responses to questions concerning speaker belief, speaker intent, and speaker humour.

Responses may be obtained using open-ended questions (e.g., “*What do you think Jane meant when she told John that he is a great driver?*”), closed-ended questions (e.g., “*Was Jane being serious when she told John that he is a great driver?*”) or through the use of ratings scales (e.g., “*Point to which face shows how funny or serious Jane was being when she told John that he is a great driver.*”). Young children are able to perceive that ironic criticisms are mean without being able to explicitly state that the speaker did not believe his/her statement to be true (Filippova & Astington, 2010). By 5- to 6-years of age, children are able to recognize that the speaker of an ironic statement does not mean what is literally said (Dews et al., 1996; Harris & Pexman, 2003). Eight-year-old children have no difficulty recognizing that a speaker’s statement has a non-literal meaning (Creusere, 2000). Children’s sensitivity to the humour function of irony increases with age and continues to develop in early adolescence (Creusere, 2000; Filippova & Astington, 2010; Pexman & Glenwright, 2007; Pexman et al., 2005).

Given that the social functions of verbal irony for adults are humour, complaining, criticizing, and politeness, it makes sense to assume that these would also be the social functions of verbal irony for children. However, children perceive these social functions differently than adults. Between 5 and 10 years of age, children perceive ironic criticisms as less mean than literal criticisms (Dews et al., 1996). Up until the age of 10 years, children do still perceive ironic criticisms as being mean but are able to somewhat recognize that these statements serve a teasing function (Pexman & Glenwright, 2007). Other findings suggest that 7- to 8-year old children perceive ironic criticisms as somewhat serious (Harris & Pexman, 2003) while 8- to 9-year-olds perceive ironic criticisms as funny (Dews et al., 1996). These studies provide a reference point of

developmental milestones for verbal irony comprehension and support the finding that irony comprehension improves with age (Pexman & Glenwright, 2007). The main difference between children and adults' perceptions of verbal irony is that children are not yet able to fully appreciate the humour function of ironic criticisms and are therefore more likely to interpret ironic criticisms as being somewhat serious.

Several factors have been presumed to be social cues that facilitate verbal irony comprehension such as tone of voice, incongruity between the context and the speaker's statement, and speaker characteristics. The speaker's tone of voice (e.g., intonation, prosody) has not been conclusively shown to be a reliable cue for verbal irony comprehension among children (Filippova & Astington, 2008; Winner & Leekam, 1991) but several studies suggest that intonation does play an important role in verbal irony comprehension in younger children, especially during the early stages of their development of verbal irony comprehension (Ackerman, 1983; Capelli, Nakagawa, & Madden, 1990; Dews et al., 1996; Dews & Winner, 1995; Keenan & Quigley, 1999; Laval & Bert-Erboul, 2005). Intonation has specifically been shown to affect ratings of speaker intent (Keenan & Quigley, 1999) and speaker humour (Ackerman, 1983; Dews et al., 1996). On the contrary, Filippova and Astington (2008) found that the ability to detect emotions via intonation was not a reliable predictor of verbal irony comprehension. In short, it can be presumed that the speaker's tone of voice aids in comprehension but the exact influence of intonation remains unresolved (Harris & Pexman, 2003).

Children make use of contextual cues to determine whether or not to reject a statement's literal form in favour of its nonliteral interpretation; therefore, the incongruity of a speaker's ironic statement with the context of a given scenario can influence the

listener's verbal irony comprehension (Ackerman, 1983). Sentence meaning is directly related to context (Dews et al., 1996) and incongruity can influence judgments of speaker intent (Climie & Pexman, 2008). When a statement is incongruent to the scenario's context, children take longer to respond to questions of speaker intent and speaker humour (Pexman et al., 2006). This can be taken to mean that it is more difficult for children to accurately judge what a person is saying if what they say violates expectations that are held about that person, as is described by the traditional view of verbal irony (Grice, 1975).

Intonation and context are not necessarily used on a mutually exclusive basis in verbal irony comprehension. It has been suggested that context is used mainly to evaluate and reject the literal form while intonation is used to guide inference (Ackerman, 1983). While it may be the case that younger children rely primarily on intonation to make sense of verbal irony, it is possible that by the age of 7 years, children are able to make use of both intonation and context in comprehending sarcastic requests (Laval & Bert-Erboul, 2005).

Speaker trait information can further add to the incongruity between a speaker's statement and the surrounding context. Children are less accurate at perceiving speaker intent when speaker personality traits (i.e., mean or nice, funny or serious) are incongruent with what the speaker has said (Climie & Pexman, 2008; Pexman et al., 2006). For instance, when a "nice" speaker makes an ironic criticism, children are more likely to perceive the ironic criticism as nicer than if that same criticism is made by a "mean" speaker. However, children do not always use speaker information as a cue to speaker humour. When given information about the relationship between the speaker and

the listener (i.e., friends, enemies, or strangers), 7- to 10-year olds do not use this relationship information in their perceptions of speaker humour (Pexman et al., 2005). Similarly, when the speaker is given a trait such as funny or serious, children are not as likely to perceive speaker humour when the speaker is described as serious (Climie & Pexman, 2008). Together, these findings suggest that children are most accurate at interpreting the social functions of verbal irony when the ironic speaker is described as having characteristics which are congruent to the speaker's statement.

A variety of developments and experiences contribute to a child's ability to comprehend verbal irony. Pexman and Glenwright (2007) suggested that the components of verbal irony comprehension include neural maturation, taking on the perspectives of others, and social learning. A deficit in any of these areas throughout the course of the development of verbal irony comprehension could result in comprehension deficits. The following sections address how deficits in executive functioning, theory of mind, and social skills affect verbal irony comprehension for atypical populations including individuals with autism spectrum disorders.

Atypical Populations and Verbal Irony Comprehension

Theories of autism. There are three main cognitive theories of autism that prevail in the developmental psychology literature: theory of mind (ToM), weak central coherence (WCC), and executive dysfunction. The ToM account posits that individuals with autism are unable to attribute mental states to themselves and others. This deficit is apparent through a failure to take other people's mental states into account (Frith, 1989). This can be used to explain the social deficits evident among individuals with autism, such as an inability to perceive the speaker's intent when an ironic statement is uttered.

Verbal irony comprehension requires the use of ToM skills. The WCC theory of autism states that there is a central system whose job is to integrate sources of information into a meaningful whole but a failure of this system results in attending to only small pieces of information instead of global patterns of information (Frith, 1989). This account can be used to provide an explanation for why individuals with autism are unable to correctly interpret verbal irony. Another important theory of autism is the executive function account of autism. Executive functions are a suite of cognitive processes including inhibitory control, cognitive flexibility, planning, and working memory (Pennington & Ozonoff, 1996). Inhibitory control is the ability to suppress a dominant response (Nigg, 2000) or to prevent oneself from making any response such as during turn-taking when a child must inhibit responding when it is another person's turn (Reed, 2002). Cognitive flexibility (or set shifting) refers to the ability to flexibly alter one's response to changing requirements within a task or activity (Reed, 2002). Planning involves the ability to generate and actively maintain potential problem-solving strategies while considering the consequences and choosing among strategies when engaging in tasks (Ozonoff & Strayer, 2001). Working memory involves the ability to both maintain and manipulate information that is stored over brief periods of time (Alloway, Gathercole, & Pickering, 2006).

The executive function theory of autism suggests that individuals with autism show impairments in executive functioning that hinder their ability to perform problem-solving strategies needed to obtain a future goal (Ozonoff, Pennington, & Rogers, 1991). These deficits include rigidity and perseveration which are widely viewed as being the result of poor cognitive flexibility (Hill, 2004) as well as difficulties with set switching

and initiating efficient lexical retrieval strategies (Kleinhans, Akshoomoff, & Delis, 2005). Further deficits that have been reported include poor performance in tasks involving short-term memory (Alloway, Rajendran, & Archibald, 2009).

Although ToM, WCC, and executive dysfunction are the main theories of autism, they are not the only theories. The underconnectivity theory (Just, Cherkassy, Keller, & Minshew, 2004) suggests that the brain circuitry used in integrating and coordinating brain regions is underfunctioning among individuals with autism. This means that when there is too much information to process, such as the changing dynamics of social interactions, there may be a disruption in the cognitive, motor, and perceptual abilities that rely on those brain areas. The enhanced perceptual functioning theory (O'Connor & Kirk, 2008) suggests that social difficulties among individuals with autism are the result of superior attention to low-level perceptual information and attention to detail which makes it difficult to integrate the information from different sensory modalities and interpret social interactions as a whole. Like the WCC, both the underconnectivity theory and the enhanced perceptual functioning theory suggest that individuals with autism are better at processing detailed information than typically developing individuals, but they struggle with the ability to combine pieces of small information into one global piece of information. The cognitive compensation hypothesis (Kasari, Chamberlain, & Bauminger, 2001), suggests that children with autism rely on a more rule-based, intellectual approach in dealing with social situations. According to this theory, these children may be capable of making the same social inferences as typically developing children but in order to do so, they require the use of a different mental process.

Verbal irony comprehension in individuals with autism. A landmark study on non-literal language comprehension among individuals with autism was the Strange Stories study conducted by Happé (1994). The Strange Stories consisted of 12 different ambiguous speech acts (e.g., irony, joke, pretend, misunderstanding, figure of speech) depicted in short scenarios with illustrations. Each scenario involved an interaction between two characters in which one of the characters made a statement relevant to the story type. For example, in the irony scenario, Ann does not thank her mother for serving her favourite meal. Her mother says, “*Well, that’s very nice, isn’t it! That’s what I call politeness!*” Using passing of first-order belief tasks as criteria, Happé matched a group of children and adults with autism ranging in age from 8.9 years to 45.1 years to a group of children and adults with a mental handicap as well as two groups of typically developing individuals (a group made up of children and a group made up of adults). Compared to the control groups of typically developing children and adults, the children and adults with autism performed significantly worse on the Strange Stories task. The results suggest that children and adults with autism view events differently than typically developing children and adults as well as demonstrating that individuals with autism have difficulty providing appropriate and accurate mental state attributions to a given event. This result is in agreement with later findings that individuals with HFA/AS perform worse than typically developing individuals on tasks involving non-literal language interpretation (Martin & McDonald, 2004). These findings indicate that the ability to understand others’ mental states (i.e., provide context-appropriate mental state justifications) is crucial to verbal irony comprehension.

Joliffe and Baron-Cohen (1999) also presented adults with HFA/AS with the Strange Stories (Happé, 1994) to see if they could replicate the finding that individuals with autism tend to give context-inappropriate mental state responses. The results gave further support to Happé's findings: adults with HFA/AS performed worse than the typically developing adults on the Strange Stories tasks. In response to speaker belief and speaker intent questions about the characters in the story, participants with HFA/AS gave explanations involving context-inappropriate mental states. Their explanations were about each individual statement without taking into account the context in which the statement was made. For instance, in the irony scenario with Ann and her mother, a context-inappropriate response would be that the mother thinks Ann is being polite even though the story explicitly states that Ann had ignored her mother and not thanked her for serving her favourite meal. This example demonstrates that when a positive statement is incongruent with the negative context, individuals with HFA/AS have difficulty making accurate interpretations.

However, Pexman et al. (2010) provided evidence suggesting that children with autism can be as accurate as typically developing children in interpreting speaker intent for ironic statements. Using nonverbal response options and measures of response latency, it was found that children with autism had faster response times for speaker intent responses than typically developing children but only for ironic statements. These results suggest that children with autism use processing strategies that require less elaboration and less consideration of the social functions of irony than typically developing children.

MacKay and Shaw (2004) compared children with autism and typically developing children on their comprehension of various types of figurative language, including verbal irony. Although both groups struggled with irony, children with autism were less successful in comprehending ironic statements in terms of speaker belief and speaker intent when compared to typically developing children. Whereas both groups of children were supposed to answer questions of speaker belief and speaker intent based on the scenarios presented, children with autism tended to apply their own idiosyncratic interpretations of the events that occurred in the stories. For instance, some of these children would describe the scenarios so that the literal meaning of the speaker's statement became valid. Overall, the results suggest that most children with autism struggle with interpreting speaker intent. However, about 75% of children with autism correctly interpreted speaker belief. This promising evidence indicates that verbal irony comprehension is possible among children with autism if they are provided with an assessment task that optimizes their abilities.

Executive functioning and autism. The executive function account of autism suggests that people with autism have more impairment in executive functioning than typically developing people or people with other developmental disabilities (Hill, 2004; Ozonoff et al., 1991). Understanding executive function deficits in individuals with HFA/AS is of great importance for not only making an accurate diagnosis but also for making appropriate educational adaptations and gaining a better understanding of the neuropsychobiological impairment in HFA/AS (Landa & Goldberg, 2005). The social world may be more difficult to interact with than the physical world for individuals with autism because it is less predictable and requires an understanding of how to integrate a

greater number of elements than the physical world (Reed, 2002). In addition, a growing body of research indicates that atypical populations with executive function deficits tend to also struggle with comprehending verbal irony. The two areas of executive functioning that will be used in this study are working memory and cognitive flexibility.

Working memory involves the ability to both maintain and manipulate information that is stored over brief periods of time (Alloway, Gathercole, & Pickering, 2006). There are two main components to working memory: verbal working memory and spatial working memory. Verbal working memory involves a phonological memory store that holds speech-based information for brief periods as well as an articulatory control in which information from the phonological memory store is refreshed through the use of articulatory rehearsal (Williams, Goldstein, Carpenter, & Minshew, 2005). Spatial working memory is responsible for the manipulation and temporary storage of visual information including spatial location of objects (Williams et al., 2005). Given that working memory is important to all tasks that people engage in (Reed, 2002); it is an important area to explore among individuals with autism. It has been suggested that individuals with autism have a working memory deficit but there is research that provides evidence both for and against this theory.

In support of a working memory deficit among individuals with autism, Reed (2002) found that as the demands made on working memory increased, task performance of individuals with autism worsened. When performing a spatial working memory task involving searching for tokens within an increasing number of boxes, it was found that individuals with autism made significantly more errors than typically developing individuals (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009; Goldberg et al,

2005; Landa & Goldberg, 2005; Steele, Minshew, Luna, & Sweeney, 2007). When compared to not only typically developing children and adolescents but also children and adolescents with comorbid ADHD, it has been found that children and adolescents with autism perform worse than typically developing children and adolescents on spatial working memory tasks but similarly to children and adolescents with comorbid ADHD (Sinzig, Morsch, Bruning, Schmidt, & Lehmkuhl, 2008). It could be that individuals with autism specifically perform worse on spatial working memory tasks over verbal memory tasks because spatial information (i.e, location) does not provide the same level of scaffolding as verbal information (i.e., letters) and so the brain needs to use a higher level of computation with spatial working memory tasks to achieve the same level of accuracy as in verbal working memory tasks (Williams et al., 2005). However, in instances where no significant group differences are found between individuals with autism and typically developing individuals, it has been suggested that higher-functioning individuals with autism may not have a working memory deficit (Ozonoff & Strayer, 2001). These examples were provided to give an indication of the support for and against working memory deficits in individuals with autism. However, the general consensus among the literature appears to support the notion of working memory impairment among individuals with autism.

Cognitive flexibility involves the ability to shift one's thoughts or actions to a different set of thoughts or actions according to the demands of a given situation (Hill, 2004). It has been suggested that individuals with autism may not have trouble shifting within a set of rules but their deficit may lie in their difficulty shifting between sets of rules (Ozonoff et al., 2004). A study by Ozonoff et al. (1991) found that children and

adolescents with autism made more perseverative responses on a cognitive flexibility task than similarly aged typically developing individuals but there were no group differences found between the number of errors made and the number of categories completed on this task. Based on effect sizes, it has been found that children and adolescents with autism made fewer errors and completed more stages on a measure of cognitive flexibility, the Intra-Extra Dimensional Set Shift task (ID/ED task; described in Method section), than both typically developing children and adolescents and children and adolescents with comorbid ADHD (Sinzig et al., 2008). This finding is somewhat supported by an earlier study which found that children and adolescents with HFA made fewer errors at the extradimensional shift stage of the ID/ED task than typically developing controls but there were no between group differences in the overall number of stages completed on this task nor were there group differences in the number of trials needed to reach criterion (Landa & Goldberg, 2005). Not all studies provide evidence in support of the idea of a deficit in cognitive flexibility. Some studies have not found any significant group differences between children with autism and typically developing children in their performances on the ID/ED task (Corbett et al., 2009; Goldberg et al., 2005). Although there is evidence both for and against cognitive flexibility impairment among individuals with autism, the majority of literature in this area tends to show support for cognitive flexibility impairment.

Executive functioning and verbal irony comprehension. It is important to gain a clear understanding of why people with brain injuries and people with autism struggle with understanding verbal irony. By assessing studies of verbal irony comprehension deficits in people with brain injuries, it appears that the types of difficulties found among

this population are similar to those found among people with autism. This would suggest that the areas of the brain associated with verbal irony comprehension could be pinpointed by looking at what types of brain injuries are linked to deficits in verbal irony comprehension.

Damage to the right hemisphere (RH) of the brain is associated with abilities related to verbal irony comprehension (McDonald, 2000; Shamay-Tsoory, Tomer, & Aharon-Peretz, 2005). Traumatic brain injury (TBI) generally entails damage to the temporal and frontal lobes of the brain. As is also the case with individuals with autism, patients with TBI tend to have trouble with verbal irony comprehension tasks. For example, McDonald (2000) reported that performance on an irony task was significantly related to those patients' performance on a neuropsychological test of concept formation, abstract reasoning, and cognitive flexibility. These are areas of executive dysfunction also found among people with autism. A type of TBI, closed head injuries, is also associated with social communication deficits, including verbal irony comprehension. Adults with closed head injuries have been found to show a markedly poorer performance in comprehending ironic remarks versus sincere remarks (Channon, Pellijeff, & Rule, 2005). Using functional magnetic resonance imaging to explore verbal irony comprehension, Wang, Lee, Sigman, and Dapretto (2006) found that the brains of typically developing children and children with autism rely on the same network of areas for judgment of speaker intent, the prefrontal and temporal regions, but as cognitive demands are increased, children with autism show greater activity in these regions of the brain. This suggests that it takes more neural effort for children with autism to process ironic statements in order to interpret speaker intent.

Accordingly, a growing body of research suggests that verbal irony comprehension is facilitated by executive functions, namely inhibitory control and working memory. Inhibitory control is the ability to suppress a dominant response (Nigg, 2000) whereas working memory involves the ability to maintain and manipulate information over brief periods of time (Alloway, Gathercole, & Pickering, 2006). Roberts and Pennington (1996) proposed an interactive framework of inhibitory control and working memory: when one goal-oriented action is activated in working memory, then by default other actions are inhibited from entering working memory. Because they are interactive, increasing working memory demands also compromises inhibitory control, leading to increased errors. This effect is observed in children's understanding of verbal irony because it requires the listener to inhibit the speaker's spoken message, to maintain relevant information in working memory, and to process the intended message (Hala et al., 2010; Pexman, 2008). These significant executive demands are likely relevant to why individuals with autism tend to misinterpret verbal irony.

Autism and technology in social teaching. Video modeling is one type of technology that has been used in teaching social skills to individuals with autism. It involves observing an individual (or individuals) engaging in a behaviour after watching a video of the occurrence of the desired behaviour. Nikopolous and Keenan (2004) studied the effects of video modeling on social initiation and reciprocal play behaviour in 7-9 year old boys with mild to moderate autism. Among all participants, it was found that social initiation and reciprocal play skills improved after watching the video showing a typically developing peer demonstrating social initiation and reciprocal play skills. These

improvements were still apparent at 1- and 3-month follow-ups suggesting that this technique allows for enduring changes in behaviour.

Virtual reality technology (VRT) is also a useful tool for teaching social skills to people with autism (Mitchell, Parsons, & Leonard, 2007; Parsons & Mitchell, 2002). VRT, a means of CMC, involves the use of 3-D computer-generated scenarios that mirror real-world environments and interactions. VRT may aid in the generalization of social skills because of its similarity to real-world situations (Parsons & Mitchell, 2002). An important advantage of VRT is its use of role-play. Using role-play to practice behaviours may be an appropriate way to promote improvements in both social understanding and behaviour but individuals with autism often do not have as many opportunities for role-play due to their limited ability to participate in make-believe (Parsons & Mitchell, 2002). Role-playing opportunities that make use of repetition and consistency, such as VRT, would be more compatible for those with autism. VRT may also encourage cognitive flexibility in responses within a safe, controlled environment. Such an environment may decrease anxiety in those with autism, thus allowing them to plan for subsequent behaviour instead of relying on repetitive, stereotyped behaviours (Parsons & Mitchell, 2002).

Mitchell et al. (2007) created virtual environments to examine how they can be used to teach social skills and social understanding to adolescents with autism. The participants trained on and used virtual environments related to where to sit in an empty, full, or partially full café. These environments involved the social skills of dealing with crowds appropriately, observing personal space, and following generally accepted rules of social decorum. The results of this study indicated that following use of the virtual

environments, participants' judgment and reasoning about where to sit improved based on responses to videotaped scenes of real-life cafés.

Rajendran and Mitchell (2006) compared 11 adolescent and adult participants with HFA/AS and 11 typically developing adolescents and adults in their ability to work out map routes by asking closed questions over the telephone or by text chat. The two groups were matched on gender and then as closely as possible on age, level of education, and verbal IQ. They predicted that adolescents and adults with HFA/AS would figure out the map route with fewer questions and make less navigational mistakes in text chat than they would over the telephone. Despite the benefits of CMC, such as allowing the user to control the pace of communication, the results of the study indicated that the adolescents and adults with HFA/AS performed similarly in both the text chat and telephone conditions. These individuals asked more questions and made more navigational errors than typically developing adolescents and adults in both text chat and over the telephone. The similar performance across condition types for the adolescents and adults with HFA/AS should be expected given that both the text chat and telephone conditions did not occur via FTF communication and therefore did not involve the social pressure and anxiety associated with FTF interactions. The finding that adolescents and adults with HFA/AS performed more poorly than typically developing adolescents and adults further demonstrates the communication problems among individuals with HFA/AS. However, the results could also be interpreted to show that individuals with HFA/AS are able to complete tasks over the telephone and via text chat but they are just not as efficient as typically developing adolescents and adults at doing so.

The Bubble Dialogue program (Cunningham et al., 1992) is another form of CMC that has been used in studies involving individuals with autism. It provides an opportunity for role play that makes use of repetition and consistency. The Bubble Dialogue consists of a comic-strip appearance in which there is an introduction to two characters in a social situation (prologue). This is followed by a user-controlled conversation between the two characters that alternates between the use of thought bubbles and the use of speech bubbles giving users the opportunity to think about what they are going to say and what is happening before they make the character “speak” (Cunningham et al., 1992).

A case study of two young adult males with AS and two adolescent males with emotional and behavioural issues sought to explore the benefits of using the Bubble Dialogue program as an educational tool (Rajendran & Mitchell, 2000). Although significant improvement in interpersonal skills was not found, individuals with HFA/AS performed similarly to the individuals with emotional and behaviour issues in terms of the content of their Bubble Dialogue responses. This is promising support for the Bubble Dialogue as it is possible that Bubble Dialogue-mediated communication helped the social impairments of the individuals with HFA/AS to be less noticeable.

The Bubble Dialogue has also been used to examine non-literal language comprehension. A study involving the Bubble Dialogue program made use of prologues based on Happé’s Strange Stories (1994) to examine non-literal language comprehension in 12 adolescents and adults with HFA/AS (Rajendran, Mitchell, & Rickards, 2005). The participants with HFA/AS were matched to a control group of 12 adolescents and adults based on gender and then as closely as possible based on chronological age, level of education, and verbal IQ. Participants were given three types of scenarios within Bubble

Dialogue: figure of speech, verbal irony, and appropriacy. It was found that adolescents and adults with AS were able to adopt their designated character in this type of CMC forum. Participants made appropriate responses as their characters and did not simply provide literal accounts of their own personal details. This is encouraging since an inability or unwillingness to participate in role-play or situations that call for an inference of others' mental state is a common problem among individuals with autism (Happé, 1994; Joliffe & Baron-Cohen, 1999).

The current research followed similar procedures to those used by Rajendran et al. (2005) by making use of the Bubble Dialogue program to portray conversations containing verbal irony and to facilitate social interactions between the participant and the experimenter. However, the present study differed in many significant ways. Given findings that manipulation of speaker characteristics can have an affect on children's perceptions of verbal irony (Climie & Pexman, 2008; Pexman et al., 2006) and that children also use their understanding of social organization and social institutions to help them understand the use of authority figures (Laupa, 1991), the current study featured the manipulation of the speaker's relationship to the listener. This manipulation resulted in three levels of speaker-listener relationship: the speaker was an authority figure (i.e., adult), a child (i.e., peer), or not given any explicit speaker attribute (i.e., control condition). The current study focused solely on verbal irony as a form of nonliteral language and had a larger group of participants. Another main difference between the present study and that of Rajendran et al. (2005) is that the present study assessed executive functioning. All of these factors allowed for a more complete picture of the

range of deficits and strengths in verbal irony comprehension among children and adolescents with HFA/AS and how the deficits can be accommodated in CMC use.

The Current Study

The purpose of the present study was to explore social relationship factors (child/peer relations and child/adult relations) that are relevant for children and adolescents with HFA/AS, specifically to examine the ability of those with HFA/AS to correctly interpret ironic remarks when spoken either by a peer or by an adult. The relationship between a child and his/her peers lends itself to verbal irony use more so than the relationship between a child and an adult because verbal irony use is considered more appropriate between members of the same peer group and is more commonly used in conversations between close friends (Jorgensen, 1996). There is evidence that children are more adept at verbal irony comprehension when given speaker trait information (Pexman et al., 2006) and given that adults do not tend to make ironic statements towards children (Eisterhold et al., 2006), it was relevant to examine how verbal irony comprehension is affected by labelling speakers as peers or adults.

When this study was initially proposed, it was anticipated that measuring response latency would provide valuable insight into analysis of the participants' results. However, due to the lengthy nature of the Bubble Dialogue procedure, it became clear that including a measure of response latency would not substantially add to the data analysis. Therefore, it was decided that participants' response latency would not be measured in this study.

The current study made use of six Bubble Dialogue scenarios highlighting an ironic criticism or a literal compliment in order to assess verbal irony comprehension

when both characters were described as children (i.e., peers), when the speaker was described as an adult, and when no speaker attribute label was provided. The research questions were as follows: Will children and adolescents with HFA/AS show poorer verbal irony comprehension than typically developing children? Will children's verbal irony comprehension be more accurate when the ironic criticism is made by a peer than when it is made by an adult? How will the measures of executive functioning (working memory and cognitive flexibility) be related to verbal irony comprehension?

As was discussed earlier, executive functioning is an important area in the understanding of autism. This study assessed two areas of executive functioning (working memory and cognitive flexibility) to see how they related to children's ability to accurately perceive speaker intent. Participants' verbal irony comprehension accuracy was compared to their accuracy scores on a working memory task and a cognitive flexibility task. It was predicted that these comparisons would reveal the extent to which capacities in these two cognitive areas are linked to competencies in verbal irony comprehension.

This study aimed to add to the findings on verbal irony comprehension in children and adolescents with HFA/AS by examining both how executive functioning and how the listener's relationship to the speaker play a role in verbal irony comprehension, particularly within the frequently used realm of CMC. Individuals with HFA/AS have stated the importance of facilitated social interactions with peers and have stated a preference for using alternative modes of communication during these interactions (Müller, Schuler, & Yates, 2008). This study examined deficits faced by children and adolescents with HFA/AS in social situations and how these deficits may be minimized

using an alternative to face-to-face interactions. In doing so, it sought to provide parents, teachers, and support staff with a possible way of enhancing social interactions for children and adolescents with HFA/AS as well as providing increased understanding of these individuals' strengths and weaknesses within the context of CMC.

CHAPTER II

Method

Participants

Participant demographics are presented in Table 1. Participants in the experimental group were 14 children and adolescents with HFA/AS who had a minimum verbal /mental age of 7 years old, as assessed by the Peabody Picture Vocabulary Test: Fourth Edition (PPVT-4; Dunn & Dunn, 2007). Since the procedure required participants to read the text in the Bubble Dialogue program, participants' reading skills were assessed using the word attack subtest of the Woodcock-Johnson Diagnostic Reading Battery (Woodcock, 1997). The control group was composed of 14 typically developing (TD) children and adolescents who were matched to the individuals with HFA/AS according to gender, standard scores of verbal/mental age, and reading ability.

In order to be paired as a match, participants needed to score within one standard deviation of each other on the PPVT-4 (Dunn & Dunn, 2007). This translates to having standard scores within 15 points of one another. Chronological age, word attack scores and Children's Communication Checklist scores (CCC; Bishop, 1998) were also matched as closely as possible. For example, if there were two TD participants with standard scores on the PPVT-4 (Dunn & Dunn, 2007) that were similar to one of the participants with HFA/AS then the TD participant who most closely resembled the participant with

HFA/AS in terms of chronological age, word attack scores, and CCC scores (Bishop, 1998) would be the one chosen as a match.¹

Independent samples t-tests were conducted to determine if there were significant differences between the two participant groups in any of the demographic information that was collected. There were no significant differences between the groups in chronological age, $t(26) = 0.86, p > .05$; PPVT-4 standard scores, $t(26) = 0.33, p > .05$; or reading ability scores on the word attack test, $t(26) = 0.76, p > .05$. The lack of differences in these areas suggests that participants in both groups were equally equipped to handle the requirements of this study's procedure. However, in terms of the CCC scores, participants with HFA/AS ($M = 113.29$) scored significantly lower than the TD participants ($M = 149.29$), $t(26) = 8.18, p < .001$. This was to be expected since individuals with autism tend to struggle with using appropriate communication in social situations (*DSM-IV-TR*, 2000).

Measures

In order to ensure that participants in the experimental group had a diagnosis of either HFA or AS, each child or adolescent's parent/guardian was asked to complete a questionnaire. The questionnaire requested background details regarding the child's diagnosis (e.g., specific diagnosis, type of diagnostic instruments used in diagnostic assessment, type of professional that conducted the diagnostic assessment). The parents/guardians of all participants were asked also to complete the CCC (Bishop, 1998), a series of statements that describe aspects of children's behaviour as assessed using Likert scales (see Appendix). The composite pragmatic scores, which were obtained from the scores on subtests C to G of the CCC (Bishop, 1998), were calculated

and those scores were used for each participant. The composite pragmatic score provides an indication of participants' conversational abilities and has been demonstrated to have substantial to almost perfect interrater reliability and sound internal consistency as measured by teachers (Bishop, 1998). Participants were given the PPVT-4 (Dunn & Dunn, 2007), a standardized test that is used to measure receptive language proficiencies ranging from preschool age to adult. It assesses the ability to match a picture with a spoken word. The PPVT-4 demonstrates excellent reliability coefficients indicating that it is a sound psychometric measure of receptive vocabulary (Dunn & Dunn, 2007). Parental responses on the CCC (Bishop, 1998) were also used to form the matched participant pairs. Given the reading component involved in use of the Bubble Dialogue program, participants' reading skills were assessed using the word attack subtest of the Woodcock-Johnson Diagnostic Reading Battery (Woodcock, 1997). The word attack subtest involved reading nonsense words aloud. These nonsense words were consistent with regular patterns in English and were used to assess word identification. The word attack subtest has been demonstrated to show excellent internal consistency (Woodcock, 1997).

Participants completed two measures of executive functioning using the Cambridge Neuropsychological Test Automated Battery software (CANTAB; Cambridge Cognition, Cambridge, UK; <http://www.camcog.com>). These measures were presented on a computer screen with an affixed touch screen and participants responded by touching objects on the screen. One test, Spatial Working Memory (SWM), assessed working memory capacity while the other test, Intra-Extra Dimensional Set Shift (ID/ED), assessed cognitive flexibility. The SWM task consisted of a group of boxes with a token hidden beneath one of the boxes. Only one blue token was hidden in one of the

boxes during each trial. For each trial, the number of boxes presented on the screen was also the number of blue tokens to be found by the participant. On the computer screen, four, six, or eight boxes were presented at one time (see Fig. 1). Participants had to fill an empty column on the right hand side of the screen by finding a blue token in each of the squares. The ID/ED task tested rule acquisition and reversal (see Fig. 2). It involved visual discrimination, attentional set formation, maintenance, shifting, and attentional flexibility (Corbett et al., 2009). Participants progressed through the task by meeting a set of learning criterion at each stage. In total, the two tests took approximately 15 minutes to complete. The CANTAB software recorded each participant's accuracy on the working memory and cognitive flexibility measures. The dependent variable of interest in the SWM task was 'between search errors' which was the total number of times the participant selected a box in which a blue token had already been located (Happé, Booth, Charlton, & Hughes, 2006). The dependent variable of interest in the ID/ED task was 'stages completed' which was the total number of stages that were successfully completed out of a possible nine stages (Gau, Chiu, Shang, Cheng, & Soong, 2009). Both the SWM task and the ID/ED task have been shown to have satisfactory levels of test-retest reliability (CANTAB, 2010).

Materials

The primary piece of hardware was a Dell Latitude E6500 laptop computer installed with the Bubble Dialogue program (Cunningham et al., 1992). Bubble Dialogue has a comic strip-like appearance involving thought bubbles and speech bubbles. In this way, it allowed users to reflect on thought as something separate from speech in the conversation. Each scenario began with a prologue introducing the two characters, who

were controlled by the experimenter (i.e., the speaker) and the participant (i.e., the listener), and the relevant social situation. This was followed by a conversation between the speaker of the literal compliment or the ironic criticism and the listener that alternated between the use of thought bubbles and the use of speech bubbles. This gave participants the opportunity to think about what they were going to say and what was happening before they typed a speech response. Use of this format allowed for tasks to be practiced and presented repetitively and consistently. It also regulated turn-taking and served as a point of interaction between users.

The experimenter and the participant were seated side-by-side in front of the computer. The characters in each scenario were the same gender as the participant. The prologue was read aloud by either the experimenter or by the participant and then the experimenter always typed the first statement. The prologue highlighted the status of the speaker (i.e., peer, adult, no label) for the three attribute conditions. Only one scenario was visible at a time. Figure 3 shows an example scenario of a Bubble Dialogue session in which an ironic criticism is spoken by an adult.

Design

The study used a 2 (Statement Type: ironic criticism, literal compliment) x 2 (Participant Group: HFA/AS, TD) x 3 (Speaker Attribute: adult, peer, no label) mixed model design with Statement Type and Speaker Attribute as within-subject factors and Participant Group as a between-subjects factor.

Procedure

Participants were tested in a quiet room. Participants were presented with a total of six statements, one ironic criticism and one literal compliment in each of the three

speaker attribute conditions (peer, adult, and no label). The order of the presentation of statement types and speaker attribute conditions were counterbalanced across participants. Prior to the start of testing, participants were trained on the response measures. They were read a series of scenarios, one by one, and were then asked to provide measures of speaker intent by pointing to a face on the nice/mean rating scale (see Fig. 4). This scale was used to gauge participants' interpretations of speaker intent for ironic criticisms and literal compliments following each Bubble Dialogue conversation. Faces on the nice/mean rating scale represented, from left to right: very nice, nice, a little bit nice, a little bit mean, mean, and very mean. The experimenter also read each participant another series of scenarios, one by one, and asked each participant to provide measures of speaker humour by pointing to a face on the funny/serious rating scale (see Fig. 5). This scale was used to gauge participants' interpretations of speaker humour for ironic criticisms and literal compliments. Faces on the funny/serious scale represented, from left to right: very funny, funny, a little bit funny, a little bit serious, serious, and very serious. During training, feedback was provided to participants until it was clear that the participants understood the meaning of each face on each scale and had demonstrated the ability to use the rating scales appropriately. At this point in time, the nice/mean scale and the funny/serious scale have not been widely used as a response measure in studies with children and adolescents with HFA/AS. To date, approximately seven studies have used one or both of these scales to effectively study verbal irony comprehension in typically developing children (Climie & Pexman, 2008; Glenwright & Pexman, 2010; Harris & Pexman, 2003; Pexman & Glenwright, 2007; Pexman et al., 2006; Pexman et al., 2005; Pexman et al., 2010).

After training on the response measures, participants were introduced to and trained on how to use Bubble Dialogue. The experimenter provided verbal instruction of how Bubble Dialogue worked and showed the participants what the thought bubbles, speech bubbles, and prologues looked like as well as informing them of the purpose of the prologue. Following the verbal instruction and visual presentation, the experimenter and participant engaged in a practice Bubble Dialogue session. The practice session consisted of two characters in a situation that did not involve the use of ironic criticisms or literal compliments. When it was clear that the participant understood how to use the Bubble Dialogue and the participant had provided verbal confirmation of having understood the task, training was considered complete.

The testing session then began and the screen was opened to the prologue of the first scenario. The prologue introduced the two characters, highlighting speaker attribute (e.g., Christian is Shane's big brother.) and providing some context to the scenario. The experimenter and/or the participant read the prologue aloud. The experimenter then said, "It is (speaker character's name)'s turn now." Then the experimenter typed using the thought bubble to highlight what had just occurred. Immediately after reading the thought bubble aloud (e.g., Christian thought, "*Shane did not follow my instructions*"), the experimenter then used the speech bubble to type an ironic criticism or a literal compliment depending on the statement type condition. The ironic criticisms were always positive statements used in negative contexts. The literal compliments were always positive statements made in positive contexts. The experimenter then read the typed speech bubble statement aloud (e.g., Christian said, "*You are a good listener.*") The experimenter then said, "It is (listener character's name)'s turn now." The participant was

prompted to read his/her typed statements aloud. Each conversation ended after the participant had responded to the ironic criticism or literal compliment using the speech bubble and had provided verbal confirmation that he/she was finished making a response.

Immediately following each conversation, participants were asked questions regarding speaker belief, speaker intent, speaker humour, and a memory control item. An example of the speaker belief question was: “When Christian said ‘*You are a good listener*’, did he think that Shane was a good listener or a bad listener?” This item assessed whether or not the participant understood that the speaker was using literal or non-literal language. An example of the speaker intent question was: “Now point to one of these faces to show me how mean or how nice Christian was being when he said, ‘*You are a good listener*’.” The response involved the participant pointing to a face on the nice/mean scale. This item assessed the participant’s perception of whether the speaker was intending to be complimentary or critical. An example of the speaker humour question was: “Now point to one of these faces to show me how serious or how funny Christian was being when he said ‘*You are a good listener*’.” to which the participant responded by pointing to a face on the funny/serious scale. This item assessed the participant’s perception of whether the speaker meant to convey humour or seriousness. The memory control item asked a question such as: “At the beginning of this conversation, how did it say that Christian and Shane knew each other?” This item assessed if the participant recalled the speaker attribute described in the prologue to determine if they had paid attention to the relationship between the speaker and the listener. Each participant completed six Bubble Dialogue scenarios: ironic criticism-peer speaker, literal compliment-peer speaker, ironic criticism-adult speaker, literal

compliment-adult speaker, ironic criticism-no speaker attribute, and literal compliment-no speaker attribute. The six scenarios were counterbalanced such that each scenario appeared only once in a given presentation order. This led to six different presentation orders being used. During the conversations, regardless of statement type, the speaker was described as an adult, a peer, or not given a speaker attribute label. Breaks were provided between scenarios as needed. Positive feedback was made by the experimenter to each participant throughout the testing sessions but no indication was given as to the correctness of a participant's responses.

CHAPTER III

Results

Open Ended Responses for Thought Bubbles

Following the literal compliment or ironic criticism presented in the speech bubble of Bubble Dialogue by the speaker, participants responded using first a thought bubble and then a speech bubble (see Fig. 3). Several participants from the group with HFA/AS chose not to type any response into the thought bubble. The two participant groups ($n = 14$ for both) were significantly different from one another in their use of no response for thought bubble responses in literal compliments and ironic criticisms, $\chi^2(1) = 16.00, p < .001$. For participants' thought bubble responses in scenarios in which they correctly interpreted speaker belief, participants with HFA/AS did not provide a thought bubble response 31 times versus only 8 times by TD participants. Specifically looking at thought bubble responses to ironic criticisms, the participants with HFA/AS provided no response more frequently than TD participants, $\chi^2(1) = 9.25, p < .01$.

Participants' thought bubble responses in Bubble Dialogue were coded by two independent coders. According to the guidelines for Cohen's Kappa set out by Landis and Koch (1977), agreement for coding of the thought bubble responses was almost perfect ($\kappa = 0.81$). Tables 2 shows the response frequencies for each theme for correct interpretations of speaker belief for the thought bubble responses.

There were six themes used to categorize the participants' thought bubble responses in Bubble Dialogue. Those themes were as follows:

1. Humour/Sarcasm: Participants responded by acknowledging the humour or sarcasm conveyed by the speaker's speech bubble response (e.g., "Ha ha, very funny" or "I think he's being sarcastic?").
2. Observation about context: Participants responded by simply making an observation about the context provided in the Bubble Dialogue prologue without providing any new information or responding directly to the speaker's speech bubble response (e.g., "Andrew just blocked my shot" or "I just caught Matthew").
3. Gratitude: Participants responded by thanking the speaker or by expressing appreciation toward the speaker (e.g., "I think you are so nice that you said that." or "Thanks Grandma!!").
4. Advice/Encouragement: Participants' thought bubble responses involved positive statements providing helpful suggestions or support towards the speaker or towards the participant's own character (e.g., "I could teach her some strategies" or "I should probably be more careful in the future").

5. Frustration/Disapproval: Participants' responses suggested the participant's character was discouraged, irritated, or upset (e.g., "Darn it" or "My mom's gonna kill me, it's a brand new shirt.").
6. Uncodable/No response: Participants responded using nonwords, irrelevant words, or did not provide any response at all (e.g., "What" or "Don't say forever! Don't say forever!").

A Group x Theme chi-square analysis was performed to determine if the two participant groups differed significantly in the content of their thought bubble responses. The results suggest that the groups answered similarly in all conditions except for their thought bubble responses when the speaker was an adult making an ironic criticism, $\chi^2(4) = 10.81, p < .05$. Out of 13 participants with HFA/AS who were included in this particular analysis, 7 of these participants did not provide any thought bubble response. However, 5 of the participants who did provide a thought bubble response made an observation about the context versus 6 out of a possible 13 TD participants who also responded in this manner. This indicates that, for those instances where participants with HFA/AS did provide a thought bubble response to ironic criticisms made by an adult speaker, the content of those responses were comparable to TD participants' responses. The most common themes for responding to literal compliments were observation about context and advice/encouragement. The most common themes for responding to ironic criticisms were observation about context and frustration/disapproval.

Open Ended Responses for Speech Bubbles

All participants typed some sort of response into the speech bubble. Participants' speech bubble responses in Bubble Dialogue were coded by two independent coders.

According to the guidelines for Cohen's Kappa set out by Landis and Koch (1977), agreement for coding of the speech bubble responses was almost perfect ($\kappa = 0.81$). Tables 3 shows the response frequencies for each theme for correct interpretations of speaker belief for the speech bubble responses.

There were eight themes used to categorize the participants' speech bubble responses in Bubble Dialogue, the same six themes used to categorize participants' thought bubble responses plus two additional themes. Those additional themes were as follows:

1. Literal Compliments: Participants responded with a positive statement toward the speaker praising that character or that character's actions (e.g., "Nice block" or "We played a good game. You are a good player").
2. Apologies: Participants responses apologized for their character's error or shortcomings as described in Bubble Dialogue prologue (e.g., "Sorry I did not listen. I was thinking about something else." or "I'm sorry that I didn't follow your instructions. Next time I will.").

A Group x Theme chi-square analysis was performed to determine if the two participant groups differed significantly in their speech bubble responses. The chi-square analysis did not produce any significant results. This indicates that there were no differences between the content of both participant groups' speech bubble responses for literal compliments or ironic criticisms regardless of whether the speaker was a peer, an adult, or when no speaker attribute was provided. The two groups responded similarly in all conditions with gratitude and advice/encouragement being the most common themes

for responding to literal compliments and observation about context and gratitude being the most common themes for responding to ironic criticisms.

Speaker Belief

Children's proportions of correct interpretation for speaker belief (understanding that an ironic speaker held a belief opposite to that conveyed by the literal sense of the statement and that a literal speaker held a belief consistent with that conveyed by the literal sense of the statement) are presented in Table 4. A 2 (Participant Group: HFA/AS, TD) x 2 (Statement Type: ironic criticism, literal compliment) x 3 (Speaker Attribute: peer, adult, no label) ANOVA using a Bonferroni adjustment was performed to analyze the speaker belief accuracy data.

The analyses showed there was a significant interaction of Statement Type and Speaker Attribute for accuracy of speaker belief, $F(2, 26) = 12.85, p < .001, MSE = 1.01$. Participants were equally as accurate in their interpretations of speaker belief for literal compliments regardless of when the remarks were made by a peer ($M = 1.00$) as they were when the speaker was described as an adult ($M = 1.00$) and when no speaker attribute label was provided for the speaker ($M = 0.93$). For ironic criticisms, both participant groups were less accurate at interpreting speaker belief when the speaker was a peer ($M = 0.50$) than when the speaker was an adult ($M = 0.96$), $t(27) = 4.26, p < .001$. Both participant groups were also less accurate at interpreting speaker belief for ironic criticisms when the speaker was a peer ($M = 0.50$) than when no speaker attribute label was provided ($M = 0.89$), $t(27) = 3.67, p = .001$. There were no significant interactions involving the Participant Group variable (Participant Group x Statement Type: $F(1, 26) = 2.89, p > .05, MSE = 0.21$; Participant Group x Speaker Attribute: $F(2, 26) = 1.70, p >$

.05, $MSE = 0.13$; Participant Group x Statement Type x Speaker Attribute: $F(2, 26) = 1.60$, $p > .05$, $MSE = 0.13$). There was a significant main effect of Statement Type, $F(1, 26) = 20.54$, $p < .001$, $MSE = 1.52$ due to participants being more accurate at interpreting speaker belief for literal compliments ($M = 0.98$) than for ironic criticisms ($M = 0.79$). There was also a significant main effect of Speaker Attribute, $F(2, 26) = 10.74$, $p < .001$, $MSE = 0.79$ which occurred because interpretations of speaker belief for both statement types were less accurate when the speaker was a peer ($M = .75$) than when the speaker was an adult ($M = .98$), $t(55) = 3.72$, $p < .001$. Interpretations of speaker belief were also less accurate when the speaker was a peer than when no speaker attribute label was provided ($M = .91$), $t(55) = 2.42$, $p < .05$. There was no main effect of Participant Group, $F(1, 26) = 3.21$, $p > .05$, $MSE = 0.21$.

Post-hoc t-tests were conducted to determine if there were differences in speaker belief accuracy between the speaker attributes for literal compliments and ironic criticisms. Given that each t-test had a different number of degrees of freedom, the means for the independent samples t-tests and the paired samples t-tests differed slightly, but not significantly, from one another. The independent samples t-test confirmed that there were no significant differences between groups in speaker belief accuracy for the literal compliments or ironic criticisms when the speaker was a peer, when the speaker was as an adult, or when no speaker attribute label was provided.

Post-hoc paired samples t-tests were conducted to investigate if there were differences in speaker belief accuracy within each participant group for literal compliments and ironic criticisms across each speaker attribute condition. There were no within group differences for participants with HFA/AS on their speaker belief accuracy

for literal compliments. When ironic criticisms were spoken by a peer ($M = 0.64$), speaker belief accuracy was significantly lower for participants with HFA/AS than when ironic criticisms were spoken by a speaker with no speaker attribute label ($M = 1.00$), $t(13) = 2.69, p < .05$. There were no other significant within group differences for participants with HFA/AS in their speaker belief accuracy for ironic criticisms. There were no significant differences among TD participants in their speaker belief accuracy for literal compliments. TD participants were less accurate at interpreting speaker belief accurately when ironic criticisms were spoken by a peer ($M = 0.36$) than when the speaker was an adult ($M = 1.00$), $t(13) = 4.84, p < .001$. Among the TD group, speaker belief accuracy was also significantly lower when the speaker was a peer ($M = 0.36$) than when no speaker attribute label was provided ($M = 0.79$), $t(13) = 2.48, p < .05$. There was no significant within group difference in speaker belief accuracy for ironic criticisms when the speaker was an adult and when the speaker attribute was not labelled.

Speaker Intent

Correct interpretation for speaker intent was defined as a correct response on the speaker belief question and a nice/mean scale rating suggesting correct detection of the speaker's intent. Specifically, for literal compliments the appropriate face scale rating was *a little bit nice*, *nice*, or *very nice*. For ironic criticisms the appropriate face scale rating was *a little bit mean*, *mean*, or *very mean*.

Participants' proportions of correct interpretation of speaker intent are presented in Table 5. A 2 (Participant Group: HFA/AS, TD) x 2 (Statement Type: ironic criticism, literal compliment) x 3 (Speaker Attribute: peer, adult, no label) ANOVA using a Bonferroni adjustment was performed to analyze the speaker intent accuracy data.

Results of the analyses of participants' proportions of correct interpretations of speaker intent showed there were no significant interactions involving Participant Group, Statement Type, or Speaker Attribute (Participant Group x Statement Type: $F(1, 9) = 0.00, p > .05, MSE = 0.00$; Participant Group x Speaker Attribute: $F(2, 9) = 1.73, p > .05, MSE = 0.14$; Statement Type x Speaker Attribute: $F(2, 9) = 1.73, p > .05, MSE = 0.14$; Participant Group x Statement Type x Speaker Attribute: $F(2, 9) = 1.73, p > .05, MSE = 0.14$). The analyses indicated there was a significant main effect of Statement Type, $F(1, 9) = 7.86, p < .05, MSE = 1.46$ because participants were significantly more accurate in their judgments of speaker intent for literal compliments ($M = 1.00$) than for ironic criticisms ($M = 0.67$). There were no other significant main effects (Participant Group: $F(1, 9) = 0.00, p > .05, MSE = 0.00$; Speaker Attribute: $F(2, 9) = 1.73, p > .05, MSE = 0.14$).

Post-hoc t-tests were conducted to determine whether or not there were differences in accuracy for judgments of speaker intent between the speaker attribute types (peers, adult, and no label) for literal compliments and ironic criticisms. The independent samples t-test confirmed that there were no significant differences between participant groups on speaker intent accuracy for literal compliments or ironic criticisms when the speaker was a peer, when the speaker was as an adult, or when no speaker attribute label was provided.

Post-hoc paired samples t-tests were conducted to investigate if there were differences in speaker intent accuracy within each participant group for literal compliments and ironic criticisms across each speaker attribute condition (peer, adult, no label). There were no within group differences for participants with HFA/AS in their

speaker intent accuracy for literal compliments. Participants with HFA/AS were significantly more accurate at judging speaker intent for ironic criticisms when the speaker was an adult ($M = 0.85$) than when no speaker attribute label was provided ($M = 0.50$), $t(12) = 2.31$, $p < .05$. There were no other significant within group differences for participants with HFA/AS in their speaker intent accuracy for ironic criticisms. TD participants did not demonstrate any within group differences in their speaker intent accuracy for literal compliments or ironic criticisms when the speaker was a peer, when the speaker was an adult, or when no speaker attribute label was provided.

Participants' mean ratings of speaker intent are presented in Figure 6. A 2 (Participant Group: HFA/AS, TD) x 2 (Statement Type: ironic criticism, literal compliment) x 3 (Speaker Attribute: peer, adult, no label) ANOVA using a Bonferroni adjustment was performed to analyze the speaker intent ratings data. There were no significant interactions involving Participant Group, Statement Type, or Speaker Attribute for participants' ratings of speaker intent (Participant Group x Statement Type: $F(1, 9) = 0.18$, $p > .05$, $MSE = 0.36$; Participant Group x Speaker Attribute: $F(2, 9) = 0.64$, $p > .05$, $MSE = 0.53$; Statement Type x Speaker Attribute: $F(2, 9) = 0.54$, $p > .05$, $MSE = 0.34$; Participant Group x Statement Type x Speaker Attribute: $F(2, 9) = 1.12$, $p > .05$, $MSE = 0.71$). There was a significant main effect of Statement Type, $F(1, 9) = 39.45$, $p < .001$, $MSE = 81.82$ because literal compliments ($M = 1.38$) were rated as being significantly nicer than ironic criticisms ($M = 3.88$). There were no other significant main effects (Participant Group: $F(1, 9) = 0.45$, $p > .05$, $MSE = 0.82$; Speaker Attribute: $F(2, 9) = 1.09$, $p > .05$, $MSE = 0.89$).

The independent samples t-test confirmed that there were no significant differences between participant groups on their speaker intent ratings for literal compliments or ironic criticisms when the speaker was a peer, when the speaker was as an adult, or when no speaker attribute label was provided.

The paired samples t-tests conducted within the participant group with HFA/AS showed that ratings of speaker intent for literal compliments when the speaker was a peer ($M = 1.64$) were higher (i.e., rated as meaner) than ratings of speaker intent when the speaker was an adult ($M = 1.29$) but this finding was only marginally significant, $t(13) = 2.11$, $p = .06$. No other differences in speaker intent ratings for literal compliments approached statistical significance among participants with HFA/AS. When the speaker was an adult ($M = 4.23$), participants with HFA/AS interpreted ironic criticisms as being more serious than when no speaker attribute label was provided ($M = 3.36$) but this finding was only marginally significant, $t(12) = 2.11$, $p = .06$. No other differences in speaker intent ratings for ironic criticisms approached statistical significance among participants with HFA/AS. TD participants did not demonstrate any within group differences in their speaker intent ratings for literal compliments or ironic criticisms when the speaker was a peer, when the speaker was an adult, or when no speaker attribute label was provided.

Speaker Humour

Correct interpretation for speaker humour was defined as a correct response on the speaker belief question and a funny/serious scale rating suggesting correct detection of the speaker's humour. Specifically, for literal compliments the appropriate face scale

rating was *a little bit serious*, *serious*, or *very serious*. For ironic criticisms the appropriate face scale rating was *a little bit funny*, *funny*, or *very funny*.

Children's proportions of correct interpretation of speaker humour are presented in Table 6. A 2 (Participant Group: HFA/AS, TD) x 2 (Statement Type: ironic criticism, literal compliment) x 3 (Speaker Attribute: peer, adult, no label) ANOVA using a Bonferroni adjustment was performed to analyze the speaker humour accuracy data. There were no significant interactions involving Participant Group, Statement Type, or Speaker Attribute (Participant Group x Statement Type: $F(1, 9) = 1.70, p > .05, MSE = 0.40$; Participant Group x Speaker Attribute: $F(2, 9) = 3.08, p > .05, MSE = 0.12$; Statement Type x Speaker Attribute: $F(2, 9) = 0.06, p > .05, MSE = 0.00$; Participant Group x Statement Type x Speaker Attribute: $F(2, 9) = 3.08, p > .05, MSE = 0.12$). The results of the analyses on the speaker humour accuracy data indicated that there was a main effect of Statement Type, $F(1, 9) = 8.22, p < .05, MSE = 1.91$ because accuracy for judgments of speaker humour was significantly higher for literal compliments ($M = 1.00$) than for ironic criticisms ($M = 0.62$). There were no other significant main effects (Participant Group: $F(1, 9) = 1.70, p > .05, MSE = 0.40$; Speaker Attribute: $F(2, 9) = 0.06, p > .05, MSE = 0.00$).

A post-hoc independent samples t-test was conducted to examine whether or not there were differences between the participant groups in their judgments of speaker humour for literal compliments and ironic criticisms across each speaker attribute (peers, adult, and no label). Participants with HFA/AS ($M = 0.85$) judged speaker humour significantly more accurately than TD participants ($M = 0.36$) for ironic criticisms when

the speaker was an adult, $t(25) = 2.87, p < 0.01$. There were no other significant participant group differences in speaker humour accuracy.

Post-hoc paired samples t-tests were conducted to investigate if there were differences in accuracy for speaker humour ratings within each participant group for literal compliments and ironic criticisms across each speaker attribute condition (peers, adult, no label). There were no significant within group differences for participants with HFA/AS in their speaker humour accuracy for literal compliments or ironic criticisms. There were also no significant within group differences for TD participants in their speaker humour accuracy for literal compliments or ironic criticisms.

Children's mean ratings of speaker humour are presented in Figure 7. A 2 (Participant Group: HFA/AS, TD) x 2 (Statement Type: ironic criticism, literal compliment) x 3 (Speaker Attribute: peer, adult, no label) ANOVA using a Bonferroni adjustment was performed to analyze the speaker humour ratings data. There were no significant interactions involving Participant Group, Statement Type, or Speaker Attribute for ratings of speaker humour (Participant Group x Statement Type: $F(1, 9) = 2.24, p > .05, MSE = 6.96$; Participant Group x Speaker Attribute: $F(2, 9) = 1.15, p > .05, MSE = 0.69$; Statement Type x Speaker Attribute: $F(2, 9) = 0.01, p > .05, MSE = 0.01$; Participant Group x Statement Type x Speaker Attribute: $F(2, 9) = 0.95, p > .05, MSE = 0.55$). There was a significant main effect of Statement Type, $F(1, 9) = 17.91, p < .01, MSE = 55.69$. Literal compliments ($M = 5.21$) were rated as being significantly more serious than ironic criticisms ($M = 3.15$). There were no other significant main effects (Participant Group: $F(1, 9) = 0.24, p > .05, MSE = 1.28$; Speaker Attribute: $F(2, 9) = 0.24, p > .05, MSE = 0.14$).

Independent samples t-tests showed that participants with HFA/AS rated ironic criticisms made by adults as funnier ($M = 2.77$) than did TD participants ($M = 4.50$), $t(25) = 3.00$, $p < .01$. There were no other significant group differences.

Paired samples t-tests were conducted to determine if within group differences existed. The results of the t-tests conducted among participants with HFA/AS showed there were no significant within group differences in speaker humour ratings for literal compliments or ironic criticisms. Paired samples t-tests showed that TD participants judged ironic criticisms as more serious when the speaker was an adult ($M = 4.50$) compared to when no speaker attribute label was provided ($M = 3.09$), $t(10) = 2.28$, $p < .05$. There were no other significant differences among TD participants in their speaker humour ratings for ironic criticisms.

Memory Control

Children's rates of correct responses for the memory control questions when speaker belief was accurately interpreted are presented in Table 7. The memory control questions were included as a means of determining if participants were paying attention to the speaker attribute labels provided in the prologues of the Bubble Dialogue scenarios. A 2 (Participant Group: HFA/AS, TD) x 2 (Statement Type: ironic criticism, literal compliment) x 3 (Speaker Attribute: peer, adult, no label) ANOVA using a Bonferroni adjustment was performed to analyze the memory control responses. These analyses indicated that there were no significant interactions involving Participant Group, Statement Type, or Speaker Attribute (Participant Group x Statement Type: $F(1, 9) = 2.76$, $p > .05$, $MSE = 0.33$; Participant Group x Speaker Attribute: $F(2, 9) = 2.00$, $p > .05$, $MSE = 0.32$; Statement Type x Speaker Attribute: $F(2, 9) = 0.09$, $p > .05$, $MSE = 0.01$;

Participant Group x Statement Type x Speaker Attribute: $F(2, 9) = 2.36, p > .05, MSE = 0.22$). There was a significant main effect of Participant Group, $F(1, 9) = 6.32, p < .05, MSE = 0.69$ with TD participants ($M = 0.83$) scoring higher than participants with HFA/AS ($M = 0.60$). There was also a significant main effect of Speaker Attribute, $F(2, 9) = 9.40, p < .01, MSE = 1.50$. For both groups, accuracy for the memory control question was higher when the speaker was a peer ($M = 0.79$) than when no speaker attribute label was provided, $t(38) = 3.57, p = .001$ as well as when the speaker was an adult ($M = 0.97$) than when no speaker attribute label was provided ($M = 0.40$), $t(49) = 3.86, p < .001$. There was no significant main effect of Statement Type, $F(1, 9) = 0.26, p > .05, MSE = 0.03$.

Post-hoc t-tests were conducted to examine whether or not there were differences in accuracy for the memory control question between the speaker attribute conditions (peers, adult, no label) for literal compliments and ironic criticisms. Independent samples t-tests were done to determine what group differences, if any, existed for memory control response accuracy. For literal compliments when no speaker attribute label was provided, participants with HFA/AS ($M = 0.23$) were significantly less accurate in responding to the memory control question than TD participants ($M = 0.69$), $t(24) = 2.56, p < .05$. There were no other significant group differences in memory control accuracy for literal compliments. There were no significant group differences in memory control accuracy for ironic criticisms.

Paired samples t-tests were conducted to explore the differences that existed within each participant group in terms of their response accuracy for the memory control questions for literal compliments and ironic criticisms across each speaker attribute.

Within the participant group with HFA/AS, memory control responses were significantly more accurate for literal compliments when the speaker was a peer ($M = 0.64$) than when no speaker attribute label was provided ($M = 0.23$), $t(12) = 2.13$, $p = .05$. These participants were also significantly more accurate for memory control responses for literal compliments when the speaker was an adult ($M = 0.86$) than when no speaker attribute label was provided ($M = 0.23$), $t(12) = 4.38$, $p = 0.001$. Within the group with HFA/AS, memory control responses were significantly more accurate for ironic criticisms when the speaker was a peer ($M = 0.89$) than when no speaker attribute label was provided ($M = 0.29$), $t(8) = 5.29$, $p = 0.001$. Within the participant group with HFA/AS, memory control responses were significantly more accurate for ironic criticisms when the speaker was an adult ($M = 0.92$) than when no speaker attribute label was provided ($M = 0.29$), $t(12) = 4.38$, $p = 0.001$. There were no significant differences among TD participants in their memory control accuracy for literal compliments or ironic criticisms.

Executive Functioning and Verbal Irony Comprehension

Participants were tested on two measures of executive functioning: working memory and cognitive flexibility. Working memory was assessed using the SWM task and cognitive flexibility was assessed using the ID/ED task. A summary of each participant groups' scores on these two measures of executive functioning can be seen in Table 8. Independent samples t-tests of the two measures of executive functioning were used to assess differences in working memory and cognitive flexibility between the two participant groups. Pearson's product-moment correlations were conducted between the participant groups' scores on the SWM task dependent variable, the ID/ED task

dependent variable and their accuracy scores for speaker belief, speaker intent, speaker humour, and memory control to determine what relationships existed between executive functioning and verbal irony comprehension. These values are presented in Table 9.

The dependent variable used in assessing working memory, between search errors, indicated how often a participant continued to select a box even after a blue token had already been found in that location. Fewer errors indicated better working memory. An independent samples t-test indicated that participants with HFA/AS did not differ significantly from TD participants in the number of between search errors they made, $t(26) = 0.83, p > .05$. For the SWM task, there were no significant relationships found between both participant groups' number of between search errors and their accuracy scores on speaker belief, speaker intent, speaker humour, and memory control.

The dependent variable used in assessing cognitive flexibility, stages completed, suggests that the higher the number of stages successfully completed, the greater the participants' ability for cognitive flexibility. An independent samples t-test indicated that participants with HFA/AS did not differ significantly from TD participants in the number of stages they completed on the ID/ED task, $t < 1$. For the number of stages completed on the ID/ED task, there were no significant relationships found among the participant group with HFA/AS. However, among TD participants, there was a significant moderate correlation between the number of stages completed and memory control accuracy for literal compliments, $r = 0.58, p < 0.05$. This implies that among the TD group, those who demonstrated greater cognitive flexibility tended to also be more accurate in response to the memory control questions for literal compliments. There were no other significant

correlations among the TD participant group for the number of stages completed on the ID/ED task.

CHAPTER IV

Discussion

The first research question was: Will children and adolescents with HFA/AS show poorer verbal irony comprehension than typically developing children? The results of this study suggest that this was not the case on the measures of verbal irony comprehension that were part of the procedure. The content of both participant groups' thought bubble and the speech bubble responses were similar, except for thought bubble responses for ironic criticisms made when the speaker was an adult. This is likely due to the fact that over half of the participants with HFA/AS did not provide a thought bubble response in this condition while all but one TD participant provided a speech bubble response. When a thought bubble response was provided, both participant groups tended to respond to ironic criticisms by making an observation about the context of the scenario. Prior to making an ironic criticism in the speech bubble, the ironic speaker's thought bubble response simply echoed the information provided in the prologue. Hence, it is possible that participants were simply mirroring back the type of thought bubble responses that had just been provided by the speaker. With regard to speech bubble responses, both participant groups tended to respond by making an observation about context or by expressing gratitude. I suspect that children and adolescents with HFA/AS responded in a similar fashion as TD children and adolescents because Bubble Dialogue, and CMC in general, allows for a more structured social interaction than face-to-face conversation. The cognitive compensation hypothesis (Kasari et al., 2001) suggests that

children with autism can make the same social inferences as TD children but they simply use a different process to arrive at that point. By allowing children and adolescents with HFA/AS to interact within a structured, somewhat rule-based medium, it allows them to use a more intellectual approach in their social interactions and thus emphasizes their strengths.

There were no significant differences between children and adolescents with HFA/AS and TD children and adolescents for their speaker belief accuracy for ironic criticisms when the speaker was a peer, when the speaker was an adult, or when no speaker attribute label was provided. Initially, this was surprising since several studies have found group differences in verbal irony comprehension (Happé, 1994; Jolliffe & Baron-Cohen, 1999; Martin & McDonald, 2004). However, it is not unheard of for children and adolescents with HFA/AS to perform as well as TD children and adolescents on verbal irony comprehension tasks (Pexman et al., 2010). When given a task that plays on their strengths, children with HFA/AS have shown the ability to successfully comprehend verbal irony (MacKay & Shaw, 2004). Importantly, Rajendran et al. (2005) have similarly shown no group verbal irony comprehension differences between children and adolescents with HFA/AS and TD children and adolescents when irony was presented with the Bubble Dialogue program.

The weak central coherence theory (WCC; Frith, 1989), the underconnectivity theory (Just et al., 2004) and the enhanced perceptual functioning theory (O'Connor & Kirk, 2008) all suggest that a critical reason why individuals with autism have difficulty with social interactions is because they have trouble integrating and processing large pieces of information as well as combining many small pieces of information into one

cohesive piece. Several studies have shown that verbal irony comprehension among typically developing children is aided by the speaker's use of intonation (Ackerman, 1983; Capelli et al., 1990; Dews & Winner, 1996; Keenan & Quigley, 1999; Laval & Bert-Erboul, 2005). My study did not rely on the use of intonation, and since participants were responding to a typed statement instead of an actual person, as would be the case in face-to-face interactions, there were not as many social cues for participants to attend to and process. By removing many of the cues present in face-to-face interactions (i.e., body language, intonation, facial expressions), my study met the communication needs of children and adolescents with HFA/AS. For this reason, I suspect they were able to perform as successfully as TD children and adolescents on the tasks presented in this study.

It was also expected that children and adolescents with HFA/AS would not be as accurate as TD children at interpreting speaker intent and speaker humour, thus, providing further support to the findings of Happé (1994) and Joliffe and Baron-Cohen (1999) that individuals with HFA/AS have greater difficulty with verbal irony comprehension than TD individuals. However, the results of the present study did not support this prediction. It is possible that the ratings of speaker intent and speaker humour were not as accurate as they would have been had intonation been used. Pexman et al. (2010) suggested that while children with HFA/AS performed as well as TD children in their judgments of speaker belief and speaker intent, they were not as successful as TD children at detecting the humour function of verbal irony, possibly because TD children made use of the insincere, mocking intonation with which the ironic criticisms were spoken.

Ironic criticisms were rated as funnier than literal compliments and as was expected, accuracy for judgments of speaker humour was higher for literal compliments than for ironic criticisms. However, there was a significant difference between the two participant groups for interpretations of speaker humour for ironic criticisms presented when the speaker was an adult. The results indicated that children and adolescents with HFA/AS rated these particular ironic criticisms as funnier than did TD children and adolescents. Children and adolescents with HFA/AS also judged speaker humour more accurately than TD children and adolescents for ironic criticisms when the speaker was an adult. I suspect that the effects of intonation were also a factor in this finding. In face-to-face conversation, as mentioned previously, ironic criticisms are often accompanied by a mocking, insincere tone of voice which differs substantially from the positive, friendly tone used for literal compliments. I expect that adults would tend to be quite mindful of using the appropriate mocking tone of voice when making an ironic criticism towards a child. As such, I presume that the lack of intonation cues in this study would have hindered the performance of TD children and adolescents when judging the humour of an ironic criticism spoken by an adult.

The second research question asked: Will children's verbal irony comprehension be more accurate when the ironic criticism is made by a peer than when it is made by an adult? Surprisingly, this did not appear to be the case. Speaker belief was examined to determine whether or not children and adolescents with HFA/AS were able to comprehend that the speaker of the ironic criticisms used in this study were saying the opposite of what they meant. Speaker intent was examined to determine if children and adolescents with HFA/AS were able to understand that an ironic criticism was intended

to be mean in comparison to a literal compliment. Speaker humour was looked at to explore how funny or how serious children and adolescents with HFA/AS interpret ironic criticisms to be. As per the theory of mind account of autism (Frith, 1989), it was expected that children and adolescents with HFA/AS would show an inability to correctly perceive speaker intent and speaker humour but that they would more accurately understand verbal irony when both the speaker and the listener of the ironic criticism were children who were peers as opposed to when the speaker was an adult and the listener was a child. However, the opposite was found in this study: interpretations of speaker belief were more accurate when the speaker was an adult than when the speaker was also a child. For ironic criticisms, children and adolescents in both groups were less accurate at interpreting speaker belief when the speaker was a peer than when the speaker was an adult, or when no speaker attribute label was provided. This was a surprising finding given that when people use verbal irony in everyday conversation, it is most commonly used between close friends and is deemed to be more appropriate when the listener is in the speaker's peer group (Jorgensen, 1996).

Prior to conducting my study, I did not ask about the children's expectations about peers, adults, and strangers. It is possible that children, depending on their age, did not view ironic criticisms as funny coming from a peer because it violated their expectations about how a peer should behave. The traditional view of verbal irony (Grice, 1975) states that if what a speaker says violates the expectations that the listener holds about that speaker, the listener may struggle to correctly interpret the speaker's statement. This finding aligns with the tradition model (Grice, 1975) and current findings that

children express disapproval of other children using verbal irony because it violates their politeness concerns (Glenwright & Pexman, 2010).

Children and adolescents with HFA/AS interpreted ironic criticisms as being meaner when the speaker was an adult than when there was no speaker attribute label provided and they were also more accurate in their judgments of speaker intent for adult speakers than for speakers with no speaker attribute label. I interpret these differences to suggest that children and adolescents with HFA/AS hold different expectations for how nice or how mean a person is trying to be, based on their relationship to that person. It suggests that ironic comments made by adults are judged more harshly than those from other people. If this is the case then the results of the present study provide further support both for and against the theory of mind account of autism (Frith, 1989). It appears that children and adolescents with HFA/AS in this study were successfully able to take others' mental states into account when the ironic speaker was an adult but were not equally able to do so when the speaker was a peer or when no speaker attribute was provided.

Furthermore, Pexman et al. (2006) found that when an the speaker of an ironic criticism was described as nice, it was rated as being significantly nicer than when the speaker was described as mean. It would not be unreasonable to assume that children and adolescents would have been taught it is acceptable for an adult whom they know to make a comment that could be judged as being critical and therefore mean, but that a stranger, or person whose relationship to them is unknown, would not likely make a critical comment. As such, if an ironic criticism were made by a stranger, it would not necessarily immediately be judged as being mean.

It is not surprising that children and adolescents with HFA/AS were more accurate in judging speaker intent for an adult speaker versus a speaker with no label since there was no speaker attribute ambiguity involved when the speaker was described as an adult. However, TD children and adolescents did not seem to make distinctions based on speaker attribute when judging speaker intent. It is possible that TD individuals make judgments based on the actual wording of the ironic criticism rather than making judgments based on the speaker of the ironic criticism.

When the speaker of an ironic criticism was described as being a funny person as opposed to being a serious person, children were more accurate in judging speaker intent (Climie & Pexman, 2008). This suggests that children hold schemas about how people behave and use these schemas to guide their interpretations of social conversations. The present study similarly show that TD participants judged ironic criticisms as more serious when spoken by an adult than when spoken by a speaker with no speaker attribute label. I think this occurred because people have more experience with ironic statements spoken by someone they have a personal relationship with than with ironic statements spoken by someone whose relationship to the listener is unknown (Eisterhold et al., 2006).

A memory control question was included for each scenario to examine whether or not children and adolescents paid attention to speaker attribute information when considering ironic criticisms. The memory control component was not a central part of the purpose of this study so it will be discussed briefly. TD children and adolescents were more accurate in responding to the memory control questions than children and adolescents with HFA/AS. This could be viewed as providing further support for the idea that children and adolescents with HFA/AS may have a working memory deficit (Sinzig

et al., 2008) but in responding to the third research question, the results do not provide additional evidence for this theory.

The third and final research question was: How will the measures of executive functioning be related to verbal irony comprehension? Working memory and cognitive flexibility were the two areas of executive functioning measured in this study. Due to evidence of executive dysfunction among individuals with HFA/AS when compared to TD individuals (Kleinmans et al., 2005; Ozonoff et al., 1991; Verté et al., 2006), it was expected that children and adolescents with HFA/AS would score lower than TD children on the measures of executive function and thus, provide further support for the executive function theory of autism (Ozonoff et al., 1991). However, this hypothesis was not supported. The children and adolescents with HFA/AS who participated in this study performed comparably to TD children and adolescents on the working memory measure and the cognitive flexibility measure used in this study. It has been suggested that individuals with HFA/AS may not actually demonstrate a working memory deficit (Ozonoff & Strayer, 2001). In line with this claim, some studies have found that children with autism are able to perform as well as TD children on ID/ED tasks (Corbett et al., 2009; Goldberg et al., 2005).

It was also predicted that lower scores on the measures of working memory and cognitive flexibility would be associated with poor verbal irony comprehension among children and adolescents with HFA/AS. This was expected because deficits in working memory and cognitive flexibility are likely to be related to problems shifting from one meaning of a word or statement to another meaning (Landa & Goldberg, 2005), which is an important part of verbal irony comprehension. The results suggested that the children

and adolescents with HFA/AS who participated in this study did not demonstrate deficits in working memory or cognitive flexibility as were assessed by the SWM and ID/ED tasks, respectively. Surprisingly, there were no significant relationships found between the verbal irony comprehension accuracy scores of the children and adolescents from both groups and their scores on the SWM task. I suspect that since the experimenter's thought bubble responses provided a recap of what had been described in the prologue and many participants also used their thought bubble responses to make an observation about the context, there may not have been as much of a working memory component to the Bubble Dialogue procedure used in this study as had originally been anticipated. In addition, each speaker belief, speaker intent, and speaker humour question restated the statement made by the speaker and therefore these questions also served to reduce the working memory demands of the task.

There were no significant differences found between children and adolescents with HFA/AS and TD children and adolescents on their performance on the cognitive flexibility measure. There were also no significant relationships found between performances on cognitive flexibility and accuracy for speaker belief, speaker intent, or speaker humour. There was a maximum of nine possible stages that could be completed on the cognitive flexibility task and the mean number of stages successfully completed was 8.36 for each participant group. This suggests that all participants were performing at ceiling, or near ceiling, levels on the cognitive flexibility task. It is possible that the chronological age and intellectual ability of the participants in this study were too high for the impact of cognitive flexibility to be seen.

Limitations

The limitations of this study should be taken into account. Since the mean age of participants in this study was 12.37 years for children and adolescents with HFA/AS and 11.61 years for TD children and adolescents, it is possible that they had not yet fully developed their ability to perceive the humour aspect of verbal irony as it may continue to develop into adolescence (Pexman et al., 2005). Another potential limitation is that for this study, even though the literature does not specify which type of working memory tasks would be best, it is possible the use of a verbal working memory measure may have been more appropriate than the spatial working memory measure that was used.

Implications

This study sought to explore how using CMC as an alternative to face-to-face interactions would affect verbal irony comprehension in children and adolescents with HFA/AS. The results obtained from this study can provide further information about verbal irony comprehension deficits and strengths in children and adolescents with HFA/AS by using a social forum that is becoming increasingly common: CMC. This study provides further evidence that children and adolescents with HFA/AS are able to successfully engage in dyadic social interactions within the context of CMC.

This study provided additional evidence about the appropriateness of role-playing programs, such as the Bubble Dialogue. The successful performance achieved by the children and adolescents with HFA/AS in this study suggests that CMC may be able to play a valuable part in the social education of children and adolescents with autism and for their parents, educators, and support people. Interviews have shown that individuals with HFA/AS appreciate the use of alternative modes of communication, including CMC,

because they alleviate some of the stress associated with face-to-face conversations (Müller et al., 2008). This study also indicates that children and adolescents with HFA/AS are able to behave accordingly in social interactions with individuals across various age groups, particularly other children, adults, and people with whom the speaker's age group is unknown. The procedure used in this study can be used for teaching social skills to individuals with autism who struggle in this area. These tasks can be practiced repetitively and consistently but they also allow for a variety of social situations to be mixed in and incorporated. Studies like this one would also be beneficial in working on conversational turn-taking skills.

With the rise in popularity of social networking sites such as Facebook and Twitter, the results of this study help to identify cues to facilitating language comprehension for children using these kinds of communication forums, especially children who struggle socially, such as children with autism. Specifically, CMC programs, like Bubble Dialogue, may be a beneficial way for children and adolescents with HFA/AS to gain access to social interactions because they provide fewer cues to speaker intent and speaker humour, which then allows children and adolescents with HFA/AS to perform more like TD children and adolescents in their understanding verbal irony. The results of this study provide support that this may indeed be the case. The Bubble Dialogue has also previously been found to minimize some of the social deficits displayed by individuals with HFA/AS (Rajendran & Mitchell, 2000) so it is possible that the Bubble Dialogue procedure used in this study aided in the success shown by children and adolescents with HFA/AS.

Given that 42% of adolescents use social networking sites on a daily basis to communicate with friends (Lenhart, 2009), it is important that children and adolescents with autism are not left out of this trend because of difficulties with being able to communicate as effectively as TD children and adolescents. As Parsons and Mitchell (2002) stated, social and behavioural abnormalities can lead to social exclusion which could be extremely difficult for people with HFA/AS because they are often able to see how these abnormalities affect their social interactions on a daily basis. Increased use of CMC as a teaching tool may prove to be a critical component in optimizing social skills of people with autism and providing them with a level playing field.

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Footnotes

¹ In current studies of children with developmental disorders, gender (Baker, Montgomery, & Abramson, 2010; Ditschel, Wisely, Goddard, Robinson, & Howlin, 2010; Griffith, Hastings, Nash, & Hill, 2010; Manning & Wainwright, 2010), PPVT standard scores (Fagan, Pisoni, Horn, & Dillon, 2007; Kjelgaard & Tager-Flusberg, 2010; Mervis & John, 2008; Rasmussen, Wyper & Talwar, 2009), and chronological age (Baker et al., 2010; Dissanayake, Shembrey, & Suddendorf, 2010; Ditschel et al., 2010; Farley, Lopez, & Saunders, 2010; Griffith et al., 2010) are commonly used as a means of matching participants with typically developing children.

Table 1. Summary of Participant Demographics.

Group	<u>Chronological Age</u>				<u>PPVT Standard Score</u>				<u>Word Attack Scores</u>				<u>CCC Composite Scores</u>			
	<i>M</i>	<i>SD</i>	Min	Max	<i>M</i>	<i>SD</i>	Min	Max	<i>M</i>	<i>SD</i>	Min	Max	<i>M</i>	<i>SD</i>	Min	Max
HFA/AS	12.37	2.59	9.08	16.17	108.29	13.94	81	131	21.79	5.40	10	29	113.29	14.56	94	153
TD	11.61	2.09	8.25	15.17	109.93	12.37	94	135	23.29	5.09	15	30	149.29	7.69	133	160

Note: *N* = 14 for each group. There were 11 males and 3 females in each group.

Table 2. Frequencies of Themes Shown in Participant Groups' Thought Bubble Responses as a Function of Statement Type/Speaker Attribute Condition

Statement Type/ Speaker Attribute	Humour/ Sarcasm		Observation About Context		Gratitude		Advice/ Encouragemen t		Frustration/ Disapproval		Uncodable/ No Response	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Literal - Peers												
HFA/AS	0	0	6	42.9	0	0	1	7.1	0	0	7	50.0
TD	0	0	11	78.6	0	0	1	7.1	1	7.1	1	7.1
Literal - Adult												
HFA/AS	0	0	5	35.7	1	7.1	0	0	0	0	8	57.1
TD	0	0	7	50.0	1	7.1	1	7.1	2	14.3	3	21.4
Literal - No Label												
HFA/AS	0	0	5	38.5	1	7.7	0	0	0	0	7	53.8
TD	1	7.7	6	46.2	0	0	2	15.4	1	7.7	3	23.1
Ironic - Peers												
HFA/AS	1	11.1	2	22.2	0	0	0	0	2	22.2	4	44.4
TD	0	0	0	0	0	0	1	20.0	2	40.0	2	40.0
Ironic - Adult												
HFA/AS	1	7.7	0	0	0	0	0	0	5	38.5	7	53.8
TD	2	14.3	3	21.4	0	0	3	21.4	5	35.7	1	7.1
Ironic - No Label												
HFA/AS	1	7.1	3	21.4	0	0	0	0	2	14.3	8	57.1
TD	1	9.1	6	54.5	0	0	1	9.1	2	18.2	1	9.1

Table 3. Frequencies of Themes Shown in Participant Groups' Speech Bubble Responses as a Function of Statement Type/Speaker Attribute Condition

Statement Type/Speaker Attribute	Literal Compliments		Apologies		Humour/Sarcasm		Observation About Context		Gratitude		Advice/Encouragement		Frustration/Disapproval		Uncodable/No Response	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Literal - Peers																
HFA/AS	2	14.3	0	0	0	0	0	0	9	64.3	2	14.3	0	0	1	7.1
TD	1	7.1	0	0	0	0	3	21.4	7	50.0	3	21.4	0	0	0	0
Literal - Adult																
HFA/AS	0	0	0	0	0	0	3	21.4	9	64.3	0	0	0	0	2	14.3
TD	2	14.3	0	0	0	0	5	35.7	7	50.0	0	0	0	0	0	0
Literal - No Label																
HFA/AS	1	7.7	0	0	0	0	2	15.4	4	30.8	6	46.2	0	0	0	0
TD	0	0	0	0	0	0	2	15.4	3	23.1	8	61.5	0	0	0	0
Ironic - Peers																
HFA/AS	2	22.2	0	0	1	11.1	2	22.2	0	0	0	0	2	22.2	2	22.2
TD	3	60.0	0	0	0	0	1	20.0	0	0	1	20.0	0	0	0	0
Ironic - Adult																
HFA/AS	0	0	1	7.7	1	7.7	1	7.7	3	23.1	2	15.4	2	15.4	3	23.1
TD	0	0	3	21.4	3	21.4	3	21.4	5	35.7	2	14.3	1	7.1	0	0
Ironic - No Label																
HFA/AS	0	0	0	0	0	0	5	35.7	3	21.4	0	0	1	7.1	3	21.4
TD	0	0	1	9.1	1	9.1	5	45.5	0	0	1	9.1	0	0	1	9.1

Table 4. Proportions of Correct Speaker Belief Responses for Literal Compliments and Ironic Criticisms as a Function of Participant Group and Speaker Attribute

Speaker Attribute by Group	Literal Compliments	Ironic Criticisms
HFA/AS		
Peers	1.00 (0.00)	0.64 (0.50)
Adult	1.00 (0.00)	0.93 (0.27)
No Label	0.93 (0.27)	1.00 (0.00)
TD		
Peers	1.00 (0.00)	0.36 (0.50)
Adult	1.00 (0.00)	1.00 (0.00)
No Label	0.93 (0.27)	0.79 (0.43)

Note. SDs are provided in parentheses.

Table 5. Proportions of Correct Speaker Intent Responses for Literal Compliments and Ironic Criticisms as a Function of Participant Group and Speaker Attribute

Speaker Attribute by Group	Literal Compliments	Ironic Criticisms
HFA/AS		
Peers	0.93 (0.27)	0.67 (0.50)
Adult	1.00 (0.00)	0.85 (0.38)
No Label	1.00 (0.00)	0.50 (0.52)
TD		
Peers	1.00 (0.00)	1.00 (0.00)
Adult	1.00 (0.00)	0.71 (0.47)
No Label	1.00 (0.00)	0.82 (0.40)

Note. Speaker intent was considered to be correctly interpreted when speaker belief was correctly interpreted and when nice/mean ratings suggested correct interpretation (for literal compliments, ratings of *a little bit nice*, *nice*, or *very nice*; for ironic criticisms, ratings of *a little bit mean*, *mean*, or *very mean*). SDs are provided in parentheses.

Table 6. Proportions of Correct Speaker Humour Responses for Literal Compliments and Ironic Criticisms as a Function of Participant Group and Speaker Attribute

Speaker Attribute by Group	Literal Compliments	Ironic Criticisms
HFA/AS		
Peers	0.93 (0.27)	0.56 (0.53)
Adult	0.86 (0.36)	0.85 (0.38)
No Label	0.93 (0.27)	0.71 (0.47)
TD		
Peers	0.86 (0.36)	0.60 (0.55)
Adult	0.93 (0.27)	0.36 (0.50)
No Label	0.77 (0.44)	0.64 (0.50)

Note. Speaker humour was considered to be correctly interpreted when speaker belief was correctly interpreted and when funny/serious ratings suggested correct interpretation (for literal compliments, ratings of *a little bit serious*, *serious*, or *very serious*; for ironic criticisms, ratings of *a little bit funny*, *funny*, or *very funny*). SDs are provided in parentheses.

Table 7. Proportions of Correct Memory Control Responses for Literal Compliments and Ironic Criticisms as a Function of Participant Group and Speaker Attribute

Speaker Attribute by Group	Literal Compliments	Ironic Criticisms
HFA/AS		
Peers	0.64 (0.50)	0.89 (0.33)
Adult	0.86 (0.36)	0.92 (0.28)
No Label	0.23 (0.44)	0.29 (0.47)
TD		
Peers	0.86 (0.36)	0.60 (0.55)
Adult	0.79 (0.43)	0.71 (0.47)
No Label	0.69 (0.48)	0.55 (0.52)

Note. Responses to the memory control questions were considered to be correct only when speaker belief was also correctly interpreted. SDs are provided in parentheses.

Table 8. Participant Groups' Mean Scores on the Spatial Working Memory and Intradimensional/Extradimensional Set Shifting Tasks

	HFA/AS		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Spatial working memory				
Total between search errors	32.57	16.69	38.14	18.76
ID/ED set shift				
Stages completed	8.36	0.93	8.36	0.93

Table 9. Correlations between Executive Function Measures and Verbal Irony

Comprehension Measures

	HFA/AS		TD	
	SWM Between Errors	ID/ED Stages Completed	SWM Between Errors	ID/ED Stages Completed
Speaker Belief				
	-0.27	0.42	-0.23	-0.20
Literal	0.22	-0.14	-0.13	0.16
Ironic				
Speaker Intent				
	0.22	-0.20	<i>a.</i>	<i>a.</i>
Literal	0.51	0.04	-0.29	-0.40
Ironic				
Speaker Humour				
	-0.09	0.12	-0.33	0.40
Literal	-0.04	-0.23	-0.08	-0.06
Ironic				
Memory Control				
	-0.06	-0.25	-0.33	0.58*
Literal	0.00	-0.18	-0.25	0.08
Ironic				

^a. Cannot be computed because one of the variables is a constant.* $p < .05$.

Figure Captions

Figure 1. Spatial working memory task.

Figure 2. Intra-extra dimensional set shift task.

Figure 3. Example Bubble Dialogue scenario.

Figure 4. Nice/mean rating scale.

Figure 5. Funny/serious rating scale.

Figure 6. Mean ratings of speaker intent for literal compliments and ironic criticisms when speaker belief correct.

Figure 7. Mean ratings of speaker humour for literal compliments and ironic criticisms when speaker belief correct

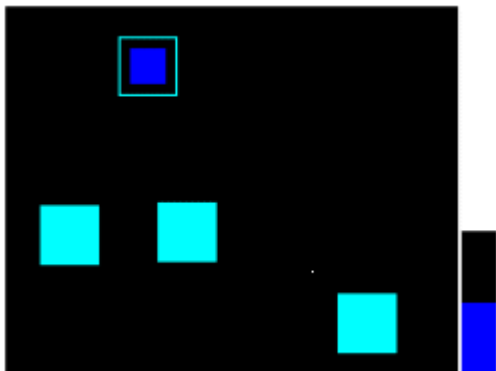
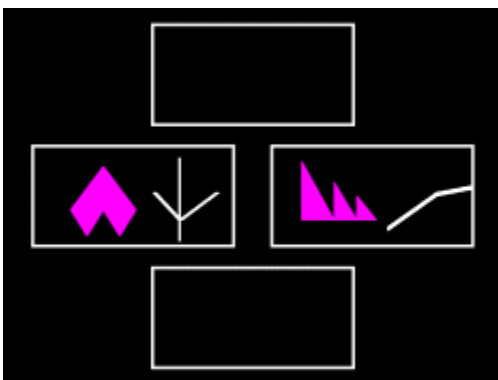
Figure 1**Figure 2**

Figure 3

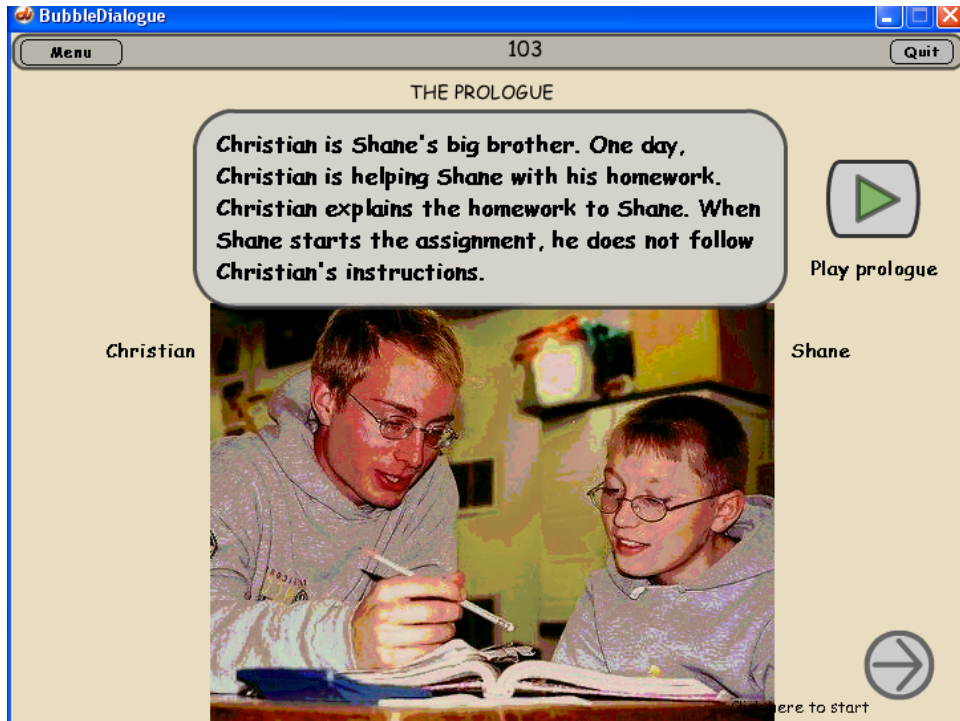






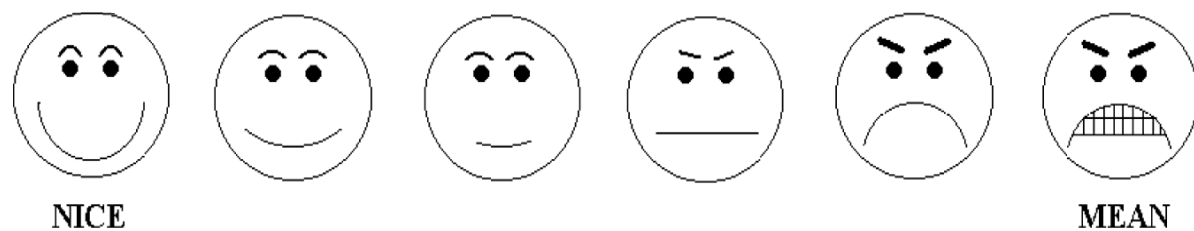
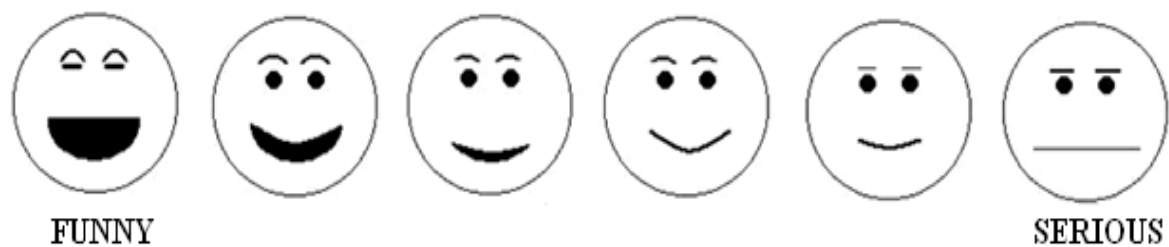
Figure 4**Figure 5**

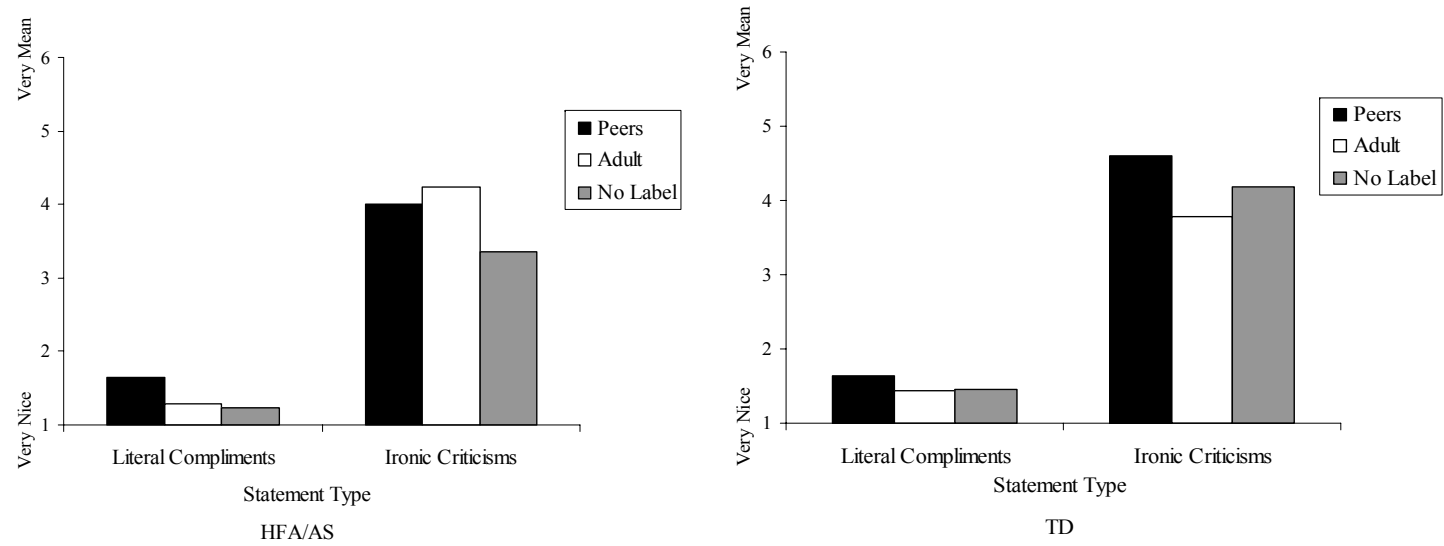
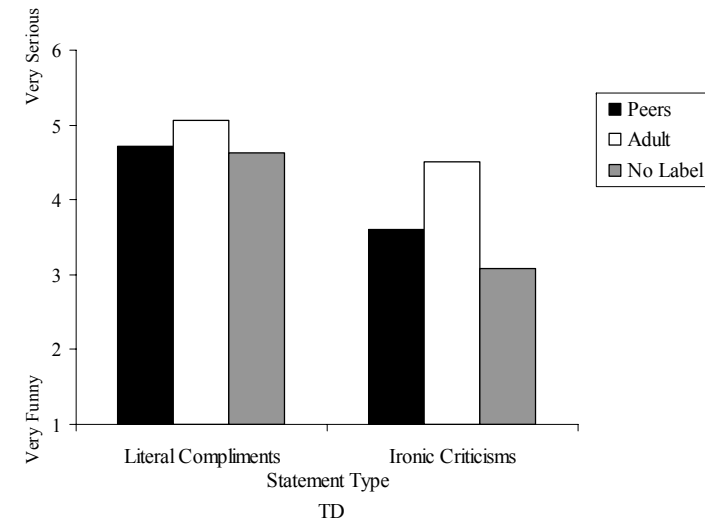
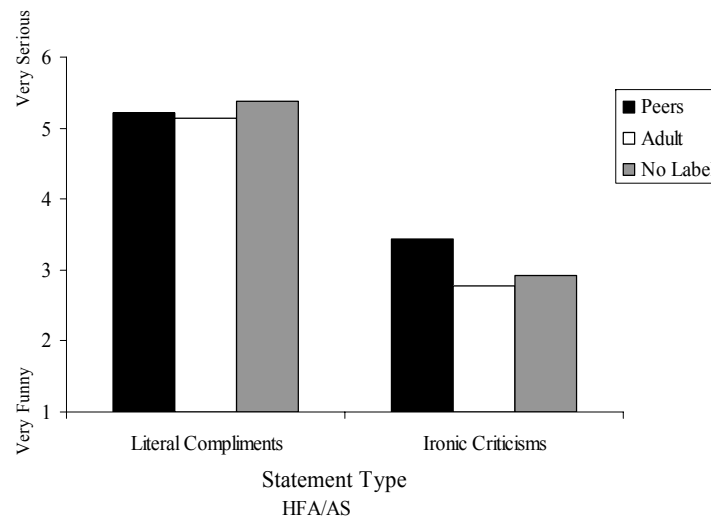
Figure 6

Figure 7

Appendix

Participant #: _____

Children's Communication Checklist (CCC)

(Bishop, 1998)

Instructions: This checklist contains a series of statements describing aspects of children's behavior. For each statement, you are asked to judge whether the statement ***definitely applies, applies somewhat or does not apply***. Please check off **one** box per item, choosing the response that, in your judgment, best describes *your child*. Do not leave any items blank. If you are unable to answer the question, please check off the box labeled *unable to judge*. **Please fill in the checklist on your own, do not discuss your answers with anyone else.** The checklist cannot capture every child's behavior perfectly, so do not worry if you feel that none of the response alternatives is exactly appropriate; check off the one you think comes closest, and if necessary, add an explanatory comment.

<i>Part A: Speech Output: Intelligibility and Fluency</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
1) People can understand virtually everything he/she says.	()	()	()	()
2) People have trouble understanding much of what he/she says.	()	()	()	()
3) Seldom makes any errors in producing speech sounds.	()	()	()	()
4) Mispronounces one or two speech sounds but is not difficult to understand; e.g. may say "th" for "s" or "w" for "r".	()	()	()	()
5) Production of speech sounds seems immature like that of a younger child, e.g. he/she says things like: "tat" for "cat", or "chimbley" for "chimney" or "bokkle" for "bottle".	()	()	()	()
6) He/she seems to have difficulty in saying "k" or "s", so that "cat" and "sat" are both pronounced as "tat".	()	()	()	()

Part A. cont'd: Speech Output: Intelligibility and Fluency	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
7) Leaves off beginnings or ends of words, or omits entire syllables (e.g. "bella" for "umbrella").	()	()	()	()
8) It is much harder to understand him/her when he/she is talking in sentences, rather than producing single words.	()	()	()	()
9) Speech is extremely rapid.	()	()	()	()
10) Seems to have difficulty in constructing the whole of what he/she wants to say: makes false starts, and repeats whole words and phrases; e.g., might say "can I-can I-can I have an-have an ice cream."	()	()	()	()
11) Speech is clearly articulated and fluent.	()	()	()	()
Part B: Syntax	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
12) Speech is mostly two to three word phrases such as "me got ball" or "give dolly".	()	()	()	()
13) Can produce long and complicated sentences such as: "When we went to the park I had a go on the swings"; "I saw this man standing on the corner."	()	()	()	()
14) Tends to leave out words and grammatical endings, producing sentences such as: "I find two dog"; "John go there yesterday"; "She got bag."	()	()	()	()

Part B cont'd: Syntax	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
15) Sometimes makes errors on pronouns, e.g. saying: "she" rather than "he" or vice versa.	()	()	()	()
Part C: Inappropriate Initiation	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
16) Talks to anyone and everyone.	()	()	()	()
17) Talks too much.	()	()	()	()
18) Keeps telling people things that they already know.	()	()	()	()
19) Talks to him/her self.	()	()	()	()
20) Talks repetitively about things that no-one else is interested in.	()	()	()	()
21) Asks questions although he knows the answers.	()	()	()	()
Part D: Coherence	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
22) It is sometimes hard to make sense of what he/she is saying because it seems illogical or disconnected.	()	()	()	()
23) Conversation with him can be enjoyable and interesting.	()	()	()	()
24) Can give an easy to follow account of a past event such as a birthday party or holiday.	()	()	()	()
25) Can talk clearly about what he/she plans to do in the future (e.g. tomorrow or next week).	()	()	()	()

Part D cont'd: Coherence	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
26) Would have difficulty in explaining to a younger child how to play a simple game such as "snap."	()	()	()	()
27) Has difficulty in telling a story, or describing what he has done, in an orderly sequence of events.	()	()	()	()
28) Uses terms like "he" or "it" without making it clear what he/she is talking about.	()	()	()	()
29) Doesn't seem to realize the need to explain what he is talking about to someone who doesn't share his experiences; for instance, might talk about "Johnny" without explaining who he is.	()	()	()	()
Part E: Stereotyped conversation	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
30) Pronounces words in an over-precise manner: accent may sound rather affected or "put-on", as if child is mimicking a TV personality rather than talking like those around him.	()	()	()	()
31) Makes frequent use of expressions such as "by the way", "actually", "you know what?"; "as a matter of fact"; "well, you know", or "of course."	()	()	()	()
32) Will suddenly change the topic of conversation.	()	()	()	()
33) Often turns the conversation to a favorite theme, rather than following what the other person wants to talk about.	()	()	()	()

<i>Part E cont'd: Stereotyped conversation</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
34) Conversation with him/her tends to go off in unexpected directions.	()	()	()	()
35) Includes over-precise information in his/her talk, e.g. will give the exact time or date of an event. For instance, when asked "when did you go on holiday" may reply "13 th July 1995", rather than "in the summer."	()	()	()	()
36) Has favorite phrases, sentences or longer sequences which he/she will use a great deal, sometimes in inappropriate situations.	()	()	()	()
37) Sometimes seems to say things that she/he does not fully understand.	()	()	()	()
<i>Part F. Use of conversational context</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
38) Tends to repeat back what others have just said.	()	()	()	()
39) His/her ability to communicate clearly seems to vary a great deal from one situation to another.	()	()	()	()
40) Takes in just one or two words in a sentence, and so often misinterprets what has been said.	()	()	()	()
41) Can understand sarcasm (e.g., will be amused rather than confused when someone says "isn't it a lovely day!" when it is pouring with rain).	()	()	()	()

Part F. cont'd: Use of conversational context	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
42) Tends to be over-literal, sometimes with (unintentionally) humorous results. For instance, a child who was asked "Do you find it hard to get up in the morning" replied "No. You just put one leg out of the bed and then the other and stand up." Another child who was told "watch you hands" when using scissors, proceeded to stare at his fingers.	()	()	()	()
43) Gets into trouble because he/she doesn't always understand the rules for polite behavior and is regarded by others as rude or strange.	()	()	()	()
44) May say things which are tactless or socially inappropriate.	()	()	()	()
45) Treats everyone the same way, regardless of social status: e.g. might talk to the head teacher the same way as to another child.	()	()	()	()
Part G: Conversational rapport	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
46) Ignores conversational overtures from others (e.g. if asked "what are you making?" the child just continues working as if nothing had happened).	()	()	()	()
47) Seldom or never starts up a conversation; does not volunteer information about what has happened.	()	()	()	()
48) Doesn't seem to read facial expressions or tone of voice adequately and may not realize when other people are upset or angry.	()	()	()	()

<i>Part G cont'd: Conversational rapport</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
49) Poor at using facial expression or gestures to convey his/her feelings; he/she may look blank when angry, or smile when anxious.	()	()	()	()
50) Makes good use of gestures to get his/her meaning across.	()	()	()	()
51) Seldom or never looks at the person he/she is talking to: seems to actively avoid eye contact.	()	()	()	()
52) Tends to look away from the person he/she is talking to: Seem inattentive or preoccupied	()	()	()	()
53) Smiles appropriately when talking to people	()	()	()	()
<i>Part H: Social relationships</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
54) Is popular with other children.	()	()	()	()
55) Has one or two good friends.	()	()	()	()
56) Tends to be babied, teased or bullied by other children.	()	()	()	()
57) Is deliberately aggressive to other children.	()	()	()	()
58) May hurt or upset other children unintentionally.	()	()	()	()
59) A loner: neglected by other children, but not disliked	()	()	()	()
60) Perceived as odd by other children and actively avoided.	()	()	()	()

<i>Part H cont'd: Social relationships</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
61) Has difficulty making relations with others because of anxiety.	()	()	()	()
62) With familiar adults, he/she seems inattentive, distant or preoccupied.	()	()	()	()
63) Overly keen to interact with adults, lacking the inhibition that most children show with strangers.	()	()	()	()
<i>Part I: Interests</i>	Definitely Applies	Somewhat Applies	Does not Apply	Can Not Judge
64) Uses sophisticated or unusual words; e.g. if asked for animal names might say "aardvark" or "tapir."	()	()	()	()
65) Has a large store of factual information: e.g. may know the names of all the capitals of the world, or the names of many varieties of dinosaurs.	()	()	()	()
66) Has one or more over-riding specific interests (e.g. computers, dinosaurs), and will prefer doing activities involving this to anything else.	()	()	()	()
67) Enjoys watching TV programs intended for children of his/her age.	()	()	()	()
68) Seems to have no interests: prefers to do nothing.	()	()	()	()
69) Prefers to do things with other children rather than on his own.	()	()	()	()
70) Prefers to be with adults rather than other children.	()	()	()	()