UNDERSTANDING CONTEXT IN AUTISM: A MODIFIED APPROACH TO STUDYING IDIOMS

by

Sarah Harward

A thesis submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Master of Science

Department of Educational Psychology

The University of Utah

May 2012

The University of Utah Graduate School

STATEMENT OF THESIS APPROVAL

The thesis of **Sarah Harward**

has been approved by the following supervisory committee members:

Anne E. Cook	, Chair	**11/30/10** Date Approved
William R. Jenson	, Member	**11/30/10** Date Approved
John C. Kircher	, Member	**11/30/10** Date Approved

and by **Elaine Clark** , Chair of

the Department of **Educational Psychology**

and by Charles A. Wight, Dean of The Graduate School.

ABSTRACT

Central coherence has been described as the tendency of the normal cognitive system to experience an unconscious drive for coherence or meaning when processing stimuli. Considerable evidence suggests that individuals with autism are less efficient at using contextual information to make inferences and to extract global meaning. This processing style has been termed *weak central coherence*. It has also been suggested that individuals with autism lack a *theory of mind*, or the cognitive ability to attribute mental states to oneself and others, and to understand that other individuals have beliefs, desires and intentions that are different from one's own. This study tested assumptions of both theory of mind and weak central coherence theory with respect to the role of context in idiom comprehension in individuals with and without autism using eye tracking technology.

Participants were recruited from the Utah Autism Research Program at the University of Utah and from the surrounding community. Participants with autism were assessed with two measurements: (a) Autism Diagnostic Interview-Revised and (b) Autism Diagnostic Observation Schedule-Generic. Participants met the criteria for autism. Eye gaze was recorded using an Applied Sciences Laboratory EyeHead Integration system while the participants read passages containing an idiom that was preceded by context that was either neutral or biased toward the intended meaning of an

idiom presented later in the text. A subsequent target sentence contained the idiom, followed by a phrase that disambiguated the idiom towards either its literal or figurative meaning. Both first pass and second pass reading times were recorded for the idiom and disambiguating phrase. Both groups appeared to use contextual information to similar degrees in processing idioms. Although context facilitated comprehension of the idiom in its figurative sense for both groups, participants with autism experienced stronger and longer lasting comprehension difficulty when presented with the figuration interpretation of idioms.

TABLE OF CONTENTS

LIST OF TABLES

Table

ACKNOWLEDGEMENTS

Special appreciation is extended to my supervisory committee, Dr. Anne E. Cook (chair), Dr. William R. Jenson and Dr. John C. Kircher (committee members), for their support and guidance on this project. Specifically, I would like to share my appreciation and admiration for Dr. Anne Cook, who showed me that with persistent dedication, anything is attainable. I would also like to thank Annie Ashcraft Bills for her guidance and dedication to this project.

CHAPTER 1

INTRODUCTION

Some researchers and theorists have proposed that the asociality of children with autism is a result of more fundamental affective deficits. For example, children with autism experience difficulty in recognizing affective stimuli like facial expressions and emotional verbalization (Hobson, 2006). Baron-Cohen, Leslie, and Frith (1985) proposed that these social deficits may result from the lack of a "theory of mind"; they suggested that children with autism have difficulties with tasks that require understanding and acknowledgement of another person's beliefs or perspectives. Theory of Mind refers to the cognitive ability to attribute mental states – beliefs, intents, desires, pretending, knowledge, etc. – to oneself and others, and to understand that other individuals have beliefs, desires and intentions that are different from one's own (Premack & Woodruff, 1978). Additionally, researchers have suggested that individuals with autism suffer from weak central coherence (Frith, 1989). According to Frith, individuals with autism lack the normal drive to integrate different sources of information to achieve global meaning; instead, they tend to process information in a more piecemeal fashion. Happé and Frith (2006) proposed that this local processing style may expand to the literary experiences, leading to impairment in nonliteral language comprehension. Individuals with autism

have repeatedly been shown to have difficulties using context to infer implicit meaning and resolve ambiguities. This inability or deficit in using contextual information, combined with impaired theory of mind, suggests that individuals with autism may be more likely to interpret figurative expressions literally. The goal of this thesis is to test this hypothesis in the context of idiom comprehension. First, however, it is necessary to provide background information on Autism Spectrum Disorders as well as work on language comprehension in autism.

Characteristics of Autism

Children diagnosed with Autism Spectrum Disorders present with a grouping of severe problems that are frequently evident by early childhood. In Leo Kanner's (1943) original description of autism, he noted a combination of symptoms including inflexibility, rigidity, desire to be alone, obsessiveness, echolalia, delayed use of functional language, and inability to relate to other people. Since then, many of Kanner's initial observations have become established diagnostic criteria in the diagnosis of Autism Spectrum Disorders. Autism is currently described as a lifelong developmental disorder with a common cause at the genetic, cognitive and neural levels (Hill & Frith, 2003). Specific diagnosis criteria, including impairment in social interaction, difficulty with communication, and the presence of stereotyped behaviors, are described in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychological Association, 1994).

The most fundamental characteristic of those diagnosed with autism is a "gross and sustained" impairment in social interaction (American Psychological Association,

1994). Often this is expressed in the form of impaired nonverbal social behaviors, difficulty establishing peer relationships, lack of spontaneous seeking of shared enjoyment, lack of social-emotional reciprocity, and decreased awareness of others (American Psychological Association, 1994).

Individuals with autism may demonstrate repetitive or restrictive behavior patterns and many have interests or preoccupations that are strange or abnormally intense (American Psychological Association, 1994). Often individuals with autism are inflexible and adhere to nonfunctional routines. Body posture may be stereotyped and motor movements such as clapping, flapping, rocking, or swaying may be observed. Additionally, individuals diagnosed with autism often become fascinated with movement and spinning, or they may become highly attached to inanimate objects (American Psychological Association, 1994).

Although the DSM-IV contains the diagnostic criteria for the disorders, there is a large amount of variability in the characteristics of individuals with autism. Recently, the term autism spectrum disorders has been used to describe a group of individuals that vary in terms of symptomology, linguistic ability, and intelligence (Hill & Frith, 2003). Asperger disorder is an example of a condition that exists within the spectrum but varies somewhat from autism. These individuals show impairments in social interaction and restrictive and repetitive behaviors, but show no significant delays in language development, cognitive development, or adaptive behavior (American Psychological Association, 1994). Also within the spectrum exists another diagnosis named pervasive developmental delay, not otherwise specified (PDD-NOS). This condition includes those who do not meet all of the diagnostic criteria for autism or Asperger disorder but exhibit

similar symptoms. This may be due to their symptoms being atypical, less frequent or intense, or the onset occurred after the age of three (American Psychological Association, 1994). Since language skills and symptoms of autism can vary greatly within the spectrum, many researchers have attempted to describe additional unifying characteristics that may be unique to autism. One area that has received much attention, and that is the focus of this thesis, is cognitive processing and language comprehension.

Individuals diagnosed with autism, according to DSM-IV criteria, also display marked impairments of verbal and nonverbal communication skills (American Psychological Association, 1994). Those with autism may fail to develop spoken language or the development of spoken language may be significantly delayed. Although communication difficulties are a core symptom among those with autism, there is great variation among individuals. As noted previously, individual abilities may range from adequate conversational skills to being completely nonverbal (Rice, Warren, & Betz, 2005). Verbal impairments affected in autism can be categorized into four interrelated systems: phonology, syntax, semantics and pragmatics.

Language Comprehension in Autism

Unusual phonological development is often observed in individuals with autism. Phonology refers to the system or pattern of speech sounds used in a particular language. In this particular linguistic system, the most notable impairment in autism involves prosody of speech; those diagnosed with autism often display peculiar pitch, tone, rate, rhythm, or vocal stress. Although individuals with autism generally display atypical

prosody, patterns of oddity are not systematic across individuals, and these peculiarities are often observed throughout the lifespan (Wilkinson, 1998).

Syntactic development, or the development of grammar, may also be affected in autism. Most children with autism show a slower rate of growth compared to typically developing children, although they develop along the same path (Tager-Flusberg et al., 1990). The most common presentation of syntactic difficulties lies in the occurrence of pronoun reversals. Although individuals with autism can apply proper nouns such as names correctly, they commonly fail to differentiate among pronouns, confusing words like "I" and "he." The theory of mind impairment reflects a difficulty with perspective taking, possibly contributing to the frequent pronoun reversal. Despite this confusion, even though the application of personal pronouns is problematic, comprehension of their meanings seem to be intact (Wilkinson, 1998).

Semantics refers to the ability to acquire new word meanings, store them in memory, and respond to them in a communicative way (Wilkinson, 1998). Individuals with autism have been known to use odd metaphorical phrases that are not appropriate to the context of the situation. Individuals with autism also commonly use unusual lexical patterns, such as made up nonsense words (neologisms). Abnormal lexical arrangements can also be seen in echolalia. Wilkinson (1998) noted that individuals with autism may develop large vocabularies, and it is the frequency and persistence of semantic oddities that often distinguish those with autism. It is thought that these semantic deficits are not related to difficulties with concept development; they are seen as more of an obscurity of application of semantic principles in functional and social situations (Wilkinson, 1998).

Lastly, irregular patterns of pragmatics, which dictate verbal and nonverbal language use in social situations, are among the most well established characteristics of autism (Wilkinson, 1998). Early deviation from typical social-communication development can be seen in significantly reduced amounts of "joint attention," or coordinated attention with caregivers (Loveland & Landry, 1986; Wilkinson, 1998). These reduced amounts of "joint attention" in very early childhood appear to be related to later language difficulties and development (Wilkinson, 1998). Other unusual pragmatic characteristics commonly seen in individuals with autism include atypical topic selection, overly formal language, failure to supply new information to a conversation, perseverative or persistent questioning, echolalia, making irrelevant remarks, and an inability to consider the listener's perspective (Rice, Warren, & Betz, 2005; Tager-Flusberg, 2007a; Wilkinson, 1998). Wilkinson (1998) described difficulties with nonverbal pragmatics as unusual eye gaze, decreased social smiling, decreased use of social gestures, and trouble with turn taking. Difficulty with pragmatics becomes problematic since much of today's spoken and written language incorporates nonliteral phrases and expressions. For example, and relevant to this study, idiomatic phrases such as *kick the bucket* and *had me in stitches* have fixed figurative as well as literal interpretations that can be difficult for individuals with pragmatic impairments to understand.

Understanding Idioms

What sets idioms apart from most other fixed expressions is their "nonlogical" nature, that is, the absence of any discernible relation between their linguistic meaning

and their idiomatic meaning (Glucksberg, 2001). Therefore, to learn an idiom, one simply must memorize the stipulated significance, as its meaning is also retrieved the same way that the meaning of a familiar word is retrieved. Many theorists agree that there is a minimum of four types of idioms, some easier to interpret than others: noncompositional idioms (e.g., *by and large*); compositional opaque idioms (e.g., *kick the bucket*); compositional transparent idioms (e.g., *spill the beans*); and quasi-metaphorical (e.g., *skating on thin ice*).

Idioms are organized by their compositional and transparent descriptors. For compositional idioms, the results of linguistic analysis would be consistent with the idiomatic meanings, so comprehension should be facilitated. In noncompositional idioms, there is no discernible connection between the idiom's constituents and the idiom's meaning. The idiomatic and linguistic meanings conflict, making comprehension more difficult, as in the idiom *lemon* to refer to a product that is flawed, hence the phrase "*lemon law*" (Glucksberg, 2001). The transparency aspect is the extent to which an idiom's meaning can be inferred from the meaning of its components. However, the literal meaning of idioms does not restrict its use in comprehension.

In compositional opaque idioms, the relations between the idiom's constituents and its meaning may be opaque, but the meaning of the specific words can nevertheless constrain both interpretation and use. Glucksberg (2001) explained, "For the idiom *kick the bucket*, the semantics of the verb *to kick* can constrain interpretation. Kicking is a discrete act, and so one could not say *he kick the bucket all week*, even though one could say *he lay dying all week.* Similarly, kicking is a swift action; when someone *kicks the*

bucket, he dies swiftly, as opposed to *giving up the ghost*, which implies going gently into that good night" (p. 74).

Compositional transparent idioms include a one-to-one semantic relationship between the idiom's constituents and components of the idiom's meaning. For example, in the idiom *break the ice*, the work *break* corresponds to the idiomatic sense of abruptly changing an uncomfortable social situation, and the word *ice* corresponds to the idiomatic sense of social tension (Glucksberg, 2001). Quasi-metaphorical idioms convey meaning via their allusional content and use the same strategies that nominal metaphors use, such as "my lawyer is a shark", or "my job is a jail" (Glucksberg, 2001).

Problems arise with comprehension and translation because idioms can be manipulated to fit a variety of situations and contexts. Many cannot survive literal translation, or can be altered and used in the past, present, or future tense (i.e., *He burned all his bridges behind him*, or *burned all his bridges in front of him*, or *I'll cross that bridge when I get to it*) (Glucksberg, 2001). Idioms can also be used with modal auxiliaries, as in *He might kick the bucket* (Glucksberg, 2001). Problems also arise when culture-specific knowledge is involved. Jargon, slang, metaphors and idioms involve important cultural beliefs and norms, thereby further complicating comprehension (Glucksberg, 2001). Idioms, like any other fixed expression, must be memorized but maintained with a degree of flexibility.

Ultimately, the cognitive framework for learning and understanding idioms requires a developed grasp of semantic duality (i.e., understanding that words and phrases can have more than one meaning), and an awareness that what is said may not correspond to what the speaker means (Kerbel & Grunwell, 1998). To accurately comprehend

idioms, one must be able to learn the meaning of individual idioms, be able to retrieve those meanings from memory and then be able to choose the appropriate idiomatic meaning for the given context over the literal sense of the expression. Since these essential abilities require flexibility of thought and theory of mind skills, impairment in these areas may impede idiom comprehension. Individuals with autism, who may not accurately interpret others' intended meaning (i.e., theory of mind impairment) or who may not use context appropriately to help them interpret that meaning (i.e., weak central coherence, may show language deficits in idiom comprehension compared to their more typically developing peers). Previous work on idiom comprehension in the context of both Theory of Mind and Weak Central Coherence Theory will be presented in the following sections.

Theories of Cognitive Impairment

Theory of Mind

Recently, Theory of Mind has been proposed in order to explain some of the deficits in language related communication that are seen in autism. Individuals with autism are described as lacking a "theory of mind," or the ability to make attributions about the mental states of themselves and others (Baron-Cohen et al., 1985). Theory of mind has most often been discussed in relation to the deficits commonly seen in pragmatic language. For example, a relationship has been found between theory of mind skills and conversation ability (Hale & Tager-Flusberg, 2005). It has been suggested by Tager-Flusberg (1996) that individuals with autism typically fail to engage in meaningful and sustained conversations due to complications in understanding the listener's

perspective. Difficulty engaging in reciprocal conversation has also been linked to a lack of understanding that others embrace knowledge different from one's own (Tager-Flusberg, 1999). This lack of perspective taking may also help to explain the common autistic characteristics of perseverative questioning, irrelevant remarks, and failure to contribute new information to a conversation. Thus, even though individuals with autism acquire the use of functional language, they still show much difficulty with the ability to communicate. Frith and Happé (1994) explained that language can be understood as a representational system governed by grammatical rules, whereas communication can be better understood as the ability to convey intended meaning through interactions with others. It is this ability to convey intention that is often described as underdeveloped in autism (Frith & Happé, 1994; Happé, 1993).

Deficits in nonverbal communication have also been linked to theory of mind. Studies have found that children with autism show a lack of many protoimperative gestures (Baron-Cohen, 1989). Protoimperative gestures are used to direct another person's attention to oneself and require engagement in joint attention with communicative intent (Baron-Cohen, 1989; Loveland & Landry, 1986). As previously mentioned, this type of engagement is often lacking in individuals with autism (Loveland & Landry, 1986; Wilkinson, 1998). It has been hypothesized that joint attention skills may be an important precursor to the development of theory of mind and indicative of later language development (Hale & Tager-Flusberg, 2005; Wilkinson, 1998).

Theory of mind is also used to explain difficulties that individuals with autism face when interpreting passages of text containing nonliteral language. Martin and McDonald (2004) conducted a study that examined the ability of individuals with autism

to interpret nonliteral ironic jokes. The authors read a series of stories to the participants and asked them to follow along. Each story contained a situation in which the protagonist commits a sneaky act. In one condition, the protagonist does not realize they have been seen and utters a lie to conceal their actions. In another condition, the protagonist realizes that s/he has been seen and utters an ironic joke in order to cover up their embarrassment. The participants were then asked to decide whether the utterance was a deceptive lie or an ironic joke. Results indicated that the participants with autism were more likely to conclude that the protagonist was lying even when s/he uttered an ironic joke. The authors concluded that the participants with autism were unable to use the social context of the situation and mental state of the protagonist to interpret the meaning of the conversation.

Happé (1995) went on to explain that metaphors require an understanding of intention and that a metaphorical utterance is essentially a loose interpretation of a speaker's thought. Happé (1993) conducted a study that examined the ability of individuals with autism to understand metaphors. She found that individuals with autism performed significantly more poorly than control participants in selecting the correct metaphor to complete a sentence. These results indicated that the level of theory of mind ability was associated with comprehension of figurative language. She described theory of mind as being crucial to the understanding of metaphors because literal interpretation can often lead to incorrect conclusions.

Weak Central Coherence Theory

Weak Central Coherence Theory is used to describe a group of cognitive processing deficits frequently exhibited by individuals with autism. Frith (1989) described typically developing individuals as having the tendency to process information within context, or experiencing a drive for coherence or meaning when processing stimuli. This tendency is described as being "built-in," and allowing for generalization "over as wide a range of contexts as possible" (p. 100). According to this perspective, typically developing individuals seek to process information within context in order to derive higher-level meaning or gist (Hill & Frith, 2003; Rajendran & Mitchell, 2007). This processing style is extremely adaptive because it allows people to make meaningful connections in their everyday lives (Frith, 1989). Long and Lea (2005) have argued that the drive for coherence experienced by typically developing individuals is not a conscious process. Rather, the initial activation process that is necessary for coherence to occur (i.e., activation of contextual background knowledge) is a passive or an unconscious process.

Frith (1989) portrayed individuals with autism as having a bias or tendency toward local processing of information, as opposed to global processing. Global processing is defined by the tendency to process information from multiple domains in order to make inferences or connections between them. Local processing is defined as the tendency to make coherent connections within only a single domain. Thus, item-to-item processing, or "chaining" would be considered an ability of local processing that does not require the use of higher-order, semantic connections (Frith, 1989).

Early work on visual-spatial tasks (Shaw & Frith, 1983) and verbal tasks (Frith & Snowling, 1983) led Frith (1989) to hypothesize that individuals with autism experience the world in unconnected fragments and have a tendency to pay attention to the small elements of a structure, as opposed to the overall pattern. She described this weakness as a deficit in extracting global form, or having weak central coherence. Furthermore, Frith argued that weak central coherence could describe many of the behavioral abnormalities seen in autism. Because of the inability of individuals with autism to make meaningful connections between different situations, their environments are often strange and unpredictable. Lack of the "bigger picture" prohibits generalization from one situation to another. In contrast, repetitious behavior seems predictable and understandable to individuals with autism. Naturally, when no overriding goal is experienced, rigidity could also appear since no reason for flexibility is needed (Frith, 1989).

Since Frith's original account of weak central coherence, many empirical studies have been conducted examining this processing style. After reviewing these studies, Happé and Frith (2006) modified Frith's (1989) original description. First, rather than viewing weak central coherence as a central processing deficit in which individuals with autism completely fail to extract global meaning, it is now considered to be a secondary outcome due to a superiority of detail-focused or local processing ability. Second, instead of being considered a core deficit that cannot be overcome, it is now described as a cognitive bias or processing style that can be overcome when explicit demands for global processing are placed on the individual. Finally, weak central coherence is no longer considered to be the cause of social difficulties but considered to be a phenomenon that occurs alongside social deficits (Happé & Frith, 2006).

A handful of studies have examined nonliteral language comprehension, specifically idiom comprehension in children with language impairments, but these studies have varied widely in the populations sampled and in the idioms selected and methodologies used, making it difficult to draw clear conclusions. Initial studies investigating weak central coherence theory targeted populations with semantic and pragmatic difficulties and developmental language disorders, to examine how idiom processing occurs in atypical populations. Research was then extended to autism populations. Norbury (2004) further explained that not having systematically varied factors such as familiarity and transparency of the idioms, or not consistently reporting linguistic and cognitive skills of the groups they are investigating makes it very difficult to pinpoint the area of idiom comprehension breakdown.

Using homonyms (i.e., multiple meaning phrases) and idioms, Rinaldi (2000) investigated the ability of students with specific developmental language disorders (SDLD) to understand ambiguous information and to explore the possibility that a difficulty with this aspect of meaning may exist despite students understanding the semantic elements of the forms studied. Two types of procedures using sarcasm, idiomatic expression, deceit and humor were implemented to examine comprehension of speaker intention in context: (1) inconsistent messages of emotion in context and (2) multiple meanings in context. In the first part of the study, after hearing an expression from an audiotape, students selected from four pictures: two representing pragmatic interpretations (interpretations that are plausible given the context), and two representing literal, nonpragmatic interpretations (implausible in the presented context). In the second part, after hearing an expression via audiotape or videotape, students demonstrated their

interpretations of the expression by selecting from a choice of three pictures to represent each of three emotions – happy, sad and angry. These measures assessed students' understanding of the semantic elements of the item such as vocabulary, tones of voices, facial expressions, etc. Rinaldi's results indicated that SDLD students were less able to use context to understand implied meaning. Nonimpaired children were also more able to rule out literal interpretations when they did not know the nonliteral meaning. These results are congruent with weak central coherence theory in that the language impairment stemmed from an inability to use contextual information appropriately. It should be noted, though, that this study involved much interaction between the tester and testee and required overt and explicit responses from the participants. This issue will be addressed in a later section.

Norbury (2004) examined the ability of children with language impairments and autism spectrum disorders to understand idioms in context. Participants included 29 children with language impairment (LI), 6 with pragmatic language impairment (PI), 29 with an autism spectrum disorder and language impairment (ASL), 29 with an autism spectrum disorder only (ASO), and 39 control participants. A previous pilot study was conducted and 10 idioms with low familiarity were selected. Participants were told they would hear some "funny expressions people sometimes use" (p. 1185). They were given an example of a common idiom and the associated figurative meaning. They were then told to listen to some expressions and tell the examiner what each expression meant. After a delay (3 to 24 hours later), the idioms were presented again within the context of a short story. After the story, participants were asked an idiom-definition question, a factual question, and a forced alternative question in which the participant had to choose

between the figurative and literal interpretation of the idiom. Results indicated that all groups gave more correct figurative interpretations of the idiom when it was presented in story context. However, the LI and ASL groups' scores were both significantly lower than the ASO and control groups' scores. The author interpreted these results as inconsistent with the predictions of weak central coherence theory because the ASO group benefited from the context to the same degree as the control group. Although the ASO group showed no significant difference from the control group, it should be noted that this study used less stringent diagnostic criteria for the autism group than previous studies. In this study, autism spectrum status was defined according to speech-language therapist diagnosis and school records. No diagnostic testing was completed and diagnostic status was not confirmed with a clinical diagnosis. These less stringent criteria may have led to including participants with milder autistic symptomology in the sample or possibly even crossover between the ASO and ASL groups.

Kerbel and Grunwell (1998) studied the relationship between a newly developed play task and a more conventional definition task. Twenty-six children between the ages of 6 and 11 were divided into four groups (semantic-pragmatic difficulties, two groups of mainstream children, and other language disorders not primarily of a pragmatic or semantic nature). All groups completed both tasks. The play task used a 1.5-minute tape-recorded story that had 12 common idioms embedded into the plot. Next, as the story was played again, sentence by sentence, the children were required to act it out using play sets and props (enough props were provided to act out either the idiomatic or literal meaning, although only the idiomatic meaning made sense in the context). The children's actions were videotaped and then played back to the child during the definition

task. The video was stopped after each idiom during the definition task and the child was asked what they thought each idiom meant. The results indicated that all four groups were less able to demonstrate their comprehension of common idioms on a definition task than on the nonverbal play task. The researchers concluded that the play task allowed opportunity to demonstrate passive and partial comprehension of idioms in the absence of developed expressive and metalinguistic skills. Yet again, the definition task yielded poorer performance results than the nonverbal task, similar to previous studies showing better results on multiple choice options rather than conventional definition tasks, or tasks that require social communication. Kerbel and Grunwell (1998) hypothesized that difficulties with the definition task may have stemmed from discrepancies in the ability to explain idioms, rather than from differences in the ability to understand them. However, results of the test were questionable due to the mechanisms through which the play task might have overestimated or underestimated idiom comprehension. Some idioms required the children to use props in a predictable or obvious way (e.g., under lock and key and kept an eye on) suggesting literal interpretations could have looked accurate in the scoring of the play task. Other arguments include unsatisfactory matching of groups suggesting that maturity was a question with the younger groups not having enough verbal skill for explanations. Although the results should be interpreted carefully, they indicate that children score higher (i.e., with greater comprehension) when they are measured using nonverbal techniques.

Measuring Idiom Comprehension and Assessment

The previous studies suggest that individuals with autism may possess intact cognitive ability to appropriately use context, yet fail to use this capacity to engage in interactive communication. Studies of idiom comprehension have used a variety of techniques over the years to measure comprehension. Kerbal and Grunwell (1996) explained that definition tasks require subjects to paraphrase each idiom, which is either presented in isolation or within a narrative context. Multiple-choice tasks require subjects to select the appropriate meaning presented in written form, or from a set of three or four drawings. However, depending on age or severity of autism and/or communication disorder, these strategies result in questionable validity and reliability. Definition tasks for idiom studies require reasonable language ability to explain fixed expressions in their "nonlogical" nature, in addition to understanding the language in which the definitions are initially phrased. Multiple-choice tasks may also be questionable depending on the methods used. In instances when using pictures, the drawings typically depict the idiom meaning, the literal meaning, and one or two foils. Depending on age and functioning, the order in which the choices are presented, and the participant's individual preference for particular pictures or preferred subject matter may interfere with reliable outcomes for comprehension. Play-based methodologies used in idiom comprehension tasks, in which the participant is required to act out the idiom using a play set and props, also disadvantages those who have poor pretend play.

While these techniques have produced interesting findings, they have also produced conflicting results. Perhaps this is because they have all attempted to measure central coherence and theory of mind abilities using response paradigms that are difficult

for individuals with autism. As discussed before, those diagnosed with autism have difficulties with many aspects of oral language and social interaction (APA, 1994). Studies have investigated idiom comprehension using various types of nonverbal responses such as interpreting idioms by pointing to a picture, or acting out stories using play props (Kerbell & Grunwell, 1998; Rinaldi, 2000). Although these techniques may be more suited to the impairments associated with autism, they are still explicit measures that examine conscious, effortful responses. Klin, Jones, Schultz, Volkmar, and Cohen (2002) argued that one of the main challenges researchers face when studying individuals with autism is the use of explicit measures. They argued that studies needed to shift from using measures that examine the task performance of individuals to implicit measures that examine the processes individuals with autism use to perform a task. For example, Klin et al. (2002) used eye tracking to investigate the ability of individuals with autism to interpret the meaning of social gestures. In one instance, an individual with autism watched a movie clip in which a character pointed to a painting on a wall (which was surrounded by many other paintings) and asked, "Who did the painting?" Eye tracking measurements indicated that although the individual with autism responded to the verbal cue, he neglected to use the nonverbal gesture to decipher which painting was being discussed. This was evidenced by the fact that he waited until after the question was asked and then gazed from picture to picture in an effort to recognize the discussed picture. The typical control participant, however, was able to identify the correct painting according to the gesture. Interestingly, the authors found that the individual with autism was able to explain the meaning of the gesture when he was explicitly questioned. Klin et al. (2002) pointed out that this experiment emphasized the difference between what the

individual with autism explicitly knew, and what he automatically did. Clearly, the strict use of explicit measures may fail to detect the processes individuals with autism use to perform a task. This study proposes using eye tracking technology to study how individuals with and without autism use contextual information to understand figurative language such as idioms during reading.

The Proposed Study

Although there have been studies investigating idiom comprehension in children and adults with autism and communication disorders, no study has ever investigated how these individuals use context to comprehend idioms with an on-line measure such as eye tracking. Eye tracking tasks provide a better measure of participants' ability to automatically activate contextual meaning while processing is occurring since no explicit response is required from the participant. Furthermore, eye tracking procedures have the ability to measure both immediate and delayed processing difficulties, rereading of areas of interest in the text, regressions into or out of areas of interest, and the duration of participants' fixations and/or combinations of fixations on areas of interest within the text.

Consider the stimuli listed in Table 1. Each passage contains an idiom (e.g., kicked the bucket) that is preceded by context that is either neutral or biased toward the meaning intended in a later target sentence. The target sentence mentioned contains the idiom, followed by a phrase that disambiguates the idiom toward either its literal or figurative meaning. In the Biased Context-Literal Interpretation condition, the expression "kick the bucket" is followed by the disambiguating phrase, "spilled liquid." Given the

Table 1

Example Stimuli Listed by Condition

Biased Context-Literal Interpretation: It was early in the morning, and the farmer needed to milk his cow. The young cow had been very mischievous and uncooperative lately, and the farmer found it very irritating. He sat down in the barn and put the milk bucket under the cow. Suddenly, the cow kicked the bucket and thus the **spilled liquid** spread everywhere. Now the farmer didn't know what to do.
Biased Context-Idiomatic Interpretation: It was early in the morning, and the farmer needed to milk his cow. The old cow had been very sick lately, and the farmer had been worried about its health. He sat down in the barn and put the milk bucket under the cow. Suddenly, the cow kicked the bucket and thus the **animal's death** really upset the farmer. Now the farmer didn't know what to do.
Neutral Context-Literal Interpretation: It was early in the morning, and the farmer needed to milk his cow. Because the sun wasn't up yet, the farmer and his old milk cow were both still sleepy. He sat down in the barn and put the milk bucket under the cow. Suddenly, the cow kicked the bucket and thus the **spilled liquid** spread everywhere. Now the farmer didn't know what to do.
Neutral Context-Idiomatic Interpretation; It was early in the morning, and the farmer needed to milk his cow. Because the sun wasn't up yet, the farmer and his old milk cow were both still sleepy. He sat down in the barn and put the milk bucket under the cow. Suddenly, the cow kicked the bucket and thus the **animal's death** really upset the farmer. Now the farmer didn't know what to do.

previous context that the cow was mischievous and uncooperative, the literal interpretation of the idiom is reasonable. Reading times on the disambiguating phrase in this condition may be comparable to those when the preceding context is neutral (Neutral Context – Literal Interpretation condition). In the Biased Context – Idiomatic Interpretation condition, however, the context is more supportive of the figurative meaning of "kicked the bucket"; if participants use contextual information to understand the idiom, their reading times on the disambiguating phrase, "animal's death" should be faster in the biased context condition than in the neutral context condition. Eye tracking measures will be recorded for the idiom and the disambiguating phrase in order to show whether readers use contextual information to facilitate interpretation of idiomatic expressions. Given the assumptions of weak central coherence theory, individuals with autism should be less likely to use context to understand idioms figuratively than their control counterparts. If the results of this study show similar reading patterns for the control and autism groups, as demonstrated in previous studies in our laboratory (Ashcraft, 2007, 2009; Speer, 2007), the findings would not consistent with weak central coherence theory, and would suggest that cognitive impairments associated with autism may not be as prevalent as indicated in the research literature.

Finally, it is expected that readers' use of context in idiom interpretation will not correlate with scores on the Social Reciprocity Scale (SRS; Constantino, 2002). These results would be consistent with the modified account of weak central coherence theory, which explains central coherence deficits as occurring alongside social deficits, as opposed to causing them (Happé & Frith, 2006). Although it is expected that the autism group and control group will have significantly different SRS scores, it is not expected

that the reading patterns of the two groups will be correlated with degrees of social impairment.

In summary, consistent with the assumptions of weak central coherence theory, it is predicted that individuals with autism will not use context as efficiently as their typically developing peers. A significant group X context interaction is expected, in which the difference between the biased context and neutral context conditions will be larger in the control group than the autism group. Corresponding with the assumptions of Theory of Mind, it is also predicted that the idiom condition will remain more difficult to understand, resulting in a group X context X target interaction. It is expected that the difference between the biased/literal and neutral/literal conditions will be larger than the difference between the biased/idiom and neutral/idiom conditions, but only for the autism group.

CHAPTER 2

METHODS

Design

This study utilized a 2X2X2 mixed factorial design, consisting of one between groups variable and two within groups variables. The between groups variable, group, contains two levels: autism and control. The first within subjects variable, context, contains two levels: biased context or neutral context. The second within subjects variable, target sentence, contains two levels: literal interpretation or idiomatic interpretation. The two within subject variables thus combined to create four within subject conditions: biased context-literal interpretation, biased context-idiomatic interpretation, neutral context-literal interpretation, and neutral context-idiomatic interpretation. Example stimuli are listed in Table 1.

Participants

Inclusion Criteria

Participants were selected to be in the study if they were at least 10 years of age and received a verbal intelligence score above 80. All participants in the autism group previously met diagnostic criteria for autism according to the Autism Diagnostic

Observation Schedule-Generic (Lord et al., 2003) and the Autism Diagnostic Interview-Revised (Rutter et al., 1994) and were included in the study if their Social Responsiveness Scale total score was above 54, indicating they fell in the autism spectrum disorder range. Control participants were included in the study if their Social Responsiveness Scale total score was below 30, indicating they fell in the normal range. All participants were screened for any history of neurological or psychiatric illness. Parents were also interviewed to determine that the participants were native English speakers. No participants were recruited who had visual acuity deficits that could not be corrected by eyeglasses or contact lenses.

Sample

Twenty-two male children and adults with autism were recruited through the Utah Autism Research Program and the University of Utah, which is a large federally funded project investigating the neurobiology of autism. Participants were male individuals between the ages of 10 and 26. All participants in the autism group previously met diagnostic criteria for autism according to the Autism Diagnostic Observation Schedule-Generic (Lord et al., 2003) and the Autism Disagnostic Interview-Revised (Rutter et al., 1994). Most participants also had a previous IQ testing using the Differential Ability Scale (Elliot, 1991) or the Wechsler Intelligence Scale for Children-Third Edition (Wechsler, 1991) for those ages 16 and younger and the Wechsler Adult Intelligence Scale-Third Edition (Wechsler, 1997) for those aged 16 and older. Those who did not have a current IQ test available were administered one of the previously mentioned IQ tests, according to age, at the time of participation. Previous IQ scores were used if they

were administered within 5 years previous to study participation and if the participant was at least 5 years old at the time of administration. All diagnostic procedures took place prior to the beginning of the current study. Participant mean diagnostic scores are presented in Table 2. For 3 of the participants in the autism group and 1 in the control group, an accurate track was not established; therefore, their data were dropped form the analyses. The number of participants with autism included in the analyses was 17.

The autism group was matched for chronological age and verbal intelligence with a control group of male children and adults, ages 10 to 28, recruited from the Utah Autism Research Program and the community. Because the intelligence profiles of individuals with autism often show variability between performance intelligence and verbal intelligence, complications often arise when making matching decisions. Therefore, in the current study, participants were matched on verbal intelligence rather than on performance intelligence or full-scale intelligence. Control participants who did not have current IQ testing through the Utah Autism Research Program were also administered an age-appropriate IQ test at the time of study participation. Previous IQ scores were used if they were administered within 5 years previous to study participation and if the participant was at least 5 at the time of administration. Two of the control participants had previous up-to-date verbal intelligence scores available, but no performance intelligence scores available. Therefore, performance IQ scores for these two participants were not included in the analyses. Two of the control participants' data were dropped from the analyses because an accurate track was not established. A second control participant's data were dropped from the analyses because his questionnaire data indicated that he had significant social and communication difficulties that placed him in

the autism spectrum range. The number of participants from the control group included in the analyses was 19.

At the time of the experiment, the parent or an acquaintance of the participants was asked to fill out the Social Responsiveness Scale (Constantino, 2002) if they had not previously done so within the last 2 years. Participants were also administered subtests from the Woodcock-Johnson Tests of Achievement, Third Edition (Woodcock, McGrew, & Mather, 2001) to examine broad reading ability, letter-word identification skills, reading fluency skills, and reading comprehension ability at the time of the experiment in order to ensure adequate reading skills. In addition, participants were administered the Peabody Picture Vocabulary Tests, Fourth Edition (Dunn & Dunn, 2007) and the concepts and directions subtest to measure receptive language ability and the recalling sentences subtest to measure expressive language ability of the Clinical Evaluation of Language Fundamentals, Third Edition (Semel, Wiig, & Secord, 1995) in order to ensure adequate receptive and expressive language ability. A few participants were slightly older than the norms available on the Clinical Evaluation of Language Fundamentals, Third Edition (i.e., participants ages 22 to 28). In this instance, their scores were calculated using the oldest norms available (i.e., norms for examinees ages 17 years, 0 months to 21 years, 11 months).

Characteristics

Independent samples *t* tests were conducted to examine whether significant differences existed between groups for chronological age, verbal intelligence, performance intelligence, broad reading ability, letter-word identification, reading

fluency, reading comprehension, picture vocabulary, concepts and directions, recalling sentences, and overall social responsiveness as well as the social responsiveness domains of awareness, cognition, communication, motivation, and mannerisms. Means and standard deviation for all variables were presented in Table 2. No significant differences existed between groups for chronological age, $t(34) = -.530$, $p = .599$ verbal intelligence, $t(34) = -1.535$, $p = .134$; broad reading ability, $t(34) = -.783$, $p = .493$; letter-word identification, $t(34) = -.448$, $p = .657$; reading comprehension, $t(34) = .219$, $p = .828$; or picture vocabulary, $t(34) = -1.480$, $p = .148$. However, there was a marginally significant difference between groups in reading fluency, $t(34) = -1.850$, $p = .079$, with the control group scoring higher than the autism group. Significant differences also existed in the concepts and directions subtest, $t(34) = -2.050$, $p = .048$, and recalling sentences subtest, $t(34) = -3.451$, $p = .002$, from the Clinical Evaluation of Language Fundamentals, Third Edition (Semel et al., 1995) with the control group scoring higher than the autism group. Finally, significant differences existed between groups on all of the Social Responsiveness Scale measures (Constantino, 2002), including total score, $t(34) = 14.377$, $p = .000$; social communication, $t(34) = 14.069$, $p = .000$; social motivation, $t(34) = 9.844$, $p = .000$; and social mannerisms, $t(34) = 10.388$, $p = .000$. As expected, individuals with autism scored higher than the control group, indicating more social and communicative impairment. Subject characteristics were presented in Table 2.

Table 2

Subject Characteristics Listed by Group

	Autism		Control			
	Mean	SD	Mean	SD	t	p
Chronological age in months	207.47	53.05	217.79	62.54	-.53	.60
Verbal intelligence	104.94	13.44	112.53	15.91	-1.54	.134
Performance intelligence	111.29	11.33	118.35	12.93	-1.69	.100
Broad reading	104.59	11.34	107.58	11.55	-.78	.44
Letter-word identification	105.76	10.81	107.32	9.92	-.45	.66
Reading fluency	99.12	13.31	106.26	9.76	-1.85	.073
Reading comprehension	104.47	8.57	103.53	15.83	.22	.83
SRS total	102.00	25.97	11.05	8.87	14.38	.000
PPVT	109.88	12.59	115.95	11.99	-1.48	.15
Concepts and directions	10.47	2.74	12.16	2.19	-2.05	.05
Recalling sentences	8.24	2.88	11.63	3.00	-3.45	.002
SRS awareness	13.53	3.26	3.37	2.54	10.48	.000
SRS cognition	17.47	5.76	1.00	1.76	11.88	.000
SRS communication	34.71	9.08	2.95	3.60	14.07	.000
SRS motivation	18.24	6.61	2.58	2.01	9.84	.000
SRS mannerisms	18.29	7.00	1.16	1.61	10.39	.000
ADOS total score (Module 3 and 4)	13.18	2.66	-	-	-	-
ADI-B total	18.81	4.72	-	-		-
ADI-verbal total	15.88	4.50	-	-		-
ADI-D total	6.50	2.61	-	-		-
ADI-age of abnormality total	3.47	.99	-	-		-

Instruments

Intelligence Tests

The Wechsler Intelligence Scale for Children – Third Edition (WISC-III) (Wechsler, 1991) is an individually administered standardized test of an individual's intellectual ability and cognitive strengths and weaknesses. The WISC-III is appropriate for children ages 16 and younger. The test is made up of several subtests that consist of verbal and nonverbal activities. The verbal tasks have items such as defining words and answering common-sense questions. Nonverbal tasks consist of constructing puzzles and recognizing patterns. Split-half reliability coefficient estimates for the composite scores range from .91 to .96. The WISC-III has also shown adequate test-retest reliability, with coefficients for the composite score ranging from .85 to .95. Reported interrater reliability estimates for the subtest range from .90 to .98. The WISC-III has also shown adequate concurrent validity estimates with correlation coefficients reaching .96 with the Wechsler Adult Intelligence Scale, Revised (WAIS-R; Wechsler, 1981) and .91 with the DAS (Elliot, 1991; Wechsler, 1991).

The Wechsler Adult Intelligence Scale – Third Edition (WAIS-III) (Wechsler, 1997) is also an individually administered, standardized test of a person's intellectual ability and cognitive strengths and weaknesses and is appropriate for individuals sixteen years and older. The test consists of verbal and nonverbal subtests that include activities such as defining words and solving puzzles. The three composite scores of the WAIS-III have shown internal reliability estimates of .93 and higher, with subtests reliabilities ranging from .83 to .87. Test-retest reliabilities range from .83 to .97 for different age groups. The WAIS-III has shown adequate convergent validity with the WISC-III

(Wechsler, 1991) for the verbal composite score (.88), the performance composite score (.78), and the full-scale score (.88). It has also shown to have strong concurrent validity estimates with the WAIS-R (Wechsler, 1974) for the verbal composite (.94), the performance composite (.86), and the full-scale score (.93) (Wechsler, 1997).

The Differential Ability Scale (DAS) (Elliot, 1991) is a standardized test of intellectual functioning. It was designed to cover a broad range of ages and abilities, from individuals with intellectual impairment through individuals who are intellectually gifted. The DAS is appropriate for individuals 16 years and younger. The DAS has shown good internal validity estimates for the composite scores, with coefficients ranging from .94 to .95. The test has also shown good test-retest reliability estimates, ranging from .89 to .93, and good interrater reliability coefficients, ranging from .90 to .96. Reported internal validity estimates of the composite scores range from .90 to .91 for the verbal scale and .57 to .67 for the special nonverbal composite scale. Concurrent validity estimates with the Wechsler Intelligence Scale for Children, Revised (WISC-R; Wechsler, 1974) are reported at .84 for the verbal composite and .71 for the special nonverbal composite. In addition, previous research has found evidence for the convergent validity of the DAS and the WISC-III (DiCerbo & Barona, 2000; Nichols, 1998).

Autism Diagnostic Interview, Revised (ADI-R)

The ADI-R (Rutter et al., 1994) is a semistructured interview consisting of 89 items that are administered to the primary caregivers of children who potentially have autism. The ADI-R relies heavily on caregiver descriptions of development in the areas

of language, communication, social interaction, and restricted, stereotyped, and repetitive behaviors. Current and past behaviors are coded; therefore, items assessing abnormal behavior are scored for both the current state of the behavior and past expressions of the behavior. Items are subdivided into three domains, according to three sets of diagnostic criteria that must be met for a diagnosis of autism: (a) qualitative abnormalities in reciprocal social interaction, (b) qualitative abnormalities in communication, and (c) restricted, repetitive, and stereotyped patterns of behavior. Reported interrater reliability estimates for the ADI-R range from .52 to .95 (Rutter et al.).

Autism Diagnostic Observation Schedule, Generic (ADOS-G)

The ADOS-G (Lord et al., 2003) is a semistructured, developmentally based, and standardized assessment of social and communication deficits generally associated with autism. It is comprised of standard activities that allow for the observation of behaviors that have been identified as important in diagnosing autism spectrum disorders at different developmental stages. The ADOS-G consists of four modules, all of which can be administered in 30 to 40 minutes. Reported interrater reliability estimates range from .84 to .93, and test-retest reliability estimates range from .73 to .82. The ADOS-G has also shown the ability to detect significant differences between individuals with and without autism (Lord et al., 2000).

Woodcock-Johnson Tests of Achievement, Third Edition (WJ-III)

The WJ-III (Woodcock et al., 2001) is an individually administered, standardized test of academic achievement. It examines academic skills in the areas of reading, math,

oral language, and written expression. The broad reading composite included tasks measuring letter-word identification skills, reading fluency, and reading comprehension. The WJ-III is appropriate for both children and adults. Reported test-retest reliability coefficients for the reading subtests range from .80 to .96. Concurrent validity estimates of the broad reading composite have shown significant correlations with the Wechsler Individuals Achievement Test, Second Edition (WIAT-II; Wechsler, 1992) total reading composite (.67) and the Kaufman Test of Educational Achievement (Kaufman & Kaufman, 1985) total reading composite (.76; McGrew & Woodcock, 2001).

Peabody Picture Vocabulary Test, Fourth Edition (PPVT-IV)

The PPVT-IV is an individually administered, standardized test of receptive vocabulary. It is appropriate for individuals age 2 years and 6 months to 90 years. Reported test-retest reliability coefficients range from .92 to .96 and split-half reliabilities range from .89 to .97. Concurrent validity estimates of the total score have shown significant correlations with the Comprehensive Assessment of Spoken Language (CASL; Corrow-Woolfolk, 1999) Lexical/Semantic composite (.77) and the Comprehensive Evaluation of Language Fundamentals, Fourth Edition (CELF-IV; Semel, Wiig, & Secord, 2003) receptive language composite (.67-.79).

Clinical Evaluation of Language Fundamentals
Third Edition (CELF-III)

The CELF-III is an individually administered, standardized tool developed for the identification and diagnosis of language skill deficits. It is appropriate for individuals age

6 to 21 years and 11 months. The Concepts and Directions subtest is a measure of receptive language and the ability to interpret, recall, and execute oral commands. Reported internal consistency reliability coefficients for the Concepts and Directions range from .59 to .88. The reported concurrent validity correlation coefficient of the Concepts and Directions subtest and the Clinical Evaluation of Language Fundamentals, Revised (CELF-R; Semel, Wiig, & Secord, 1987) Oral Directions subtest is .56.

Social Responsiveness Scale (SRS)

The SRS (Constantino, 2002) is a 65-item rating scale that can be used to measure social impairments in individuals with autism and in typically developing individuals as they occur in natural settings. This instrument helps in providing a clear picture of a child's social impairments by assessing social awareness, social information processing, capacity for reciprocal communication, social anxiety/avoidance, and autistic preoccupations and traits. The SRS can be used to assess individuals between the ages of 4 and adulthood and is completed by a primary caregiver or someone who has known the participant for at least 6 months. It can typically be completed in 15 to 20 minutes. Total score reliability estimates are reported to be above .90. Subscale reliability estimates range from .76 to .85 (median .85) for males and females rated by parents and teachers. Two-year, test-retest reliability has been estimated at .83 (Constantino et al., 2003). Previous research has shown that social deficits on the SRS are continuously distributed and that the SRS reliably distinguishes children with an autism spectrum disorder from those with other psychiatric disorders (Constantino & Todd, 2000).

Stimuli

Familiar and well-known idioms were used to create the stimuli for the present study. In order to ensure that the experimental population was familiar with the idiom phrases, a pilot study was conducted. Pilot study participants were recruited through the Educational Psychology Subject Pool and the community. A method similar to those used by Gilhooly and Logie (1980) and Carroll and White (1973a) was employed. Twenty-five participants were asked to define idioms and rate the age at which they acquired the nonliteral interpretation of each idiom. Previous research has found that rated age of acquisition of words provides a valid measure of chronological age of acquisition (Gilhooly & Gilhooly, 1980). In addition, rated age of acquisition of words has been shown to be predictive of performance on many tasks including picture naming (Carroll & White, 1973b; Gilhooly & Gilhooly, 1979; Lachman, Schaffer, & Hennrikus, 1974), word completion (Gilhooly & Gilhooly 1979), and lexical decision-making (Butler & Hains, 1979; Whaley, 1978). Participants were presented with a test booklet containing 49 idiom phrases to ensure enough phrases would be available to create the stimuli. See Appendix A for list of idioms. Following each phrase, a space was provided for the participant to write the nonliteral translation of the phrase. A 7-point scale appeared after the translation. The scale ranged from 1 (6 years of age and younger) to 7 (17 years of age and older) and participants were asked to circle the number that best indicated their age when they each acquired the nonliteral translation of the phrase. The 20 idioms used in the final stimuli came from the top 30 idioms rated highest in familiarity by participants. Results from the pilot study indicated that 90% of the idioms used in the final stimuli were acquired before age nine to ensure the highest percentages

of comprehension and familiarity. The two idiomatic expressions "break the ice" and "in the doghouse" were acquired before age 13.

The experimental materials consisted of 20 passages similar to the example presented in Table 1. Each passage began with a context section (neutral or biased toward either literal or idiom meaning). The mean context length across all passages was 45.1 words (*S.D.* = 0.33) *(It was early in the morning, and the farmer needed to milk his cow. The old cow had been very sick lately, and the farmer had been worried about its health. He sat down in the barn and put the milk bucket under the cow*). This was followed by a target sentence that included the idiom followed by a phrase that disambiguated it towards either the literal or figurative meaning. The mean number of words in the target sentence of the passage was 15.35 words (*S.D.* = 2.14) (Suddenly, the cow kicked the bucket and thus the animal's death really upset the farmer; or, Suddenly, the cow kicked the bucket and thus the spilled liquid spread everywhere). The mean number of words in each idiom phrase within the target sentence was 4.05 words (*S.D.* = 1.05) (kicked the bucket). The mean number of words in each posttarget region was 2.4 words (*S.D.* = 0.50) (and thus the). The mean number of disambiguating words directly after the posttarget region was 2.32 words (*S.D.* = .48) (animal's death; or spilled milk). A closing sentence was used across all conditions to complete the story. The mean number of words in the closing statement was 11.75 (*S.D.* = 0.72) (Now the farmer didn't know what to do).

Four counterbalanced stimulus sets were created. In each set, the items appeared in random order. Across the four sets, each item appeared only once in each condition, and each condition appeared an equal number of times. Conditions consisted of biased

context-literal interpretation, biased context-idiomatic interpretation, neutral context-literal interpretation, and neutral context-idiomatic interpretation. A complete list of stimuli can be found in Appendix C. All participants read approximately 50 paragraphs, including experimental items and filler items. The idiom passages were embedded within a larger set of passages that were unrelated to the experiment.

To ensure participants were reading for comprehension, after completion of the eye tracking task, 20 true/false questions that were unrelated to the idiom or disambiguating content were administered by handout (e.g., True or False, early in the morning, the farmer got up to milk his cow). The list of comprehension questions can be found in Appendix B. Every participant scored 60% or higher on the comprehension questions. However, there was a significant difference between groups in mean true/false accuracy, $t(32) = 2.3$, $p=.028$, $\eta^2 = .14$, with the control group scoring higher on average (mean = 83% correct) than the autism group (mean = 75% correct).

Apparatus

Participants' gaze behaviors were measured with an Applied Sciences Laboratory Model 501 head-mounted eye tracker with a magnetic head tracker. The eye tracker was interfaced and controlled via a Hewlett-Packard 1.8GHz computer. Another HP 1.8GHz computer, with a 23 inch Samsung 213T flat panel monitor (dimensions measuring 18.6 inches x 18 inches x 8.7 inches) rotated 90 degrees into portrait mode was used to control the experiment. Participants had free head and eye movement, and head movements and orientation were recorded using the ASL EyeHead Integration system. The eye tracker did not touch the participant's eye at any point during the experiment. The eye tracker

has an accuracy range of one to one half degree of visual angle (approximately four characters of text). Viewing was binocular, with eye location recorded from the right eye. The position of the participant's eye was sampled at 60 Hz (approximately every 16 milliseconds). Each sample was compared to the previous sample to determine whether the eye was fixated or moving. Luminance on the 22-inch monitor was adjusted to a comfortable brightness for each participant, and then held constant. The room was dark except for a lamp located directly behind the participant to enable the experimenter to keep notes. The eye tracker was individually calibrated for each participant.

Setting

Participants were seated in a comfortable armchair approximately 25 inches from the monitor. The screen was relatively large, and therefore filled up most of the participants' visual field, cutting down on peripheral visual distractions. The experimenter sat behind the participant, running the eye tracker, and was therefore out of the participants' eyesight.

Procedure

Participants were assessed individually in the reading laboratory. Each session lasted approximately 90 minutes for those who had previous IQ scores and approximately 4 hours for those who did not have current IQ scores were not available and had to be tested. Upon arrival, parents and participants were given a brief description of the research tasks and shown around the reading laboratory. After informed consent and assent were obtained, parents were asked to complete the SRS if a current score was not

available. Participants were then fitted with the eye tracker, which recorded their eye movements during the experiment. The eye tracker was individually calibrated for accuracy. The participants then took part in a desensitization task in order to allow them to get comfortable prior to the start of the experiment. The examiner then gave directions to the participants and any questions were answered. Participants then took part in the eye tracking task. They read approximately 50 paragraphs that included practice items, experimental items, and filler items. When finished, the eye tracker was removed and the participant filled out 20 true/false comprehension questions to ensure the participant actually read the stimuli.

Following the completion of experimental tasks, the participants were given three subtests from the WJ-III (Woodcock et al., 2001) to assess their reading skill level. If an IQ score needed to be obtained, an IQ test was administered following the reading test. Participants and their parents were then debriefed and a detailed explanation of the study's purposes and goals were described to them. They were also informed about how the study will contribute to the existing literature on autism and information processing. Before leaving, participants were given 15 dollars to compensate them for their participation in the study.

CHAPTER 3

RESULTS

Analyses

Separate analyses were conducted for each subtest of passages, and for each reading measure in each subtest. Analysis consisted of 2X2X2 ANOVAs, with Group (Autism vs. Control) as a between subjects factor, and Context (Biased vs. Neutral) and Target Sentence (Literal vs. Idiom) as within subject factors. The following reading measures were recorded for the idiom, the post-target region, and the disambiguating region. Eye-tracking response times for all reading measures for the eye-tracking task are presented in Table 3. First Pass Reading Time is the sum of all fixations made once a fixation is made in a region until a saccade is made out of that region. This was used as a measure of immediate processing difficulty. Second Pass Reading Time is the sum of all fixations made during rereading of a region. This was used as an indicator of delayed processing difficulty.

A power analysis was conducted based on the large group effects observed by Happé (1997; Cohen's d = .556 to .787) and Jolliffe and Baron-Cohen (1999; Cohen's d = 1.214). Results indicated that a sample size between 20 and 26 participants per group would provide approximately 80% power to detect a large effect. Unfortunately, due to

Table 3

Response Time and Eye-Tracking Measures as a Function of Group and Stimulus Condition

	Conditions			
	Neutral/Literal	Neutral/Idiom	Biased/Literal	Biased/Idiom
First pass reading time on idiom				
Autism	543	417	435	454
Control	471	463	463	508
Second pass reading time on idiom				
Autism	400	502	444	359
Control	326	334	323	288
First pass reading time on posttarget region				
Autism	294	337	341	317
Control	330	364	317	340
Second pass reading time on posttarget region				
Autism	240	182	162	221
Control	166	163	249	163
First pass reading time on disambiguating region				
Autism	451	457	429	414
Control	503	462	468	482
Second pass reading time on disambiguating region				
Autism	322	204	159	280
Control	153	240	181	211

the constraints of this study, only 36 participants' data could be included in the final analysis (17 in autism group and 19 in control group). The reading demands of this study required participants to have relatively high verbal IQ scores (i.e., ≥ 81), which significantly limited the number of Utah Autism Research Program participants who were eligible to participate. In addition, participants were required to meet the most stringent scores on both the autism diagnostic assessments, limiting the pool. Finally, data from 4 of the participants who took part in the study had to be dropped from the analyses due to issues of poorly established tracks, an unusually high score on the Social Responsiveness Scale, or both.

Idiom

For first pass reading times on idioms there was no significant effect of context, or target, $F < 1$, but there was a significant interaction of context by target, $F(1,28) = 7.96$, $p = .009$, partial $\eta^2 = .221$. This suggests that biasing context tended to facilitate processing of the idiom in the literal condition, but it slowed processing in the idiom condition. For the target phrase, there was no significant effect of group, $F < 1$, and no interaction of group with context, $F(1,28) = 2.31$, $p = .14$. In contrast, the interaction of group with target was marginally significant, $F(1,28) = 3.22$, $p = .084$. Additionally, the three-way interaction of context, target and group was not significant, $F(1,28) = 1.49$, $p = .233$.

For the second pass on the idiom, there was no significant effect of context, $F(1,28) = 1.20$, $p = .282$, no significant effect of target, $F < 1$, and no significant interaction of context with target, $F(1,28) = 2.49$, $p = .126$. There was no significant effect of group, $F(1,28) = 1.729$, $p = .58$, no significant interaction of group with context, or with target, $Fs < 1$, and the three-way interaction of context, target and group was not significant, $F(1,28) = 2.12$, $p = .157$.

Posttarget Region

For the first pass reading times on the post-target region, there was no significant effect of context, $F < 1$, a marginal effect of target, $F(1,28) = 3.31$, $p = .079$, and no significant interaction of context with target, $F(1,28) = 2.29$, $p = .142$. Additionally, there was no significant effect detected for group, $F < 1$, no interaction of group with context, $F(1,28) = 1.58$, $p = .142$, no interaction of group with target, $F < 1$, and the

three-way interaction of context, target, and group was not significant, $F(1,28) = 1.18$, $p = .287$.

For the second pass reading times on the post-target region, there was no significant effect of context, target, or interactions of context with target, $Fs < 1$, and no significant effect of group, $F < 1$. A marginal interaction of group with context was detected, $F(1,28) = 3.36$, $p = .077$, but there was no interaction of group with target, $F(1,28) = 1.25$, $p = .273$. There was a marginal three-way interaction of context, target and group, $F(1,28) = 3.08$, $p = .090$.

Disambiguating Region

For the first pass reading time in the disambiguating region, there was no significant effect of context, $F(1,28) = 1.26$, $p = 271$, no significant of target, $F < 1$, and no significant interaction of context and target, $F < 1$. No significant effect of group was detected, $F(1,28) = 1.08$, $p = .306$, there were no interactions of group with context, or with target, $Fs < 1$. The three-way interaction of group with target was not significant, $F < 1$.

For the second pass reading times in the disambiguating region, there was no significant effect of context, $F < 1$, and no significant effect of target, $F(1,28) = 1.73$, $p = .199$. There was a significant interaction of context and target, $F(1,28) = 4.69$, $p = .039$, partial $\eta^2 = .143$, indicating that biasing context facilitated processing in the literal condition but the opposite effect was observed in the idiom condition. Also, for the second pass in the disambiguating region there was no significant effect of group, $F(1,28) = 1.51$, $p = .230$, no interaction of group with context, $F < 1$, no interaction of group with

target, $F < 1$, but there was a significant three-way interaction of context, target and group, $F(1,28) = 8.12$, $p = .008$, partial $\eta^2 = .225$, demonstrating that the interaction between context and target was primarily due to the autism group, and that biased context again facilitated processing in the literal condition but the opposite occurred in the idiom condition.

CHAPTER 4

GENERAL DISCUSSION

The goal of this study was to assess theory of mind and weak central coherence theory with respect to the role of context in idiom comprehension. Theory of mind refers to the cognitive ability to attribute mental states – beliefs, intents, desires, pretending, knowledge, etc. – to oneself and others, and to understand that other individuals have beliefs, desires and intentions that are different from one's own (Premack & Woodruff, 1978). Individuals with autism may also suffer from a weak central coherence (Frith, 1989), which may impair their abilities to use context to infer implicit meaning and resolve ambiguities in text. This inability or deficit in using contextual information, combined with impaired theory of mind, may lead to difficulties in processing figurative expressions in text, even in the presence of disambiguating context.

The goal of this study was to test these assumptions by investigating how individuals with autism use contextual information to understand idioms during reading. Past studies of idiom comprehension have used a variety of explicit techniques over the years to measure comprehension; however, the strict use of explicit measures may have failed to detect the processes individuals with autism used to perform a task. Using eye tracking technology provided a measure of participants' abilities to automatically activate

and integrate contextually appropriate meanings of idioms during reading without requiring explicit responses. Participants read 20 passages, each containing an idiom that was preceded by context that was either neutral or biased toward the intended meaning of an idiom presented later in the text. A subsequent target sentence contained the idiom, followed by a phrase that disambiguated the idiom towards either its literal or figurative meaning. Both first pass and second pass reading times were recorded for the idiom and the disambiguating phrase.

These effects in this study suggest that both groups were easily able to access and integrate the literal meaning of the idiom, and this was only facilitated in the presence of literal-biasing context. It is the access and integration of the figurative meaning of idioms that is more interesting in this study. Initially, both groups of participants showed slower processing times on the idiom when the preceding context had supported the figurative meaning than when the context was neutral. First pass reading times on the idiom were slower in the biased idiom condition than in the neutral idiom condition. However, by the time the disambiguating region was encountered, the control participants were faster to read the information related to the figurative meaning of the idiom (e.g., the cow died) when it had been preceded by a biased context than when it was preceded by neutral context. The individuals in the autism condition still showed difficulty with processing the figurative meaning, however; the rereading times on the disambiguating region in the biased idiom condition were slower than in the neutral idiom condition.

To understand these effects, consider the role of context in the processing of biased ambiguous words (e.g., bank) – those that have a dominant meaning (e.g., money) and a less frequent, or subordinate, meaning (e.g., river). Researchers have demonstrated

that when presented with context that is either neutral or biased toward the dominant meaning of an ambiguous word, access of the dominant meaning is facilitated. When biasing context supports the subordinate meaning of ambiguous words, however, access of the subordinate meaning may be facilitated, but access of the dominant meaning is unaffected. As a result, even when context supports the subordinate meaning, both the dominant and subordinate meanings may be accessed simultaneously, thus creating processing difficulty. Typically, researchers have found that in such conditions, reading times on an ambiguous word in a subordinate biasing context condition are slower than in a neutral context condition. This effect has been named the *subordinate bias effect* and has been found to be extremely robust in the reading literature (Duffy, Morris, & Rayner, 1988; Folk & Morris, 2003; Rayner, Cook, Juhasz, & Frazier, 2006; Rayner & Duffy, 1986; Rayner & Frazier, 1989; Sereno, 1995; Sereno, Brewer & O'Donnell, 2003; Sereno, O'Donnell & Rayner, 2006; Sereno, Pacht, & Rayner, 1992).

In the present study, idioms also have two interpretations: literal and figurative. As with biased ambiguous words, the first pass data on the idiom shows that context that biases interpretation toward the literal meaning tends to facilitate processing compared to a neutral condition. When the figurative meaning of the idiom was intended, both groups were initially slower to read the idiom when the context was biased toward the idiom meaning than when it was neutral. Thus, the first pass reading times in the idiom conditions data demonstrate an *idiom bias effect*, in which the literal and figurative interpretations of the idiom mirror the dominant and subordinate meanings of ambiguous words, respectively. The autism and control groups both initially showed an idiom bias effect, indicating that both groups used context to understand idiomatic expressions. This

finding is inconsistent with weak central coherence theory's assumption that individuals with autism fail to use context appropriately, and it suggests that an overarching statement that those with autism are not capable of global processing of information or integrating of context is incorrect.

Although both groups initially displayed the idiom bias effect, the control participants quickly recovered; the effect was no longer evident in rereading times on the disambiguating phrase. However, participants with autism still demonstrated slower processing in the biased idiom condition compared to the neutral idiom condition. This slower recovery from the idiom bias effect in the autism group may be a result of stimulus overselectivity (Lovaas & Schreibmanm, 1971; Lovaas, Schreibmanm Koegel & Rehm, 1971; Lovaas, Koegal & Schreibman, 1979). Frequently, individuals with autism show stimulus overselectivity, a response to only a limited number of cues in their environment. For example, in the study of Lovaas et al. (1971), stimulus overselectivity was tested in children with and without autism by instructing each participant to press a lever as soon as three different stimuli were presented at the same time (i.e., a light, a sound, and a touch). Later in the study the three aspects of the stimuli were presented individually. Their results showed that the children with autism pressed the lever when only one of the three stimuli was presented; a child pressed the lever when a light was presented, but did not press the lever when the sound was presented alone or when the touch was presented alone. The researchers concluded that during the initial learning phase, the children with autism attended to only one of the three aspects of the complex stimulus rather than all three aspects (Lovaas, Schreibmanm Koegel & Rehm, 1971). Responding to only one of many aspects or dimensions of an object or situation may

make it difficult for individuals with autism to learn about or comprehend their worlds. When interpreting idioms, stimulus overselectivty may help explain the autism groups' difficulty in resolving the idioms, as seen in the results of the second pass on the disambiguating region, due to the tendency to be overselective with the interpretations of the phrases.

Furthermore, idioms tend to require some creativity and flexibility of thought since the expression has a figurative meaning that can be entirely separate from the literal meaning or definition. Rigidity and lack of pretend play could hinder the encoding of figurative meanings. Lastly, idioms frequently express emotions, feelings and thoughts (e.g., down in the dumps/sad; fell head over heels/in love; and black sheep/different). All of these factors could affect the ability of individuals with autism to access and subsequently integrate figurative meanings of these expressions during online reading. As a result, although context clearly influences idiom comprehension in individuals with autism, it may not be able to completely override difficulties they have in comprehending figurative language expressions. These findings are consistent with research on theory of mind deficits in autism, particularly with respect to comprehension of nonliteral language (Happé, 1993; Happé, 1995; Martin & McDonald, 2004).

As previously noted, theory of mind impairment reflects a difficulty with perspective taking, attributing mental states to oneself and others, and understanding that others can have different beliefs, desires and intentions from one's own (Premack & Woodruff, 1978; Tager-Flusberg, 1999; Wilkinson, 1998). Theory of mind has often been discussed in relation to the deficits commonly seen in pragmatic language and interpreting passages of text containing nonliteral language (Martin & McDonald, 2004).

Irregular patterns of pragmatics, the component of language that examines the ways in which context contributes to meaning, is a well-established characteristic of autism. Therefore, although we found that context influences comprehension, theory of mind is crucial to the understanding of idioms since literal interpretations often lead to incorrect conclusions (Happé, 1995). In conclusion, theory of mind assumptions, not the inability to integrate context to facilitate meaning, may limit participants' with autism abilities to quickly assess or comprehend figurative expressions since they struggle with making attributions about the mental states of themselves and others (Baron-Cohen et al., 1985).

Limitations

Because the total number of participants' data included in the analyses was smaller than that suggested by the power analysis, it is likely the results may have reflected inadequate power to detect a small effect. Future research should focus on obtaining a larger sample in order to secure more easily interpretable results. Second, it is possible that certain participant variables may have affected the outcomes of this study. This investigation matched controls and participants with autism who had high (≥80) verbal scores. It is arguable that the current results do not generalize to all individuals on the autism spectrum, specifically those individuals with lower functioning autism and/or those with specific language deficits. In addition, the pilot study may not have supplied enough idioms to ensure that the most familiar idioms were used in creating the stimuli. Furthermore, the selected idioms for the final stimuli were chosen because they were conducive to creating the four stimuli conditions. Many of the higher rated idioms that were learned at earlier ages (e.g., go bananas) could not be manipulated into a biased

context-literal interpretation, biased context-idiomatic interpretation, neutral context-literal interpretation, and neutral context-idiomatic interpretation. Therefore, the restrictions of creating the four stimuli conditions of equal lengths largely dictated which idioms were selected. Finally, one may argue that the group difference on the true/false questions suggests that the autism group did not read the stories as thoroughly as the control group. However, the 20 comprehension questions were presented at the end of the eye tracking experiment instead of after every individual story was read. This test of memory for nonsalient story details may have been more difficult for the autism group; this is consistent with the group difference for scores on the CELF Recalling Sentence subtest. However, individuals with autism did not differ significantly from individuals in the control group on measures of comprehension (e.g., Woodcock Johnson subtests), which were more closely related to the eye tracking dependent measures used in this study.

Conclusion

The current study utilized an implicit measure of weak central coherence during reading and found contextual processing to be intact in both autism and typically developing groups. Although participants with autism were able to use context appropriately, they still showed stronger and longer-lasting difficulty with processing figurative expressions. Future research should focus on recruiting a larger and more diverse sample of participants with autism to better tease out how language and theory of mind impairments associated with autism affect online reading comprehension processes.

APPENDIX A

COMPLETE PILOT TEST PACKET

ID#:
Date:
Date of Birth:

Idioms are phrases that have fixed figurative meanings, but may have an additional literal interpretation. Idioms occur frequently in both spoken and written language, and have become an important area of research due to their reoccurring status. Learning the figurative interpretation of such phrases is a protracted process, beginning in early childhood and continuing throughout adolescence and into adulthood (Nippold, 1998; Nippold & Duthie, 2003).

In the space provided, please write a translation of the phrase (what the saying means) and circle the number indicating when you believe you had learned the meaning of each phrase according to the following scale.

1 = 6 years of age or younger
2 = 7-9 years of age
3 = 9-11 years of age
4 = 11-13 years of age
5 = 13-15 years of age
6 = 15-17 years of age
7 = 17 years of age or older

Example:

Kick the Bucket	*I think this one means to die Or give up*	*1 2 3 (4) 5 6 7*

Saying:	**What it Means…**	**When I learned it…**
Kick the bucket		1 2 3 4 5 6 7
Spill the beans		1 2 3 4 5 6 7
Bite your tongue		1 2 3 4 5 6 7
Not her cup of tea		1 2 3 4 5 6 7
Full of baloney		1 2 3 4 5 6 7
Bring home the bacon		1 2 3 4 5 6 7
Break the ice		1 2 3 4 5 6 7
Smelled a rat		1 2 3 4 5 6 7
Acting like a chicken		1 2 3 4 5 6 7
Let the cat out of the bag		1 2 3 4 5 6 7
Let him get her goat		1 2 3 4 5 6 7
Fell head over heels		1 2 3 4 5 6 7
Time to face the music		1 2 3 4 5 6 7
Fell flat on his face		1 2 3 4 5 6 7
Put his foot in his mouth		1 2 3 4 5 6 7

Example:

Kick the Bucket	*I think this one means to die Or give up*	*1 2 3 (4) 5 6 7*

Saying:	**What it Means…**	**When I learned it…**
Pull the wool over his eyes		1 2 3 4 5 6 7
Pulled her leg		1 2 3 4 5 6 7
Dragging her feet		1 2 3 4 5 6 7
Had a chip on his shoulder		1 2 3 4 5 6 7
Had a green thumb		1 2 3 4 5 6 7
A pretty penny		1 2 3 4 5 6 7
All ears		1 2 3 4 5 6 7
All thumbs		1 2 3 4 5 6 7
As cold as ice		1 2 3 4 5 6 7
Beat around the bush		1 2 3 4 5 6 7
Barrel of monkeys		1 2 3 4 5 6 7
Don't cry over spilled milk		1 2 3 4 5 6 7
In the dark		1 2 3 4 5 6 7
Bite the bullet		1 2 3 4 5 6 7
Bite the dust		1 2 3 4 5 6 7
Break a leg		1 2 3 4 5 6 7
Black sheep		1 2 3 4 5 6 7
Bury the hatchet		1 2 3 4 5 6 7
Butterflies in your stomach		1 2 3 4 5 6 7
Cold feet		1 2 3 4 5 6 7
Cold turkey		1 2 3 4 5 6 7
Count sheep		1 2 3 4 5 6 7
Don't hold your breath		1 2 3 4 5 6 7
Down in the dumps		1 2 3 4 5 6 7
Down and out		1 2 3 4 5 6 7
Drag your feet		1 2 3 4 5 6 7
Early bird catches the worm		1 2 3 4 5 6 7
On the fence		1 2 3 4 5 6 7

Example:

Kick the Bucket	*I think this one means to die Or give up*	*1 2 3 (4) 5 6 7*

Saying:	**What it Means…**	**When I learned it…**
From the horses mouth		1 2 3 4 5 6 7
Full of hot air		1 2 3 4 5 6 7
Go bananas		1 2 3 4 5 6 7
Grain of salt		1 2 3 4 5 6 7
In the doghouse		1 2 3 4 5 6 7
My hands are tied		1 2 3 4 5 6 7

APPENDIX B

COMPLETE LIST OF COMPREHENSION QUESTIONS

Comprehension Questions:

	Circle the Correct Answer	
1. Suzie helped her grandmother with the cooking and cleaning.	TRUE	FALSE
2. Tommy loved turkey sandwiches.	TRUE	FALSE
3. The farmer had three dogs to help watch the animals.	TRUE	FALSE
4. At the birthday party they only ate ice cream.	TRUE	FALSE
5. The company party was at a cabin in the woods.	TRUE	FALSE
6. There was a story about two men who drove a garbage truck.	TRUE	FALSE
7. Johnny was going on his first date with Susan.	TRUE	FALSE
8. Jerry wanted to try a new activity and he picked roller-skating.	TRUE	FALSE
9. Early in the morning, the farmer got up to milk his cow.	TRUE	FALSE
10. The surprise party was help at school.	TRUE	FALSE
11. Eric was late and stubbed his toe on the way to school.	TRUE	FALSE
12. Cindy loved to play outside and on the playground.	TRUE	FALSE
13. The baker liked to feed the neighborhood cats.	TRUE	FALSE
14. Anna was going to be in the school musical.	TRUE	FALSE
15. The sheep were always kept in a barn.	TRUE	FALSE
16. Mary did not like picnics because there were too many bugs.	TRUE	FALSE
17. Robert and Jenny went on a ski trip.	TRUE	FALSE
18. Kenny asked a girl to the school dance.	TRUE	FALSE
19. Rachel liked to spend time in her garden.	TRUE	FALSE
20. The father was on time for dinner.	TRUE	FALSE

APPENDIX C

COMPLETE LIST OF STIMULI

1. Not her cup of tea.

Neutral Context – Literal Interpretation
Last year Suzie's grandmother moved in with her because she was getting very old and frail. Everyday, Suzie would clean and vacuum and collect and wash all the dishes. After dinner, Susie walked into the living room and picked up a mug from the table.
However, this was not her cup of tea because she **drank hot coffee** while she watched television.
Suzie's grandmother was grateful for the help.

Neutral Context – Idiom Interpretation
Last year Suzie's grandmother moved in with her because she was getting very old and frail. Everyday, Suzie would clean and vacuum and collect and wash all the dishes. After dinner, Susie walked into the living room and picked up a mug from the table.
However, this was not her cup of tea because she **hated housework** no matter who it was for.
Suzie's grandmother was grateful for the help.

Biased Context – Literal Interpretation
At her grandmother's house, Suzie cooked the meals and did the laundry and the dishes. That night, Suzie made herself something to drink while they watched a television show. After dinner, Susie walked into the living room and picked up a mug from the table.
However, this was not her cup of tea because she **drank hot coffee** while she watched television.
Suzie's grandmother was grateful for the help.

Biased Context – Idiom Interpretation
At her grandmother's house, Suzie cooked the meals and did the laundry and the dishes. Suzy spent lots of time cleaning and vacuuming because she needed to help her grandmother. After dinner, Susie walked into the living room and picked up a mug from the table.
However, this was not her cup of tea because she **hated housework** no matter who it was for.
Suzie's grandmother was grateful for the help.

2. Full of Baloney

Neutral Context – Literal Interpretation
Everyday at noon Tommy's class walked to the cafeteria to eat lunch. Tommy liked to eat in the cafeteria because their teacher would sit with all the other teachers at a different table and he could eat his lunch and make all of his friends laugh.
Today, Tommy was full of baloney and soon his **round belly** felt like it was about to burst.
Tommy's favorite part of the day was lunchtime.

Neutral Context – Idiom Interpretation
Everyday at noon Tommy's class walked to the cafeteria to eat lunch. Tommy liked to eat in the cafeteria because their teacher would sit with all the other teachers at a different table and he could eat his lunch and make all of his friends laugh.
Today, Tommy was full of baloney and soon his **absurd lies** were going to get him in trouble.
Tommy's favorite part of the day was lunchtime.

Biased Context – Literal Interpretation
Everyday at noon Tommy's class walked to the cafeteria to eat lunch. Tommy's mom always packed her soon a really big meal of at least three sandwiches and some fruit. Sandwiches were his absolute favorite food, and he loved eating them for lunch every day.
Today, Tommy was full of baloney and soon his **round belly** felt like it was about to burst.
Tommy's favorite part of the day was lunchtime.

Biased Context – Idiom Interpretation
Everyday at noon Tommy's class walked to the cafeteria to eat lunch. Tommy was a big trickster and he loved to pull pranks on his teacher and his classmates. One of Tommy's favorite pastimes was to make up stories and spread rumors in the cafeteria.
Today, Tommy was full of baloney and soon his **absurd lies** were going to get him in trouble.
Tommy's favorite part of the day was lunchtime.

3. Bring Home the Bacon

Neutral Context – Literal Interpretation
The farmer had lots of animals on his farm, including cows, chickens, and pigs. Every morning he would wake up very early to take care of all the work

associated with the animals. On Saturdays, the farmer operated a small stand at the local market.
At the end of the day the farmer would bring home the bacon and all of **the other meat** that was leftover from the butchering.
The farmer was a very hard worker.

Neutral Context – Idiom Interpretation
The farmer had lots of animals on his farm, including cows, chickens, and pigs. Every morning he would wake up very early to take care of all the work associated with the animals. On Saturdays, the farmer operated a small stand at the local market.
At the end of the day the farmer would bring home the bacon and all of **his earnings** would be used to buy more farm animals.
The farmer was a very hard worker.

Biased Context – Literal Interpretation
The farmer had lots of animals on his farm, including cows, chickens, and pigs. Every morning he would wake up early to take care of all the chores. His least favorite job was butchering the pigs and preparing everything to bring to the local market.
At the end of the day the farmer would bring home the bacon and all of **the other meat** that was leftover from the butchering.
The farmer was a very hard worker.

Biased Context – Idiom Interpretation
The farmer had lots of animals on his farm, including cows, chickens, and pigs. Every morning he would wake up very early to make sure the farm was operating efficiently. On Saturdays, the farmer sold his products at a small stand at the local market.
At the end of the day the farmer would bring home the bacon and all of **his earnings** would be used to buy more farm animals.
The farmer was a very hard worker.

4. It's a Piece of Cake –

Neutral Context – Literal Interpretation
There were many activities planned at the birthday party. Many of the children at the birthday party were very excited to try everything for the first time. One girl was the first to volunteer for a game that involved tasting something while she was blindfolded.
The girl thought it was a piece of cake because the **sweet dessert** was her favorite and she had been looking forward to it.
Birthday parties are always a lot of fun.

Neutral Context – Idiom Interpretation
There were many activities planned at the birthday party. Many of the children at the birthday party were very excited to try everything for the first time. One girl was the first to volunteer for a game that involved tasting something while she was blindfolded.
The girl thought it was a piece of cake because the **simple task** was something she found very easy.
Birthday parties are always a lot of fun.

Biased Context – Literal Interpretation
There were many activities planned at the birthday party. After the children played some games it was time to sing happy birthday and have some food. One girl had never been to a birthday party before, so she asked the host what they were eating.
The girl thought it was a piece of cake because the **sweet dessert** was her favorite and she had been looking forward to it.
Birthday parties are always a lot of fun.

Biased Context – Idiom Interpretation
There were many activities planned at the birthday party. First the children played pin the tale on the donkey and then they played a round of musical chairs. The girl who got the last chair bragged to all the other children about winning the game.
The girl thought it was a piece of cake because the **simple task** was something she found very easy.
Birthday parties are always a lot of fun.

5. Break the Ice

Neutral Context – Literal Interpretation
This year the company's Christmas party was held at a cabin by the lake. The boss wanted to get away from the office to celebrate the year. As soon as the employees arrived, they all went down to hang out and talk by the lake.
Someone needed to break the ice because the **water beneath** was needed to wash dishes.
The holiday party ended up being very enjoyable.

Neutral Context – Idiom Interpretation
This year the company's Christmas party was held at a cabin by the lake. The boss wanted to get away from the office to celebrate the year. As soon as the employees arrived, they all went down to hang out and talk by the lake.
Someone needed to break the ice because the **nervous tension** in the group was really uncomfortable.
The holiday party ended up being very enjoyable.

Biased Context – Literal Interpretation
This year, the company's Christmas party was held at a cabin by the lake. The lake had completely frozen over and looked like it would be solid enough to ice skate on. Once everyone arrived, they all headed out towards the edge of the lake.
Someone needed to break the ice because the **water beneath** was needed to wash dishes.
The holiday party ended up being very enjoyable.

Biased Context – Idiom Interpretation
The company's Christmas party was held at a cabin by the lake. In the office, everyone battled for positions, which made them competitive and unfriendly toward each other. As soon as everyone arrived, the boss asked them to participate in a group activity by the lake.
Someone needed to break the ice because the **nervous tension** in the group was really uncomfortable.
The holiday party ended up being very enjoyable.

6. Let The Cat Out of The Bag

Neutral Context – Literal Interpretation
Jack and Eddie drove a garbage truck every Tuesday. Jack would always drive the truck and Eddie would throw the bags of trash in the back. One day, Eddie noticed a mysterious ripped trash bag and looked into it to find out what it contained.
Then the cat was out of the bag because the **scared animal** leapt out and ran away.
Collecting trash was always an adventure but still had its risks.

Neutral Context – Idiom Interpretation
Jack and Eddie drove a garbage truck every Tuesday. Jack would always drive the truck and Eddie would throw the bags of trash in the back. One day, Eddie noticed a mysterious ripped trash bag and looked into it to find out what it contained.
Then the cat was out of the bag because the **secret crime** had been discovered.
Collecting trash was always an adventure but still had its risks.

Biased Context – Literal Interpretation
Jack and Eddie drove a garbage truck every Tuesday. Jack always drove and Eddie threw the bags of trash in the back. Sometimes Eddie found surprises that people threw in the garbage. For example, once he opened a bag and saw a small kitten inside.
Then the cat was out of the bag because the **scared animal** leapt out and ran away.
Collecting trash was always an adventure but still had its risks.

Biased Context – Idiom Interpretation
Jack and Eddie drove a garbage truck every Tuesday. Jack always drove and Eddie threw the bags of trash in the back. Sometimes Eddie found some strange things that people threw in the garbage. For example, once he opened a bag and saw some stolen merchandise inside.
Then the cat was out of the bag because the **secret crime** had been discovered.
Collecting trash was always an adventure but still had its risks.

7. Fell Head Over Heels

Neutral Context – Literal Interpretation
Johnny didn't want to be late for his date with Susan, and he was rushing down the street to make it there on time. When he arrived, his date was waiting outside and he started to run up the sidewalk to where she was standing.
Johnny quickly fell head over heels because he **tripped clumsily** on a rock on the ground.
Susan just laughed and smiled at Johnny.

Neutral Context – Idiom Interpretation
Johnny didn't want to be late for his date with Susan, and he was rushing down the street to make it there on time. When he arrived, his date was waiting outside and he started to run up the sidewalk to where she was standing.
Johnny quickly fell head over heels, because he **loved the girl** so much and so deeply.

Susan just laughed and smiled at Johnny.

Biased Context – Literal Interpretation
Johnny was late for his date with Susan and was rushing down the sidewalk. Johnny never looked where he was going and was always getting hurt. Because he was in such a rush to get to Susan's house, he wasn't looking where he was going.
Johnny quickly fell head over heels because he **tripped clumsily** on a rock on the ground.
Susan just laughed and smiled at Johnny.

Biased Context – Idiom Interpretation
Johnny was late for his date with Susan and was rushing down the sidewalk. He had such a big crush on her that he wanted to ensure he didn't keep her waiting. When he arrived, Johnny smiled happily at Susan because she looked so pretty.
Johnny quickly fell head over heels, because he **loved the girl** so much and so deeply.
Susan just laughed and smiled at Johnny.

8. Put His Foot In His Mouth

Neutral Context – Literal Interpretation
Jerry thought it would be fun to try a new activity. After talking to a few friends, he decided to take yoga classes. Jerry had observed that people always looked calm while they were in the various positions, so he decided to try a few.
Jerry had to put his foot in his mouth even though **the difficult pose** was not something he'd tried before.
Jerry ended up liking yoga very much.

Neutral Context – Idiom Interpretation
Jerry thought it would be fun to try a new activity. After talking to a few friends, he decided to take yoga classes. Jerry had observed that people always looked calm while they were in the various positions, so he decided to try a few.
Jerry had to put his foot in his mouth even though **his embarrassment** was incredibly overwhelming.
Jerry ended up liking yoga very much.

Biased Context – Literal Interpretation
Jerry thought it would be fun to try a new activity. After thinking about it, Jerry decided to take yoga classes. In the very first class, he was surprised at how stiff he was as he tried to do a lot of new different stretches.
Jerry had to put his foot in his mouth even though **the difficult pose** was not something he'd tried before.
Jerry ended up liking yoga very much.

Biased Context – Idiom Interpretation
Jerry thought it would be fun to try a new activity. After thinking about it, Jerry decided to take yoga classes. He thought yoga looked easy, and he laughed at the beginners. Jerry was upset, however, when he struggled during his first day in class.
Jerry had to put his foot in his mouth even though **his embarrassment** was incredibly overwhelming.
Jerry ended up liking yoga very much.

9. Kick the Bucket

Neutral Context – Literal Interpretation
It was early in the morning, and the farmer needed to milk his cow. Because the sun wasn't up yet, the farmer and his old milk cow were both still sleepy. He sat down in the barn and put the milk bucket under the cow.
Suddenly, the cow kicked the bucket and thus the **spilled liquid** spread everywhere.
Now the farmer didn't know what to do.

Neutral Context – Idiom Interpretation
It was early in the morning, and the farmer needed to milk his cow. Because the sun wasn't up yet, the farmer and his old milk cow were both still sleepy. He sat down in the barn and put the milk bucket under the cow.
Suddenly, the cow kicked the bucket and thus the **animal's death** really upset the farmer.
Now the farmer didn't know what to do.

Biased Context – Literal Interpretation
It was early in the morning, and the farmer needed to milk his cow. The young cow had been very mischievous and uncooperative lately, and the farmer found it very irritating. He sat down in the barn and put the milk bucket under the cow.
Suddenly, the cow kicked the bucket and thus the

spilled liquid spread everywhere.
Now the farmer didn't know what to do.

Biased Context – Idiom Interpretation
It was early in the morning, and the farmer needed to milk his cow. The old cow had been very sick lately, and the farmer had been worried about its health. He sat down in the barn and put the milk bucket under the cow.
Suddenly, the cow kicked the bucket and thus the **animal's death** really upset the farmer.
Now the farmer didn't know what to do.

10. Spill the Beans

Neutral Context – Literal Interpretation
Sally was in the den preparing for the surprise party for Billy. She was putting up streamers and decorations all over the house. Her friends were in the kitchen getting ready making chili with lots of tasty ingredients before Billy was supposed to show up.
Unfortunately, Sally had spilled the beans and now the **ruined food** would have to be cleaned up.
Everyone still had fun at the party, though.

Neutral Context – Idiom Interpretation
Sally was in the den preparing for the surprise party for Billy. She was putting up streamers and decorations all over the house. Her friends were in the kitchen getting ready making chili with lots of tasty ingredients before Billy was supposed to show up.
Unfortunately, Sally had spilled the beans and now the **big secret** would no longer be a surprise.
Everyone still had fun at the party, though.

Biased Context – Literal Interpretation
Sally was decorating for the surprise party for Billy. She was working fast and making a mess. Her friends were in the kitchen making chili and were ready to add the final ingredient to the chopped tomatoes and onions that were already in the pot.
Unfortunately, Sally had spilled the beans and now the **ruined food** would have to be cleaned up.
Everyone still had fun at the party, though.

Biased Context – Idiom Interpretation
Sally was decorating for the surprise party for Billy. She was excited and had a hard time keeping the details about the party to herself. Her friends were in the kitchen making chili for the party and agreed that it was hard to keep quiet.
Unfortunately, Sally had spilled the beans and now the **big secret** would no longer be a surprise.
Everyone still had fun at the party, though.

11. Bite Your Tongue

Neutral Context – Literal Interpretation
Eric was running late for school. He was in a bad mood because he rushed through breakfast and he didn't like his new teacher. He ran to school and got to his seat as the bell rang. The teacher asked Eric why he was running.
Eric had bitten his tongue and so his **mouth was hurting** and he couldn't talk.
Eric couldn't wait for the school day to end.

Neutral Context – Idiom Interpretation
Eric was running late for school. He was in a bad mood because he rushed through breakfast and he didn't like his new teacher. He ran to school and got to his seat as the bell rang. The teacher asked Eric why he was running.
Eric had bitten his tongue and so his **refusal to speak** kept him out of trouble.
Eric couldn't wait for the school day to end.

Biased Context – Literal Interpretation
Eric was running late for school. He didn't want to be late and was eating breakfast so fast he hardly chewed before swallowing. He ran to school and got to his seat just as the bell rang. The teacher asked Eric why he was running.
Eric had bitten his tongue and so his **mouth was hurting** and he couldn't talk.
Eric couldn't wait for the school day to end.

Biased Context – Idiom Interpretation
Eric didn't want to go to school. He hated his teacher but knew if he didn't have anything nice to say, he shouldn't say anything. He ran to school and got to his seat as the bell rang. The teacher asked Eric why he was running.
Eric had bitten his tongue and so his **refusal to speak** kept him out of trouble.
Eric couldn't wait for the school day to end.

12. Pull Her Leg

Neutral Context – Literal Interpretation
Cindy was the shortest girl in her class and loved to play outside on the monkey bars. Jake was the class troublemaker and didn't always play as nicely as he could with his classmates. Today at school, Cindy got really mad at Jake during recess.
Jake was pulling her leg and he had **held her foot** while she was playing on the monkey bars.
Cindy wished Jake would pick on someone else.

Neutral Context – Idiom Interpretation
Cindy was the shortest girl in her class and loved to play outside on the monkey bars. Jake was the class troublemaker and didn't always play as nicely as he could with his classmates. Today at school, Cindy got really mad at Jake during recess.
Jake was pulling her leg and he had **told some lies** to Cindy and the other younger kids.
Cindy wished Jake would pick on someone else.

Biased Context – Literal Interpretation
Cindy was the shortest girl in her class and loved to play on the monkey bars. Jake was a bully and he often tried to physically overpower kids that were smaller than him. For example, today at school, Cindy got really mad at Jake during recess.
Jake was pulling her leg and he had **held her foot** while she was playing on the monkey bars.
Cindy wished Jake would pick on someone else.

Biased Context – Idiom Interpretation
Cindy was the shortest girl in her class and loved to play on the monkey bars. Jake was the class troublemaker and loved to tease the younger kids. Cindy was gullible and always fell for Jake's pranks. Today she got mad at Jake during recess.
Jake was pulling her leg and he had **told some lies** to Cindy and the other younger kids.
Cindy wished Jake would pick on someone else.

13. Don't Cry Over Spilled Milk

Neutral Context – Literal Interpretation
Every morning, the baker would place a saucer of milk outside for the neighborhood cats. The cats were rambunctious and often made a big mess. One morning, the baker was upset when he discovered that the hungry cats had tipped over and emptied the bowl.
The baker was crying over spilled milk because the **wasted liquid** was now ruined and worthless.
He quickly got to work to correct the problem.

Neutral Context – Idiom Interpretation
Every morning, the baker would place a saucer of milk outside for the neighborhood cats. The cats were rambunctious and often made a big mess. One morning, the baker was upset when he discovered that the hungry cats had tipped over and emptied the bowl.
The baker was crying over spilled milk because the **silly accident** was really no big deal.
He quickly got to work to correct the problem.

Biased Context – Literal Interpretation
Every morning, the baker would place a saucer of milk outside for the neighborhood cats. He was very poor and fed the cats even though he couldn't afford it. One morning, the baker was upset to discover that the cats had tipped over the bowl.
The baker was crying over spilled milk because the **wasted liquid** was now ruined and worthless.
He quickly got to work to correct the problem.

Biased Context – Idiom Interpretation
Every morning, the baker would place a saucer of milk outside for the neighborhood cats. He would sit with the cats while he thought about his work. One morning, the old man spent so much time with the cats that he burned all his bread.
The baker was crying over spilled milk because the **silly accident** was really no big deal.
He quickly got to work to correct the problem.

14. Break A Leg

Neutral Context – Literal Interpretation
Opening night was just a few days away and Anna was tired from practicing every day for the school musical. Anna told another girl in the show how she was feeling, and she started wishing she had never tried out to be in the show.
The girl told her to break a leg because the **painful injury** would take Anna out of the show.

Anna was the star of the school musical.

Neutral Context – Idiom Interpretation
Opening night was just a few days away and Anna was tired from practicing every day for the school musical. Anna told another girl in the show how she was feeling, and she started wishing she had never tried out to be in the show.
The girl told her to break a leg because the **lucky thoughts** were just what Anna needed.
Anna was the star of the school musical.

Biased Context – Literal Interpretation
Opening night was a day away and Anna was so tired from practicing that she had a difficult time paying attention to the dance steps. One of the other dancers was cruel, and every time Anna made a mistake the girl would make a mean remark.
The girl told her to break a leg because the **painful injury** would take Anna out of the show.
Anna was the star of the school musical.

Biased Context – Idiom Interpretation
Opening night was just a few days away, and Anna was tired from practicing every day for the school musical. Right before the show on opening night, Anna's best friend went back stage to give Anna some encouragement before she went out on the stage.
The girl told her to break a leg because the **lucky thoughts** were just what Anna needed.
Anna was the star of the school musical.

15. Black Sheep

Neutral Context – Literal Interpretation
In the summer, the mother, father, and their son herded their family of sheep up to the pastures to graze. The son always complained because he didn't like watching the animals, and that sometimes it was difficult to keep track of all of the sheep.
The father was unhappy with the black sheep of the family because the **dark-coated animal** was hard to see at night.
The father just didn't know what to do about him.

Neutral Context – Idiom Interpretation
In the summer, the mother, father, and their son herded their family of sheep up to the pastures to graze. The son always complained because he didn't like watching the animals, and that sometimes it was difficult to keep track of all of the sheep.
The father was unhappy with the black sheep of the family because the **ill-behaved child** often caused embarrassment to his parents.
The father just didn't know what to do about him.

Biased Context – Literal Interpretation
In the summer, the mother, father, and their son herded their entire flock of sheep up to the high pastures to graze. From the top of the hills the family could watch and count all the sheep and see all of their different colored coats.
The father was unhappy with the black sheep of the family because the **dark-coated animal** was hard to see at night.
The father just didn't know what to do about him.

Biased Context – Idiom Interpretation
In the summer, the mother, father, and their son herded their flock of sheep up to the high pastures to graze. The middle son didn't like tending the sheep and often snuck to the town pub when he was supposed to be guarding the flock.
The father was unhappy with the black sheep of the family because the **ill-behaved child** often caused embarrassment to his parents.
The father just didn't know what to do about him.

16. Butterflies in Her Stomach

Neutral Context – Literal Interpretation
Everyone in the class except for Mary was very excited about springtime. For Mary, spring meant the bugs and animals would be out, and that the class now had to play outside during recess. Mary particularly didn't like eating her lunch outside during the spring.
Mary had butterflies in her stomach just after **eating the insects** that were covering her lunch.
Spring was an exciting time of the year.

Neutral Context – Idiom Interpretation
Everyone in the class except for Mary was very excited about springtime. For Mary, spring meant the bugs and animals would be out, and that the class now had to play outside during recess. Mary particularly

didn't like eating her lunch outside during the spring.
Mary had butterflies in her stomach just after **getting so nervous** about the change in the seasons.
Spring was an exciting time of the year.

Biased Context – Literal Interpretation
Everyone in the class except for Mary was excited about springtime. Springtime meant the class had to play outside during recess. On Monday, all the cocoons hatched and hundreds of bugs flew around. The class had a picnic but bugs kept landing on their food.
Mary had butterflies in her stomach just after **eating the insects** that were covering her lunch.
Spring was an exciting time of the year.

Biased Context – Idiom Interpretation
Everyone in the class except for Mary was excited about springtime. Mary didn't like springtime because it meant she had to play outside on the playground and couldn't stay indoors. Mary had a hard time making friends and hated having to play outside at recess.
Mary had butterflies in her stomach just after **getting so nervous** about the change in the seasons.
Spring was an exciting time of the year.

17. Cold Feet

Neutral Context – Literal Interpretation
Robert and Jenny went on a ski trip. This was the first time Robert had ever taken Jenny, his girlfriend, skiing. On the last day of their ski vacation, Robert took Jenny for a walk in the snow because he had a big surprise planned.
Suddenly, Robert got cold feet and so he **had frozen toes** by the time he got inside.
Robert decided to wait a little longer.

Neutral Context – Idiom Interpretation
Robert and Jenny went on a ski trip. This was the first time Robert had ever taken Jenny, his girlfriend, skiing. On the last day of their ski vacation, Robert took Jenny for a walk in the snow because he had a big surprise planned.
Suddenly, Robert got cold feet and so he **changed his mind** before he talked to Jenny.
Robert decided to wait a little longer.

Biased Context – Literal Interpretation
Robert and Jenny went on a ski trip for the weekend. They were high up in the mountains, where it was cold and snowy the whole weekend. On the last day of their ski vacation, Robert took Jenny for a walk out in the snow.
Suddenly, Robert got cold feet and so he **had frozen toes** by the time he got inside.
Robert decided to wait a little longer.

Biased Context – Idiom Interpretation
Robert and Jenny went on a romantic ski trip for the weekend. This was the first time Robert had ever taken Jenny, his girlfriend of many years, skiing. On the last day of their ski vacation, Robert had planned to ask Jenny to marry him.
Suddenly, Robert got cold feet and so he **changed his mind** before he talked to Jenny.
Robert decided to wait a little longer.

18. Down In the Dumps

Neutral Context – Literal Interpretation
When Kenny asked Jules to the dance, she laughed and said "no." After she rejected him, Kenny went for a long walk to make himself feel better. He didn't pay attention to his route and ended up at the landfill at the edge of town.
Kenny was down in the dumps and all the **discarded junk** was piled three stories high.
Eventually, Kenny decided that he would ask someone else to the dance.

Neutral Context – Idiom Interpretation
When Kenny asked Jules to the dance, she laughed and said "no." After she rejected him, Kenny went for a long walk to make himself feel better. He didn't pay attention to his route and ended up at the landfill at the edge of town.
Kenny was down in the dumps and all the **sad feelings** made him want to go home.
Eventually, Kenny decided that he would ask someone else to the dance.

Biased Context – Literal Interpretation
When Kenny asked Jules to the dance, she laughed and said "no." After she rejected him, Kenny went for a walk, and he ended up at the landfill at the edge of town. He hadn't been there before and was amazed at what he saw.
Kenny was down in the dumps and all the

discarded junk was piled three stories high.
Eventually, Kenny decided that he would ask someone else to the dance.

Biased Context – Idiom Interpretation
When Kenny asked Jules to the dance, she laughed and said "no." After she rejected him, Kenny was heartbroken and swore that he would never love another girl ever again. At school everyone was really worried about Kenny, because he was not acting like himself.
Kenny was down in the dumps and all the **sad feelings** made him want to go home.
Eventually, Kenny decided that he would ask someone else to the dance.

19. A Green Thumb

Neutral Context – Literal Interpretation
Ever since Rachel was a little girl, she loved to spend time in her garden. She liked planting vegetables and flowers and watching them grow. It was a very dirty and messy job, and at the end of the day, Rachel pulled off her gardening gloves.
Rachel had a green thumb because the **grass stains** went all the way through her gloves.
Every year, Rachel couldn't wait for the snow to melt so that she could start her gardening.

Neutral Context – Idiom Interpretation
Ever since Rachel was a little girl, she loved to spend time in her garden. She liked planting vegetables and flowers and watching them grow. It was a very dirty and messy job, and at the end of the day, Rachel pulled off her gardening gloves.
Rachel had a green thumb because the **healthy plants** grew well under her care.
Every year, Rachel couldn't wait for the snow to melt so that she could start her gardening.

Biased Context – Literal Interpretation
Ever since Rachel was little, she loved to garden. She liked planting different vegetables and flowers and helping them grow. Even though she tried to stay clean while she worked, Rachel was amazed at just how dirty she was at the end of the day.
Rachel had a green thumb because the **grass stains** went all the way through her gloves.
Every year, Rachel couldn't wait for the snow to melt so that she could start her gardening.

Biased Context – Idiom Interpretation
Ever since Rachel was little, she loved to spend time outside in the garden. Rachel had a special talent knowing exactly how much sun and water her plants needed. Every year Rachel won awards for the amazing flowers and vegetables that grew in her garden.
Rachel had a green thumb because the **healthy plants** grew well under her care.
Every year, Rachel couldn't wait for the snow to melt so that she could start her gardening.

20. In the Doghouse

Neutral Context – Literal Interpretation
Lily had spent all day preparing a special dinner while her husband worked on something out in the yard for their new puppy. Her children had helped by cleaning the house. When their father was late for dinner, Lily started to wonder where he was.
Her husband was in the doghouse because the **animal's shelter** wasn't quite finished yet on the inside.
The father made sure he was always at dinner on time.

Neutral Context – Idiom Interpretation
Lily had spent all day preparing a special dinner while her husband worked on something out in the yard for their new puppy. Her children had helped by cleaning the house. When their father was late for dinner, Lily started to wonder where he was.
Her husband was in the doghouse because the **trouble he faced** was something he'd been warned about before.
The father made sure he was always at dinner on time.

Biased Context – Literal Interpretation
Lily had spent all day preparing a special dinner while her husband worked in the yard building a place for their new puppy to sleep. He had been working on this project for days.
When he was late for dinner, Lily wondered where he was.
Her husband was in the doghouse because the **animal's shelter** wasn't quite finished yet on the inside.
The father made sure he was always at dinner on time.

Biased Context – Idiom Interpretation

Lily had spent all day preparing a special dinner and had warned her husband if he were late to dinner, she would be very angry. He had been late three times that week. When he was late for dinner again, Lily wondered where he was. Her husband was in the doghouse because the **trouble he faced** was something he'd been warned about before. The father made sure he was always at dinner on time.

REFERENCES

American Psychological Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a theory of mind? *Cognition, 21,* 37-46.

Berument, S. K., Rutter, M., Lord, C., Pickles, A., & Bailey, A. (1999). Autism screening questionnaire: Diagnostic validity. *British Journal of Psychiatry*, 175, 444-451.

Beversdorf, D. Q., Anderson, J. M., Manning, S. E., Anderson, S. L., Nordgren, R. E., Felopulos, G. J. et al. (1998). The effect of semantic and emotional context on written recall for verbal language in high-functioning adults with autism spectrum disorder. *Journal of Neurology, Neurosurgery, and Psychiatry*, 65, 685-692.

Burnette, C. P., Mundy, P. C., Meyer, J. A., Sutton, S. K., Vaughan, A. E., & Charak, D. (2005). Weak central coherence and its relations to theory of mind and anxiety in autism. *Journal of Autism and Developmental Disorders, 35*(1), 63-73.

Butler, B., & Hains, S. (1979). Individual differences in word recognition latency. *Memory and Cognition*, 7, 68-76.

Carroll, J. B., & White, M. N. (1973a). Age-of-acquisition norms for 220 picturable nouns. *Journal of Verbal Learning and Verbal Behavior*, 12, 563-576.

Carroll, J. B., & White, m. N. (1973b). Word frequency and age of acquisition as determiners of picture-naming latency. *Quarterly Journal of Experimental Psychology*, 25, 85-95.

Carrow-Woolfolk, E. (1999). *Comprehensive Assessment of Spoken Language*. Circle Pines, MN: American Guidance Service.

Constantino, J. N. (2002). *Social Responsiveness Scale.* Los Angeles: Western Psychological Services.

Constantino, J. N., Davis, S. A., Todd, R. D., Schindler, M. K., Gross, M. M., Brophy, S.L. et al. (2003). Validation of a brief quantitative genetic measure of autistic traits: Comparison of the Social Responsiveness Scale with the Autism Diagnostic Interview-Revised. *Journal of Autism and Developmental Disorders, 33*(4), 427-433.

Constantino, J. N., & Todd, R. D. (2000). The genetic structure of reciprocal social behavior. *American Journal of Psychiatry, 157,* 2043-2045.

Duffy, S. A., Morris, R. K., & Rayner, K. (1988). Lexical ambiguity and fixation times in reading. *Journal of Memory and Language, 27,* 429-446.

Dunn, L. M., & Dunn, D. M. (2007). Peabody Picture Vocabulary Test (4th ed.) Minneapolis, MN: Pearson Assessments.

Elliott, C. D. (1991). *Differential Abilities Scale.* San Antonio, TX: The Psychological Corporation.

Frith, U. (1989). *Autism: Explaining the enigma.* Cambridge, MA: Basil Blackwell.

Frith, U. (2003). *Autism: Explaining the enigma* (2nd ed.) Malden, MA: Blackwell.

Frith, U., & Happé, F. (1994). Language and communication in autistic disorders. *Philosophical Transactions of the Royal Society of London-Series B: Biological Sciences, 346*(1315), 97-104.

Frith, U., & Snowling, M. (1983). Reading for meaning and reading for sound in autistic and dyslexic children. *British Journal of Developmental Psychology, 1,* 329-342.

Folk, J. R., & Morris, R. K. (2003). Effects of syntactic category assignment on lexical ambiguity resolution in reading: An eye movement analysis. *Memory and Cognition, 31,* 87-99.

Gilhooly, K. J., & Gilhooly, M. L. M. (1979). Age-of-acquisition effects in lexical and episodic memory tasks. *Memory and Cognition*, 7, 214-223.

Gilhooly, K. J., & Gilhooly, M. L. M. (1980). The validity of age of acquisition ratings. *British Journal of Psychology*, 71, 105-110.

Gilhooly, K. J., & Logie, R. H. (1980). Age-of-acquisition, imagery, concreteness, familiarity, and ambiguity measures for 1,944 words. *Behavior Research Methods and Instrumentation*, 12(4), 395-427.

Glucksberg, S. (2001). *Understanding figurative language: From metaphor to idioms.* Oxford University Press, Incorporated.

Hale, C. M., & Tager-Flusberg, H. (2005). Social communication in children with autism: The relationship between theory of mind and discourse development. *Autism, 9*(2), 157-178.

Happé, F. G. E. (1993). Communicative competence and theory of mind in autism: A test of relevance theory. *Cognition, 48,* 101-119.

Happé, F. G. E. (1997). Central coherence and theory of mind in autism: Reading homographs in context. *British Journal of Developmental Psychology, 15,* 1-12.

Happé, F., & Frith, U. (2006). The weak coherence account: Detail-focused cognitive style in autism spectrum disorders. *Journal of Autism and Developmental Disorders, 36*(1), 5-25.

Hill, E. L., & Frith, U. (2003). Understanding autism: Insights from mind and brain. *Philosophical Transactions of the Royal Society of London-Series B: Biological Sciences, 358,* 281-289.

Hobson, R. P. (2006) The autistic child's appraisal of expression of emotion. *Journal of Child Psychology and Psychiatry, 27*, 321-342.

Hobson, R. P., Ousten, J., & Lee, A. (1988) What's in a face? The case of autism. British Journal of Psychology, 79, 441-453.

Jolliffe, T., & Baron-Cohen, S. (1999). A test of central coherence theory: Linguistic processing in high-functioning adults with autism or Asperger's syndrome: Is local coherence impaired? *Cognition, 71,* 149-185.

Jolliffe, T., & Baron-Cohen, S. (2000). Linguistic processing in high-functioning adults with autism or Asperger's syndrome: Is local coherence impaired? *Psychological Medicine, 30,* 1169-1187.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2,* 217-250.

Kerbel, D., & Grunwell, P. (1997). Idioms in the classroom: An investigation of language unit and mainstream teachers' use of idioms. *Child Language Teaching and Therapy, 13,* 113-124.

Kerbel, D., & Grunwell, P. (1998a). A study of idiom comprehension in children with semantic-pragmatic difficulties. Part I: Task effects on the assessment of idiom comprehension in children. *International Journal of Language and Communication Disorders, 33*, 1-22.

Kerbel, D., & Grunwell, P. (1998b). A study of idiom comprehension in children with semantic-pragmatic difficulties. Part II: Between-groups results and discussion. *International Journal of Language and Communication Disorders, 33*, 23-44.

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002). Defining and quantifying the social phenotype in autism. *American Journal of Psychiatry, 159,* 895-908.

Lauchman, R., Schaffer, J. P., & Hennrikus, D. (1974). Language and cognition: Effects of stimulus codability, mane-word frequency, and age-of-acquisition on lexical reaction time. *Journal of Verbal Learning and Verbal Behavior*, 13, 613-625.

Long, D. L., & Lea, R. B. (2005). Have we been searching for meaning in all the wrong places? Defining the "search after meaning" principle in comprehension. *Discourse Process, 39,* 279-298.

Lopez, B., & Leekam, S. R. (2003). Do children with autism fail to process information in context? *Journal of Child Psychology and Psychiatry, 44,* 285-300.

Lord, C. Risi, S., & Pickles, A. (2004). Trajectory of language development in autistic spectrum disorders. In M. L. Rice & S. F. Warren (Eds.) *Developmental language disorders: From phenotype to etiologies*. Mahwah, NJ: Erlbaum.

Lord, C. & Rutter, M. (1994). Autism and pervasive developmental disorders. In E. Taylor (Ed.) *Child and adolescent psychiatry: Modern approaches* (Vol. 3, pp. 569-593). Oxford: Blackwell.

Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C. et al. (2000). The autism diagnostic observation schedule-generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders, 30*(3), 205-334.

Lord, C., Rutter, M., & DiLavore, P. C. (2003). *Autism Diagnostic Observation Schedule-Generic.* Los Angeles: Western Psychological Services.

Lovaas, O. I. & Schreibman, (1971). Stimulus overselectivity of autistic chidren in a two stimulus situation. *Behaviour Research and Therapy, 9*(4), 305-310.

Lovaas, O. I., Schreibman, L., Koegel, R. & Rehm, R. (1971). Selective responding by autistic children to multiple sensory input. *Journal of Abnormal Psychology, 77*(3), 211-222.

Lovaas, O. I., Koegel, R. & Schreibman, L. (1979). Stimulus overselectivity in autism: A review of research. *Psychological Bulletin, 86*(6), 1236-1254.

Loveland, K. A., & Landry, S. H. (1986). Joint attention and language in autism and developmental language delay. *Journal of Autism and Developmental Disorders, 16*(3), 335-349.

Martin, I., & McDonald, S. (2004). An exploration of causes of non-literal language problems in individuals with asperger syndrom. *Journal of Autism and Developmental Disorders, 34*, 311-328.

McGrew, K. S., & Woodcock, R. W. (2001). *Woodcock-Johnson III technical manual.* Itasca, IL: Riverside Publishing.

Nichols, K. (1998). *A comparison of DAS and WISC-III scores for children with disabilities.* Paper presented at the 30th annual meeting of the National Association of School Psychologists, Orlando, FL.

Norbury, C. F. (2004). Factors supporting idiom comprehension in children with communication disorders. *Journal of Speech, Language, and Hearing Research*, 47, 1179-1193.

Norbury, C. F. (2005). Barking up the wrong tree? Lexical ambiguity resolution in children with language impairments and autistic spectrum disorders. *Journal of Experimental Child Psychology*, 90, 142-171.

Norbury, C. F., & Bishop, D. V. M. (2002). Inferential processing and story recall in children with communication problems: An exploration of specific language impairment, pragmatic language impairment, and autism. *International Journal of Language and Communication Disorders, 37,* 227-251.

Pacht, J. M., & Rayner, K. (1993). The processing of homophonic homographs during reading: Evidence from eye movement studies. *Journal of Psycholinguistic Research, 22,* 252-271.

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *The Behavior of Brain Sciences, 4,* 515-526.

Rajendran, G., & Mitchell, P. (2007). Cognitive theories of autism. *Developmental Review, 27*(2), 224-260.

Rayner, K., Cook, A. E., Juhasz, B. J., & Frazier, L. (2006). Immediate disambiguating of lexically ambiguous words during reading: Evidence from eye movements. *British Journal of Psychology, 97*, 467-482.

Rayner, K., & Duffy, S. A. (1986). Lexical complexity and fixation times in reading; Effects of word frequency, verb complexity, and lexical ambiguity. *Memory & Cognition, 14,* 191-201.

Rayner, K., & Frazier, L. (1989). Selection mechanisms in reading lexically ambiguous words. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15,* 779-790.

Rayner, K., Pacht, J. M., & Duffy, S. A. (1994). Effects of prior encounter and global discourse bias on the processing of lexically ambiguous words: Evidence from eye movements. *Journal of Memory and Language, 33,* 527-544.

Rice, Warren, & Betz (2005). Language symptoms of developmental language disorders: An overview of autism, down syndrome, fragile x, specific language impairment, and Williams syndrome. *Applied Psycholinguistics*, 26, 7-27.

Rinaldi, W. (2000). Pragmatic comprehension in secondary school-aged students with specific developmental language disorder. *International Journal of Language and Communication Disorders, 35*, 1-29.

Rutter, M., Le Couteur, A., & Lord, C. (1994). *Autism Diagnostic Interview-Revised.* Los Angeles, CA: Western Psychological Services.

Saldaña, D. & Frith, U. (2007). Do readers with autism make bridging inferences from world knowledge? *Journal of Experimental Child Psychology*, 96, 310-319.

Semel, E., Wiig, E. H., & Secord, W. A. (1987). *Clinical evaluation of language fundamentals-revised.* San Antonio, TX: The Psychological Corporation.

Semel, E., Wiig, E. H., & Secord, W. A. (1995). *Clinical evaluation of language fundamentals* (3rd ed.) San Antonio, TX: The Psychological Corporation.

Semel, E., Wiig, E. H., & Secord, W. A. (2003). *Clinical evaluation of language fundamentals* (4th ed.) San Antonio, TX: The Psychological Corporation.

Sereno, S. C. (1995). Resolution of lexical ambiguity: Evidence from an eye movement priming paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 582-595.

Sereno, S. C., Brewer, & O'Donnell, P. J. (2003). Context effects in word recognition: Evidence for early interactive processing. *Psychological Science, 14,* 328-333.

Sereno, S. C., Pacht, J. M., & Rayner, K. (1992). The effects of meaning frequency on processing lexically ambiguous words: Evidence from eye movements. *Psychological Science, 3,* 296-300.

Sereno, S. C., O'Donnell, P. J., & Rayner, K. (2006). Eye movements and lexical ambiguity resolution: Investigating the subordinate-bias effect. *Journal of Experimental Psychology: Human Perception and Performance, 32,* 335-350.

Shah, A., & Frith, U. (1983). An islet of ability in autistic children: A research note. *Journal of Child Psychology and Psychiatry, 24,* 613-620.

Snowling, M., & Frith, U. (1986). Comprehension in "hyperlexic" readers. *Journal of Experimental Child Psychology, 42,* 392-415.

Tager-Flusberg, H. (1992). Autistic children's talk about psychological states: Deficits in the early acquisition of a theory of mind. *Child Development*, 63, 161-172.

Tager-Flusberg, H. (1996). Brief report: Current theory and research on language and communication in autism. *Journal of Autism and Developmental Disorders, 26*(2), 169-172.

Tager-Flusberg, H. (1999). A psychological approach to understanding the social and language impairments in autism. *International Review of Psychiatry, 11,* 325-334.

Tager-Flusberg, H. (2007a). Atypical language development: Autism and other neurodevelopmental disorders. In E. Hoff & M. Shatz (Eds.), *Blackwell handbook of language development* (pp.432-453). Boston, MA: Blackwell Publishing.

Tager-Flusberg, H. (2007b). Evaluating the theory-of-mind hypothesis of autism. *Current Directions in Psychological Science*, 16(6), 311-315.

Tager-Flusberg, H., Calkins, S., Nolin, T., Baumbeger, T., Anderson, M., & Chadwick-Dias, A. (1990). A longitudinal study of language acquisition in autistic and Down's syndrome children. *Journal of Autism and Developmental Disorders*, 20, 1-21.

Vance, M., & Wells, B. (1994). The wrong end of the stick: Language impaired children's understanding of non-literal language. *Child Language Teaching and Therapy, 10*, 23-46.

Wechsler, D. (1974). *Wechsler Intelligence Scale for Children-Revised.* New York: The Psychological Corporation.

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale-Revised.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children* (3rd ed.). San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1992). *Wechsler Individual Achievement Test.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale* (3rd ed.). San Antonio, TX: The Psychological Corporation.

Whaley, C. P. (1978). Word-nonword classification time. *Journal of Verbal Learning and Verbal Behavior*, 17, 143-154.

Wilkinson, K. M. (1998). Profiles of language and communication skills in autism. *Mental Retardation and Developmental Disabilities, 4,* 73-79.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson Tests of Achievement* (3rd ed.). Itasca, IL: Riverside Publishing.