Symbolic Understanding in Children with Social Communication Impairments

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ABSTRACT

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Symbolic Understanding in Children with Social Communication Impairments

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Despite a growing body of literature examining the social communication challenges children with developmental disabilities such as autism experience, relatively less is known about their symbolic representation skills. This study examined how children with social communication difficulties perceive and describe representations of language concepts. Children were asked to draw ten early emerging concepts such as “on” and “more” (Light & Drager, 2007). Children’s drawings were analyzed according to features such as physical appearance and use of color. In a second task, children looked at symbols conventionally used in Augmentative and Alternative Communication (AAC) systems (PCS symbols) and were asked to label each picture. Findings revealed individual variation in children’s representations and descriptions of target concepts. The majority of children experienced difficulty identifying PCS symbols. Implications and future directions regarding symbolic understanding in children with autism are discussed.

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CHAPTER 1: INTRODUCTION

Background

According to the Centers for Disease Control and Prevention (2007), 1 in every 150 children has a diagnosis on the autism spectrum. Autism Spectrum Disorder (ASD) is characterized by deficits in social communication (American Psychiatric Association, Diagnostic and Statistical Manual IV-TR, 2000). Approximately one-third to one-half of all children diagnosed with ASD never develop functional spoken language, and of those that do, many experience difficulties in language comprehension, expression and pragmatics (National Research Council, 2001). There is a need for research to evaluate improving the abilities of children with ASD to communicate via other modalities when their natural speech is not adequate to meet their daily communication needs. One technique used to enhance communication in children with ASD is Augmentative and Alternative Communication (AAC). Finding an appropriate symbolic representation of language is critical for anyone using AAC (Beukelman & Mirenda, 1998). Unfortunately there is a lack of information about the most appropriate representations for children with autism and other social communication impairments.

Representation of Language Concepts

When discussing the ability of children to understand drawings as symbols, considerations should be made in regards to the construction of those symbols. Some concepts are easier to represent and have a relatively “universal” symbol. For example the word *cat* can be depicted in a way that most people would understand the symbol. Admittedly, there are many different colors and breeds of cats, but for most typically developing children, a drawing of a cat is a fairly easily understood symbol. In contrast,
more abstract symbols can have multiple representations. For example, *big* can be used in a variety of contexts such as *big issue, big tree, and big movie* (Worah, 2009). This creates difficulties when attempting to represent the general concept of *big* to one person in a way that can capture all the nuances of that word. Greater difficulty can be found in attempting to represent an abstract concept such as *big* to a wider audience, such as is the convention when creating symbol sets for AAC systems. Implementing strategies such as maximizing how easy a symbol is to learn when developing symbol systems can lead to users’ greater understanding of the symbol sets.

*Theoretical Perspectives: Overview of Work by DeLoache*

Language is a symbolic system, and many believe it is this “flexible use of symbols” (DeLoache, 1995) that differentiates humans from nonhuman primates and other animals. Symbols are an important part of human existence, and being able to flexibly utilize a large array of symbols is what makes symbol use in humans so remarkable (DeLoache, 1995). A symbol can be defined as essentially anything that represents something other than itself (DeLoache, 2004). Children are exposed at a young age to a variety of symbolism, including the alphabet, words in books, and illustrations in a variety of modalities.

DeLoache’s “Model model” (1995) delineates factors that may be important in symbolic understanding as a whole. These features include: *saliency, iconicity, experience, and instruction*. Saliency refers to the symbol itself and how easy it is to determine what a picture is depicting. For example, if relating a drawing of a cat to the cat itself, saliency refers to how easy it is to understand that the image refers the real-world referent (the actual cat). The *iconicity* of a symbol refers to how apparent the
relationship is between the symbol and the real-world. Iconicity and saliency are closely related. If two images were compared for their iconicity, a color photograph would be more iconic than a black and white line drawing, because a color photograph more closely resembles the real-life referent (DeLoache, 1995). *Experience* is concerned with how familiar the symbol user is with symbols and representational thinking. The ability to use this skill to help interpret symbolic relationships increases with age, as older children are more experienced with symbol use than younger children. In the example of the cat, a child who frequently uses symbols will understand the relationship between the symbol and referent more easily than a child who has minimal experience with symbols. Finally, *instruction* refers to the social context surrounding the interaction using symbols, including where the symbol is located, its physical proximity to its referent and how others (especially more experienced symbol users) treat the situation. For example, if the drawing of the cat was near the real cat, and an adult was actively using the drawing as a symbol, then the child will be more likely to understand the relationship than if the child is alone in the room with the symbol. Further, DeLoache (1995) discusses a two-way relationship, or dual representation, of symbols and referents. Children who are able to understand the symbolic nature of drawings are likely to examine both symbol and referent to further understand the relationship. This leads to better mapping of novel words and understanding meanings of symbols.

DeLoache questions when and how children come to grasp the full symbolic nature of pictures. This is not a skill that comes all at once in a particular time frame, but instead is a gradual process throughout the first few years of a child’s life. Some of the earliest work by DeLoache and colleagues focused on the ability of infants to understand
representation from three-dimensional to two-dimensional objects (DeLoache, Strauss & Maynard, 1979). In this study, there were a variety of tasks utilizing photographs and real toys. Infants were shown two real objects (dolls), then they were shown color and black-and-white photographs of the same doll, as well as photographs of a novel doll. Infants’ fixation times on a given picture were recorded and considered a measure of familiarity with a picture. After testing for a preference for novel pictures, infants were shown an array of pictures. The infants showed preference for the doll they had previously been exposed to, even when they were shown the black-and-white photographs. Findings from this study demonstrated that children as young as 5 months old are able to distinguish photographs of familiar objects as being two-dimensional representations of real objects.

DeLoache and colleagues discuss children in their growing abilities to conceptualize photographs, line drawings and other depictions as items that can explicitly represent real, three-dimensional objects. A more recent study by DeLoache and colleagues examined children in their second year of life (Ganea, Allen, Butler, Carey & DeLoache, 2009). In this study, 15-18- and 24-month olds were shown a photograph of a novel word ("blicket"). After they had learned the word for the photograph, they were given the choice between the photograph and the real object. Children in each age group frequently chose either the real object or both the object and the photograph. This demonstrates that even as young as 15 months of age, there is some understanding that pictures are representative of real objects.

The question remains, however, as to how much of this understanding is symbolic, as opposed to merely associative learning in this age range. This study by Ganea and colleagues (2009) sought to answer that question by performing the same task on 18- and
24-month old children but varying the color between the real object and photograph. The results of this task painted quite a different picture. Significantly more children in both age groups chose the photograph when asked to indicate the “blicket,” demonstrating a lack of generalization and symbolic understanding. In this interpretation, Ganea and colleagues (2009) posit that the relationship between a novel word and picture is associative and is a matter of “perceptual similarity” as opposed to true understanding. This interpretation is evidenced in the study by the finding that children were significantly less accurate when identifying the novel object when the object and photograph were perceptually dissimilar (a change in color).

Later, children may be able to make significant distinctions between items they view as more realistic, or iconic (Tare, Chiong, Ganea & DeLoache, 2010). In the investigation by Tare and colleagues (2010), 30- and 36- month old children were read picture books with two animals, one target and one foil. One group saw a book with manipulatives, one saw a book with illustrations and one saw a book with realistic photographs. The group who read the book with realistic pictures learned the novel target word more accurately and was able to generalize the target across multiple modalities (line drawing, manipulative, miniature three-dimensional object). The results of the study imply that children may understand the nature of realistic or iconic images more easily as representations of real-world objects as compared to less realistic ones. Further, their ability to generalize this new learning across multiple modalities has important implications for symbol use in therapeutic contexts.
Typically Developing Children and Symbol Development

Pictures and symbols are used frequently in the everyday life of a child, including on signs, packaging and in picture books. Children gradually learn the relationships between symbols and their referents throughout the first years of life (Callaghan, 2000; DeLoache & Burns, 1994). There is a progression of symbolic development throughout these years in typically developing children that represents a gradual attainment of symbolic understanding.

Initially, young infants have little understanding of the symbolic nature of drawings or photographs. Nine-month-old children manually explore photographs (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998), and the more iconic a photograph is, the more the infant will manually explore (Pierroutsakos & DeLoache, 2003). DeLoache and colleagues (1998) found that infants of approximately nine months of age were likely to attempt to manipulate photographs; that is, all ten sampled infants manually explored at least one photograph. They tended to attempt to pick up, rub or grab items in the photograph. Pierroutsakos and DeLoache (2003) extended this study to include color photographs, black and white photographs, color line drawings and black and white line drawings. This study found that infants displayed a greater number of instances of manual exploration when images were perceptually similar (i.e., color photographs) as opposed to distinctly different (i.e., black and white line drawings) when compared to the real-world referent. This implies that children around nine months of age do not understand the connection between real objects and two-dimensional images of objects, thus little symbolic understanding is present. By 19 months of age, children manually explore photographs infrequently, and favor pointing and labeling photographs
instead (DeLoache et al., 1998). Using the protocol with color photographs and allowing children to explore, 19-month-old children used pointing significantly more than younger children, and manually explored photographs significantly less than younger children. This shows a higher level of symbolic understanding, because 19-month-old children are able to recognize pictures as representations of real-world objects and use them as a means of social communication, through pointing.

Preissler and Carey (2004) found that typically developing 24-month-old children interpreted a symbol for a novel word symbolically. Children heard a novel word and shown a line drawing of a novel object. Later, when asked to identify the whisk and given the choice between a line drawing and a real whisk, children were more likely to choose the real object. Results of this study indicated that children understood the representative nature of the line drawing and that the novel word represented a real object. This type of representational understanding is required for using symbols to represent language as well.

Other factors may also influence the understanding of symbolic relationships. Stephenson (2009) suggested that many factors influence the ability to relate symbols to referents including previous experiences with symbols, the social context of the symbol as well as comprehension of language. Sevcik, Romski, and Wilkinson (1991) posited that the ability to comprehend the words used when learning symbols is a key to more efficient understanding of symbol systems. In other words, it is easier to understand the relationship between the symbol and its referent when one understands the spoken word beforehand. This idea is further evidenced in a study by Franklin, Mirenda, and Phillips (1996) in which children with severe intellectual impairments were less likely to match
photos to objects if they did not first understand the spoken word for the object. This study demonstrates the importance of receptive language comprehension in teaching symbolic understanding, particularly to individuals with cognitive impairments. Reduced language capabilities may hinder the ability to utilize symbols in a representational way.

*Iconicity and Symbols*

Iconicity is another factor relating to understanding of symbols. Iconicity can be defined as the degree to which a picture is visually similar to its referent (DeLoache 1995). The premise behind iconicity is that the more similar a picture is to its referent (i.e., the object to which it refers), the more easily typically developing children can understand the relationship between the picture and the real object. Iconicity clearly plays a role even before symbolic understanding is established. As previously mentioned, nine-month-old infants have been shown to engage in increased manual exploration of photographs if the photograph was more iconic of the real-world object (DeLoache et al., 1998). As children grow and develop symbolic understanding skills, iconicity plays a larger role in this development. It is easier for children to understand the relationship between symbol and referent because the symbol is highly iconic, or representative, of the real-world object (Ganea, Pickard, & DeLoache, 2008). Simcock and DeLoache (2006) found that young children (18- to 30-months old) were better able to imitate a novel action following the reading of a picture book as a function of the iconicity of the pictures. These children were read a picture book and shown pictures detailing how to assemble a rattle (a novel action). The pictures varied in their level of iconicity, and following the reading, children were asked to perform the same task as was demonstrated in the book. Children who were shown books containing more iconic pictures were able
to more accurately complete this task. These results indicate that typically developing children are able to more easily understand pictures and interpret them as symbols for real-world objects and actions when those pictures are iconic. It is important to note that iconicity can vary from one person to another, and the most meaningful symbol to an individual may include artifacts from that individual’s life experience.

Understanding how children represent concepts to create more easily understood symbols is one strategy that could improve symbols for use in modalities such as AAC systems. The field of AAC has been particularly interested in the issue of iconicity in symbol systems. There is limited research into the transparency of symbol systems for children with intellectual or communication impairments, and this information is vitally important to best facilitating communication in these populations (Mirenda & Locke, 1989). For children with intellectual impairments (including those with autism), Mirenda and Locke (1989) examined the transparency of a number of symbol sets by asking children with intellectual disabilities to match given symbols with sample objects. Of the symbol sets they examined, Mirenda and Locke (1989) found that there was a relatively stable hierarchy of transparency. Line drawings such as PCS, Picsyms, Self-Talk, and Rebus were the least transparent symbols, falling well behind other means of representation such as real objects, photographs, and miniature objects, indicating a low level of transparency for these commonly used symbol sets (Mirenda & Locke, 1989).

Some concepts are more concrete and their symbols are more transparent across a variety of modalities such as American Sign Language (Konstantareas, Oxman, & Webster, 1978), and graphic symbols, leading to faster acquisition (Kozleski, 1991). Concepts like “eat,” “drink,” and “sleep” are among these highly concrete symbols, that
may be easily recognized by typically developing children as well as those with intellectual impairments. However, having only these concepts to communicate is not enough for AAC users. More abstract concepts are required in an AAC lexicon, such as pronouns, adjectives, and abstract verbs; these tend to be difficult to depict in any symbol set (Mirenda, 2003).

Other research has systematically examined the transparency of currently available symbol sets. Mizuko (1987) compared the transparency of three symbols systems: PCS, Picsyms and Blissymbols. A total of 36 children ages 29- to 44-months old were randomly assigned into three groups. Each group was shown pages of a book that contained one target symbol and three foils. Participants were instructed to find the symbol that represented the target word. Results from this study found PCS symbols and Picsyms to be more transparent than Blissymbols for nouns, verbs and descriptors. Further, PCS and Picsyms were similarly transparent for nouns, and PCS symbols were more transparent than Picsyms and Blissymbols for verbs and descriptors. Overall, PCS symbols appeared to be the most transparent and the easiest to learn. The caveat of this study is that it examined only commercially available symbol sets; however, there is little research to date on how children with autism depict early developing concepts.

Symbol Use in Individuals with Disabilities

Many speech-language pathologists and other professionals use commercially available symbols (such as PCS) for a variety of communicative and educational purposes. As such, it is important to be certain that these symbols are able to be understood by individuals with disabilities. Barton, Sevcik, and Romski (2006) assessed the ability of preschool children to use and understand both arbitrary and relatively
transparent symbols. These children were able to establish emergent symbol-referent relationships, with both Blissymbols and lexigrams. It can be argued, however, that Blissymbols, the relatively transparent symbol set used in this study may be considered ambiguous, and increasing transparency may be beneficial to supporting positive outcomes. This study demonstrates the fact that children are able to learn arbitrary relationships between concepts and symbols. The question remains however, as to how to make symbols most easily understood in order to decrease instruction time and maximize the therapeutic use of symbols.

A key factor in how easy or difficult a symbol is to understand is based on its transparency and translucency. The term transparency refers to how immediately understandable a symbol is. The term translucency refers to how quickly a person can learn a symbol. Research has examined the transparency of commercially available symbol sets. Mizuko and Reichle (1989) investigated the transparency of Blissymbols, PCS and Picsyms with adults with intellectual impairments. Participants were divided into three groups, and each group was shown a different symbol set. Each participant was shown a field of four symbols and given a verbal label, then asked to choose a symbol that best represented the label. Their results indicated that both PCS and Picsyms were significantly more transparent than Blissymbols, and that PCS and Picsyms were easier to learn. Following this trial, an additional trial showed the participants the same stimuli after they had been exposed to symbols and their labels to assess immediate learning ability. Results for the learning portion indicated similar trends. PCS and Picsyms were similarly translucent and Blissymbols were significantly less translucent than the former two systems. While there are advantages to learning a system such as Blissymbols,
namely because the symbols can be combined to form novel symbols of varying complexities, children with autism may benefit more from systems that are more transparent and translucent. Beginning communicators need to begin using AAC at a level at which they can be successful, and in which the demands placed on them to learn the system are minimal to avoid frustration and possible rejection of a system due to operational difficulty. To this end, finding symbols that are maximally transparent, and require minimal instruction to learn for children with autism would be ideal.

Using symbols in order to augment communication can be a valuable tool for children with language disabilities. Not only are symbols used to augment the communication of those who need AAC, symbols can also be helpful in augmenting spoken input for children with disabilities (Romski et al., 2010). This work by Romski and colleagues (2010) compared two types of augmented interventions (input and output) and a spoken communication intervention. Results of this study indicated that both the input and output groups who had access to augmented communication showed significant gains in spoken language as well as vocabulary size. While this study did not include children with autism, it may be possible to extend the ideas behind the work of Romski et al. (2010) to this population with further research.

*Symbolic Development in Children with ASD*

One application for symbols is their use during therapy and educational activities for children with autism spectrum disorders (ASD). Due to noted communication deficits in children with ASD (American Psychiatric Association, 2000), communication aides such as AAC systems and visual supports are frequently used during education and intervention with this population. Children with ASD have pragmatic deficits and delays
in the ability to communicate their intentions (Landa, 2000). Presupposition skills, which are required for successful conversation, are also noted to be a difficulty (Landa, 2000). Semantic deficits are also a key area of concern for children with ASD. For example, Hermelin and O’Connor (1970) demonstrated that children with ASD rarely utilized meaning when recalling lists of words. When they were asked to recall a list containing colors and numbers, typically developing children grouped colors and numbers together, whereas children with ASD did not use this semantic strategy. A study by Simmons and Baltaxe (1975) examined language samples from children with ASD, and found that the most frequent errors exhibited in this group were errors of semantic constraints. While some children with ASD may have extremely large vocabularies (Ricks & Wing, 1976), semantic difficulties may manifest themselves in higher-level semantic tasks, which may be related to conceptualization and cognition skills (Tager-Flusberg, 1981). Those with high-functioning autism and Asperger syndrome often exhibit difficulty understanding nonliteral meanings, figurative language and word play (Happé, 1994). Individuals with ASD also have significant difficulty with abstract terms (Eskes, Bryson & McCormick, 1990), and deictic words (i.e., words whose meanings change based on speaker or time such as “now” or “I”; Tager-Flusberg, Lord & Paul, 2005). They may also have difficulty understanding social and emotional terms (Eskes et al., 1990).

As such, line drawings, photographs, symbols, and other visual stimuli are often used to help improve language expression and language comprehension. It is important to note, however, that research has shown that individuals with ASD perceive people, objects and their environment differently than typically developing children (Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Riby & Hancock, 2009). Children with autism were
found to attend to faces of both people and cartoons in movies for less time than is typical for individuals without autism (Riby & Hancock, 2009). Further, they attend to different details of a visual scene than individuals without disabilities (Klin et al., 2002). For example, Klin and colleagues found that individuals without disabilities frequently attend to the eyes of people in videos as opposed to individuals with autism who frequently attended to the mouths of people. There are clear differences in what individuals with autism attend to in their visual environment. Commercially available symbol sets do not account for this difference in visual preferences, and relatively little research has been done to examine how these preferences affect symbolic understanding in children with autism.

Because the perception of real-world objects and people by children with autism may be distinctly different from typically developing children, it would follow that their understanding of pictures and symbols may differ as well. Preissler (2008) taught children with autism a novel word paired with a line drawing of an unfamiliar object as reported by parents. When given the choice between the line drawing and the real-world object, children with autism were more likely to choose the line drawing than language-matched typically developing peers. This finding persisted even in children who used the Picture Exchange Communication System (PECS) and were well-acquainted with using symbols for communication. These findings indicate that children with autism do not perceive pictures and symbols in the same way as typically developing children. They experience difficulty in understanding the representative nature of pictures and how they relate to real-world referents.
One possible reason for the discrepancy is that the representative nature of pictures and symbols may differ for children with autism. Children with autism are frequently taught picture-object relationships (e.g., when using PECS), but it may be the case that the use of these symbols for communication may be centered around arbitrary relationships based on conditioning, and that children with ASD may not understand the representative nature of the symbols. Awareness of what is easiest for children with autism to understand and learn could help speech-language pathologists, teachers, parents and others select or construct more effective symbols for children with ASD. If symbol sets are constructed based on what is most understandable to children with ASD, a more transparent relationship between symbol and object can be formed, leading to greater outcomes using symbols for therapy and communication purposes, such as in PECS and other AAC systems.

While typically developing children are able to better understand drawings when they can infer the intentions of the artist, children with autism often have difficulty with this skill. When shown a drawing, children with autism inferred the subject of the drawing by monitoring the eye gaze of the artist less often than typically developing peers (Allen, 2009). Allen (2009) told children that an adult in the room was painting a picture of one of the objects out of an array, and that the child was to tell experimenters which object. The actual painting was ambiguous and children were required to infer the subject of the painting. Typically developing children used social cues, namely monitoring the gaze of the painter, to infer the subject of the painting. On the other hand, children with autism performed no better than chance on this task, implying that they were not employing gaze-monitoring to help them infer the subject of the painting. This
finding stands in contrast to a relatively equivalent accuracy of naming the subject of the
drawing when they were the artists as compared to typically developing peers (Allen,
2009). In this portion of the study, children with autism were able to recall their own
intentions from their paintings (Allen, 2009). The findings of this study bring about
questions regarding the social understanding of children with autism. In order to infer an
artist’s intention, a child must have the ability to understand the intentionality and mental
states of others as separate from their own. This skill, called theory of mind, is one that is
typically considered a deficit in children with autism (Williams & Happe, 2010).

Understanding intentionality of others’ drawings may be a relative weakness for
children with autism; however, general drawing skills tend to be similar to their mental
age-matched peers. Charman and Baron-Cohen (1993) found that children with autism
with a mental age of approximately 5 years old experience the same mental shift to visual
realism in their drawings as typically developing five-year-olds. A total of 17 children
with autism (M age 13:6) with a verbal age of approximately 5 years were compared to
16 typically developing children (M age 5:4). These children were asked to draw various
pictures of objects which included partially covered portions. At approximately 5 years
old, typically developing children will shift from drawing the portions that are covered to
omitting them because the children know they are to draw only what they see and repress
portions that they cannot see. Charman and Baron-Cohen (1993) showed that children
with autism with a verbal age of 5 years experience the same shift in drawing abilities.

Previous studies have suggested a framework for augmenting communication for
children with ASD. Visual supports can be used for a variety of functions and across
many contexts. These primary functions include language expression, language
comprehension, and organization (Shane & Weiss-Kapp, 2008). Visual supports can serve to augment communication in all of these ways, and further, can be utilized in a number of communicative functions, such as protests, transitions, requests, comments, questions, and social pragmatics (Shane, O’Brien, & Sorce, 2009). This framework may be helpful in supplementing communication for individuals with ASD. However, more research is needed to investigate symbolic understanding in children with ASD and how clinicians can best construct and utilize symbols in the clinical setting.

Children who use AAC need access not only to concrete, easily depicted symbols, but also to abstract linguistic concepts, just as their typically developing peers have access to through spoken language. In contrast, AAC users need vocabulary to be programmed or represented in some way in order to have access. As such, language development and vocabulary acquisition is often delayed (Cress & Marvin, 2003). AAC users need to have the ability to use language in a manner similar to their typically developing peers, including word classes such as verbs, adjectives and question words (Beukelman & Mirenda, 1998). These words are often highly abstract and can be represented in a variety of ways. Due to the difficulty in representing highly abstract concepts, but the need to include them in symbol sets, current symbol systems often use depictions that are difficult for young children to learn (Light & Drager 2002, 2007). By increasing the ability for children to understand symbols by capitalizing on easily understandable images, professionals can increase the ease of learning and using AAC systems.
Development of Drawing in Typically Developing Children

In addition to examining the development of symbolic understanding, it is also important to understand how children draw pictures. Children have been found to use functional and physical properties in their drawings to represent concrete objects (McGregor, Friedman, Reilly & Newman, 2002). Twenty-five typically developing children (M age = 5;5) were instructed to draw, define and name 20 words such as anchor, kangaroo and umbrella. Overall, semantic naming errors, particularly taxonomic errors, were most common during the naming task. In their drawings, children’s drawings were rated on accuracy. Items that were named accurately were rated significantly higher for their drawing accuracy. Further, children tended to use functional and physical properties in order to depict target words. These words, however, were all concrete objects. More research is needed to determine how children depict early emerging concepts that are more abstract in nature.

Ring (2001) summarized the symbolic progression of drawing for children from 1 through 3 years old. At around 1 year old, children have no intentional symbolism in their drawings. They manipulate language, their own movements and art materials, and they explore the physical and visual properties of materials. Between 1 and 2 years, children derive meaning from the gestures that they make, as opposed to what they actually drew (Ring, 2001). By age 3, children can discuss their drawings with others and tailor their conversations to partners’ interests. They can also draw similarities between their drawings and physical features of what they drew (Ring, 2001). Luquet (1913, as cited in Strommen, 1988) described children’s drawing skills in a stage progression. He depicted the ages of 5 to 9 years old as being that of intellectual realism, where children’s
drawings reflect the child’s mental conceptualization of the subject. As children approach age 9, they shift to a realism stage in which their drawings are based on their visual perceptions instead of their mental conceptions. After age 12, Luquet (as cited in Strommen, 1988) proposed that language is the prevailing modality of expression, less emphasis should be placed on drawing’s value for diagnostic purposes. Others have found that as children age, they are able to include more and more relevant details in their drawings and draw more complex representational drawings (Cherney, Seiwert, Dickey, & Flichtbeil, 2006).

With regard to the social context of drawings, several studies have shown that typically developing children show sensitivity to their own intentions during drawing as well as to the ability of others to understand their drawings. Bloom and Markson (1998) asked 3- to 4-year-old typically developing children to draw pictures of a balloon, a lollipop, themselves, and the researcher. Not surprisingly, the balloon and lollipop, and both of the drawings of people, looked remarkably similar. However, when later asked to tell the difference between their drawings, children were able to correctly identify which drawing was intended to be which object, even when an adult observer could not differentiate among them. This demonstrates children’s ability to draw with intention as well as recall that intention when presented with drawings at a later time. Further, children have been shown to produce more detailed, recognizable drawings when they know they will later be shown and interpreted by adults, and when they were not effective in communicating what the child had intended (Callaghan, 1999). A total of 32 three- and four-year old children participated in a study by Callaghan and were instructed to communicate which of two toys an experimenter was to manipulate through drawing.
The experimenter then displayed confusion about ambiguous drawings. These children were asked to draw another picture to clarify which toy the experimenter should manipulate. Both 3- and 4-year-old children made more distinctions on their new drawings to clarify their intended message. Typically developing children showed an understanding of their own intentions as well as the ability to consider the mental states of others when drawing.

Drawings produced by children are often very different from those that are commercially available (e.g., Boardmaker). Light and Drager (2007) studied 50 typically developing children of various cultural backgrounds and asked them to draw 10 early emerging abstract concepts. Their drawings contained entire scenes, included the child in the drawing, and rarely used pieces or parts of objects to depict a concept. These results vary greatly from commercially available symbol sets, which often use isolated parts, include directional arrows and lines and show only single objects or actions instead of entire scenes. There is a need to redesign symbol sets to incorporate the way children represent abstract concepts to facilitate symbolic understanding.

Individual differences also play a role in the representation of a concept, particularly when considering how to make a “universal” symbol set. Each person has a different mental representation of given vocabulary, particularly abstract concepts such as on and more. These concepts are difficult to depict visually, because they appear in a variety of contexts (e.g., turn on the light; put on your hat; the cat is on the bed). Therefore, representations of concepts differ across individuals, and may, in fact, vary greatly. However, understanding of general patterns and finding symbols that are easy to learn or understand is important to document in order to improve overall transparency of
symbols. By examining how children represent concepts, researchers can help to identify salient features that may improve the construction of symbol sets.

Summary of Previous Research

In an effort to consolidate the research that was mentioned above, a summary of the major findings follows. First and foremost, the definition of a symbol as being anything that represents something other than itself (DeLoache, 2004) is integral to research regarding symbolic understanding. Further, according to work by DeLoache (2005), it is important when examining symbol use and symbolic understanding to consider all facets of the interaction, including the symbol itself, its relationship with the referent, the symbol user’s background knowledge, and the environment surrounding the interaction.

Communication deficits related to ASD are well recognized (Happé, 1994, Tager-Flusberg, Paul & Lord, 2005) as is the fact that these language difficulties often result in the need for AAC to help improve communication of these individuals. When discussing AAC use in those with ASD, there is a need for research regarding the most appropriate symbolic representation for this group of users (Beukelman & Mirenda, 1998).

Research regarding typically developing children has demonstrated that children gradually learn symbol-referent relationships (Callaghan, 2000; DeLoache & Burns, 1994) and that the more closely a symbol represents its referent, the more easily understandable the symbol-referent relationship is (Ganea & DeLoache, 2008; Simcock & DeLoache, 2006). However, it is well documented that there are differences regarding symbolic understanding for children with ASD (Preissler, 2008), as well as differences in visual perception (Klin et al., 2002; Riby & Hancock, 2009). Previous research has
demonstrated that when typically developing children draw abstract concepts, they frequently include entire scenes, many colors, and themselves in their drawings. However, due to the noted differences between typically developing children and children with ASD, it cannot be assumed that findings from typically developing children translate well for children with ASD. The present study seeks to add insight into the symbolic understanding of children with ASD and into the relationship of symbolic understanding and social communication impairments.

Present Study

The goal of the present study was to examine how children with autism and social communication impairments visually represent certain early emerging abstract concepts and infer potential modalities to symbol sets for children with ASD who also require AAC. In order to improve the use of symbols for communication aides and visual supports, the symbols used in these systems need to be as understandable as possible for the user. Determining what is most easily understandable for children with autism in regards to these symbols and including these features in symbol systems can improve understanding of symbol-referent relationships and increasing their effectiveness as communication aides and supports. Typically developing children learn the relationships between symbols and their referents more easily for iconic/transparent symbols than less transparent symbols (Ganea et al., 2008). Using symbols that are more easily learned decreases demands necessary to use those symbols for functional communication. There has been little research on how children with ASD and other social communication difficulties, who frequently use symbols for communication and visual supports, understand basic concepts and how they would depict them. Shane (2006) concluded
through literature review and clinical observation that visual supports across many contexts (expressive, receptive, and organizational) are frequently constructed with little consideration for matching the level of representation with the individual’s abilities. A more in-depth analysis regarding transparency of symbols would help to inform clinical decision-making. Further, there is little research regarding what information children with autism take away from currently available symbol sets. This study attempts to evaluate both of these concerns through the drawing and identification tasks. It is important to note that this study is examining only two-dimensional line drawings as symbols, and is not including three-dimensional and photographic representations. Two-dimensional representations were chosen because these symbols are more frequently used due to their portability and ease of access for professionals.

This study aimed to examine the following research questions: How do children with social communication difficulties, including ASD: a) pictorially represent and describe early emerging concepts such as “on” and “who”; b) identify Picture Communication Symbols (PCS) typically used in many AAC systems; and c) recall what target concepts they drew after a short delay? Researchers anticipated some individual differences in children’s depictions and descriptions of targeted concepts, considering the heterogeneous population of individuals with social communication difficulties. However, certain thematic commonalities relative to the various strengths and weaknesses observed in children with ASD were also anticipated. The findings of previous studies with typically developing children and symbolic representation were also expected to overlap only partially with findings from children with social communication difficulties. Further, the transparency of certain abstract PCS was
investigated, because it was expected that children would experience difficulty in identifying the symbols.
CHAPTER 2: METHOD

Participants

Ten children with social communication difficulties were recruited by advertisement fliers at schools, child care centers, community boards (e.g., libraries and community centers), and through summer camps for children with autism in regions of Ohio, including Athens, Cincinnati, Cleveland and Dayton. The ratio of male to female participants was 5:1 which is similar to the 4:1 male to female incidence of autism.

Demographic Information

The group of 10 participants was comprised of 8 males and 2 females ($M \text{ age} = 7.68 \text{ years}; \text{range} = 4 \text{ years 9 months to 11 years 2 months}$). Nine children had a diagnosis of ASD, PDD-NOS, or Asperger syndrome. One child (participant 10) was suspected of having Asperger syndrome, but this diagnosis was not pursued by his parents or by his school. However, his social interaction difference index (SIDI) on the Children’s Communication Checklist-2 (CCC-2; Bishop, 2003) was -12, which is suggestive of a communication profile similar to that of ASD. Further, four out of six subscales of the pragmatics portion of the CCC-2 were below normal limits (initiation, nonverbal communication, social relations and interests), indicating social communication skills which may be impaired. All children had some form of social communication difficulties as reported by their parents. All background information including diagnosis, services received and history with AAC was reported by the parent who attended the session with the participant. Six of the participants attended school in a general education classroom with accommodations (aide, pull-out sessions), one participant attended an integrated preschool classroom with both typical students and
students receiving special education services; one child was in a special education classroom; and, two participants were homeschooled. Two participants had at least one parent who completed high school and/or a technical or AA degree. The other eight participants had at least one parent who completed at least college degree.

The CCC-2 was administered to assess participants’ language and pragmatics skills. This instrument is a parental report measure, and care must be taken to analyze the results with the child-caregiver relationship in mind. See Table 1 for participant demographic information including composite CCC-2 scores. Table 2 contains the CCC-2 domain scaled scores for each participant. Scores bolded in Table 2 indicate scores falling below normal limits. Note that the speech and syntax subscales are a relative strength for participants; however, semantics as well as many of the pragmatic skills are a weakness for many of the children in this sample.

**Inclusionary Criteria**

Parents of prospective participants called the lab of the investigators and completed a phone screen to determine eligibility. All participants met the following criteria: a) Age: All children were 4-12 years old with social communication difficulties as per parent report. The ages of participants to be included were chosen based on the requirement for children to talk about their drawings. Children with ASD younger than 4 years old may not have the language or fine motor skills necessary to draw and discuss their pictures. Additionally, while 12-year olds who are able to communicate rationale behind their drawings do not necessarily represent “beginning communicators” who usually use AAC systems, they do represent children with autism who perceive the world differently than typically developing children (Klin et al., 2002). b) Fine motor skills: All
participants were able to generate original drawings as reported by parents/caregivers during a screening measure prior to participation. c) Verbal Ability: Participants were able to talk about their drawings, as reported by parents/caregivers in the screening. 

*Exclusionary Criteria*

Participants were excluded from participating if they a) had significant, uncorrected hearing or vision problems, or b) were currently using a picture system (i.e., PECS) to communicate, in order to control for their current understanding of symbol-referent relationships. However, symbols are frequently used in classrooms and therapy settings as a means of behavior modification and visual supports. These symbols are also used in classrooms for typically developing children. As such, prior exposure to symbols in this modality was not grounds for exclusion from the study. Because children who currently use PECS have been shown to be no more likely to understand novel symbol-referent relationships (Preissler, 2008), exposure to symbols in the home or classroom was not an exclusionary criteria for this study given that the child was not using these symbols as his or her primary means of communication.
Table 1

*Demographic Information of Participants*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Services</th>
<th>AAC history</th>
<th>CCC-2 Composite</th>
<th>CCC-2 SIDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4;9</td>
<td>M</td>
<td>Asperger’s</td>
<td>Speech: peer group 3x/week</td>
<td>None</td>
<td>90</td>
<td>-23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PT/OT: Fine and gross motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4;11</td>
<td>M</td>
<td>Autism</td>
<td>Speech: Delayed onset of vocabulary</td>
<td>None</td>
<td>89</td>
<td>-8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PT/OT: Delayed milestones fine and gross motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4;11</td>
<td>M</td>
<td>Autism</td>
<td>Speech: speech delay</td>
<td>None</td>
<td>75</td>
<td>-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PT: Gross motor delay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ABA: 20+ hrs/week</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5;6</td>
<td>M</td>
<td>Autism</td>
<td>Speech: Speech/language therapy 1x/week</td>
<td>None</td>
<td>76</td>
<td>-11</td>
</tr>
<tr>
<td>5</td>
<td>6;5</td>
<td>M</td>
<td>PDD-NOS; Sensory processing disorder</td>
<td>Speech: Delays related to sensory processing disorder</td>
<td>Uses visual “timeline” at school</td>
<td>75</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OT: Targeting sensory processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8;6</td>
<td>M</td>
<td>Asperger’s; ADHD; Talented and Gifted</td>
<td>Speech: Social/behavioral targets</td>
<td>None</td>
<td>78</td>
<td>-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Counseling: Social and behavioral objectives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>9;2</td>
<td>M</td>
<td>Asperger’s/PDD-NOS; ADHD; Gifted</td>
<td>OT: Sensory targets</td>
<td>None</td>
<td>93</td>
<td>-22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tutor: Spelling/writing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Note

Children’s Communication Checklist-2 (CCC-2) Composite scores: $M = 100$, $SD = +/- 15$; CCC-2 Social Interaction Difference Index (SIDI) scores: -11 or lower indicates a communicative profile of ASD; 11 or greater is indicative of specific language disorder. PT = Physical Therapy, OT = Occupational Therapy.

<table>
<thead>
<tr>
<th>#</th>
<th>Age</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Intervention Details</th>
<th>Score</th>
<th>SIDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>10;2</td>
<td>F</td>
<td>Asperger’s</td>
<td>Counseling: Anxiety and sensory targets; Social group next school year; Preschool: used visual supports for familiar routines and emotion pictures; some sign language</td>
<td>68</td>
<td>-13</td>
</tr>
<tr>
<td>9</td>
<td>11;2</td>
<td>F</td>
<td>Asperger’s</td>
<td>One-on-one tutoring for all academics; OT: Ehlers-Danlos syndrome-fine motor skills; fatigue</td>
<td>None</td>
<td>67</td>
</tr>
<tr>
<td>10</td>
<td>11;2</td>
<td>M</td>
<td>Suspected Asperger’s; diagnosis not pursued</td>
<td>Speech: articulation, pragmatics (e.g. conversational turn-taking); OT: writing and gait difficulties, no therapy</td>
<td>None</td>
<td>82</td>
</tr>
</tbody>
</table>
Table 2

Language and Pragmatic Scaled Domain Scores on Children’s Communication Checklist-2

<table>
<thead>
<tr>
<th>Participant</th>
<th>Language</th>
<th>Pragmatics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Speech</td>
<td>Syntax</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
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</tr>
<tr>
<td>6</td>
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<td>12</td>
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<td>8</td>
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<tr>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

*Note.* M = 10 and SD = +/-3 meaning score of 7-13 is considered within normal limits. Bolded Scores indicated below normal limits.
Procedures

Participants completed all tasks either in the research laboratory (n = 6) or in their homes (n = 4). Tasks included parent questionnaires, a drawing task and two symbol identification tasks. The entire interaction was video recorded to allow for transcription, coding, and reliability measures after the tasks were completed. The order of presentation of the drawing and identification tasks was the same for all participants, as exposure to symbols in the naming task prior to the drawing task may have influenced the participants’ drawings. The total time taken for the entirety of the study ranged from 23 to 102 minutes with a mean time of 46 minutes for those participants who completed all tasks. The discrepancy in range was largely due to the number and duration of breaks necessary for each participant. After participation in the study, participants were allowed to keep the kit containing crayons and markers, and families were given ten dollars as compensation.

Measures

Parent Questionnaires

After the consent/assent process, the parent/caregiver was given a set of questionnaires: a) Social, communicative and developmental history and demographic information questionnaire and b) Children’s Communication Checklist-2 (CCC-2; Bishop, 2003) in order to assess the child’s current communicative abilities. Questionnaire 1 is contained in Appendix A. The CCC-2 (Bishop, 2003) is a useful tool to identify children with language impairments (Norbury, Nash, Baird, & Bishop, 2004). It is a parent questionnaire that assesses a number of language skills across multiple
domains including syntax, semantics and coherence. Further, it assesses pragmatic skills such as initiation, context and nonverbal communication. It demonstrates a test-retest reliability coefficient of .93, and an internal coherence coefficient average of .95. This measure was used to contextualize findings from participant tasks within current language skills functioning as reported by parents.

**Drawing Task**

Prior to beginning any tasks, participants were shown a photograph schedule of the tasks they were to complete, and the experimenter reviewed the schedule with the child. Children were encouraged to ask questions at any time throughout the study, and were allowed breaks as needed.

The first task involved the participant drawing pictures of 10 targeted early emerging concepts which were primarily abstract in nature (i.e., could be depicted in more than one way or have variable meanings). These concepts, which were used in studies by Worah (2009), and Light and Drager (2007), are: *all gone, big, come, eat, more, open, up, want, what, and who* and are taken from the McArdur-Bates Communicative Development Inventory (Fenson et al., 1993). These words were chosen in an attempt to replicate the study reported by Light and Drager (2007) with children with social communication impairments. Participants were given paper and a choice of drawing utensils (nine crayons or nine markers). All participants in this study chose to use markers for this task. They were then instructed by the researcher that he/she will be drawing pictures of 10 different words, one at a time. The participants were not explicitly told they could use all the colors, but they had ample access to drawing utensils at all
times. The experimenter told the participant “draw a picture of what the word ____ means.” Participants did not complete a trial drawing with the experimenter in an attempt to reduce contamination of subsequent drawings. Concepts were presented in a random order to control for order effects. There was a 10-minute time limit for each drawing. Once 5 minutes elapsed, a timer was used to show the child the remaining time left. If the child appeared to be finished drawing but continued to color on top of his or her drawing, the experimenter prompted the participant to finish that picture.

If the participant was reluctant to draw or was drawing very little, general prompts were given to encourage drawing, such as “There are no right or wrong answers, just try your best, then we can talk about your drawing later,” or “There is still a lot of white space, is there anything else you want to draw?” Prompts were general in nature in an attempt to avoid leading the participant to draw concepts in a particular way. If the participant was having difficulty identifying how to draw a concept, the experimenter was able to prompt them using phrases such as “think of a time when you heard or said the word _____. Draw a picture of what that meant.” See Appendix B for more specific instructions regarding prompts. After the participant had completed each drawing, the experimenter asked a series of questions to elicit an explanation of what the drawing was and why it represented the concept. Prompts were, again, general in order to avoid leading the discussion in a direction unintended by the participant. Discussion prompts included “tell me about your picture,” “what is this?,” “who is this?,” and “why is this a picture of ____ (concept) ____?” as applicable for each picture. Following discussion of each picture, a new piece of paper was given for each concept so that previous drawings did
not influence new ones. This task lasted approximately 1-2 hours, depending upon how long the child spent drawing each picture and discussing with the experimenter.

**Identification of PCS Task**

Following completion of the drawing task, each child was asked to verbally assign a name to 20 individual symbols. Ten of the concepts were the same as those used on the drawing task in order to allow for future comparison of children’s drawings to their responses; the other ten were from the McArthur-Bates Communicative Development Index (*help, clean up, on, get, go, play, loud, next, first, goodbye*). These concepts were chosen because they are common words for beginning communicators and may often be targets for speech and language therapy. The experimenter asked general questions such as “what do you think this is a picture of?” Each picture was a black and white Picture Communication Symbols (PCS) line drawing on an 8½” x 11” piece of white paper. For the symbols used, see Appendix C. The examiner asked the participant to label each drawing. Two trials were completed prior to the 20 target pictures using highly concrete objects (a cat and a ball) to encourage participation and solidify understanding of the task. Participants were encouraged to attempt to answer using a general prompt such as “I know this is hard, but there is no right or wrong answer, just make your best guess.” Prompts were general so as to not influence the participants’ answers. After one prompt, if the participant continued to respond that he or she did not know the answer, then the experimenter moved on to the next item. The order of these concepts was randomized between participants. This task took approximately 5-10 minutes.
Identification of Drawings Task

Following the drawing and identification tasks, the participants were shown their own drawings in a different order than they were drawn. The child was asked which concept was intended for each drawing. The following prompt was used: “I want you to tell me what word you were trying to draw in each picture.” The participant was shown each of his or her drawings in random order, and asked to tell the examiner what the drawing represented. Again, general prompts were given to elicit responses when the participant is reluctant to answer, such as “I know this is hard, just give me your best guess.” This task was aimed at examining the ability of participants to recall their own intentions from their drawings. This task lasted approximately 5-10 minutes.

Coding

Drawing Task

The coding for the drawing task was analyzed after all subjects had completed the study. Three codes were established a priori: use of self, isolated parts, and entire scene. These codes were established before the study began based on Light and Drager (2007). Additional codes were established after participants had completed the study. These codes are discussed in the results section.

There were two exceptions to the aforementioned protocol during the drawing task. Participant 1 was missing video and transcript for the original descriptions of the first seven drawings. He did, however, describe the pictures a second time during the drawing identification and was included in analysis. Participant 3 did not complete the drawing task. He demonstrated difficulty understanding the task, and chose to repeatedly
draw numbers and letters. The primary investigator made the decision to end the drawing task after two concepts were attempted. Participant 3 was not included in the analysis of the drawing task.

The primary investigator completed the coding by watching the videotaped interaction and following the transcript of the session while examining the drawing. The primary investigator rated the presence or absence of each code for each of the 10 drawings for the 9 participants who completed this portion of the study.

In order to assess reliability, a second coder was trained on the operational definitions of the themes used and classified each drawing based on the presence or absence of the themes by examining the drawings, watching the videos and reading the transcripts. The first and second coder completed one drawing together and discussed codes as they appeared. The second coder then completed a drawing independently and was allowed to ask questions. Discrepancies between coders were discussed until the appropriate code was determined. Following this practice drawing, the second coder completed three drawings from each participant. Analysis of reliability revealed a kappa value of .891 between coders. When discrepancies arose, the first coder’s results were used.

*Identification of PCS Task*

The expressive portion of this task was coded based on the percentage of pictures identified correctly or partially correct. To earn a correct code, the participant had to say the target word either by itself (e.g., eat), or in a sentence (e.g., he’s eating mud). In order to earn a partially correct code, the participant had to label the picture in a way that had
the same meaning as the target word, but did not say the target word (e.g., “person in the front” instead of “first”). All participants completed this task. Performance on this task sought to evaluate how transparent selected abstract PCS symbols are to children with autism. An error analysis was performed in order to discuss patterns.

Reliability was assessed by a second coder coding the responses of 30% of participants (3 out of 10) using the transcript and video from the session. The first and second coder completed the scoring for one participant together and discussed answers. The second coder then completed the responses of an additional participant and was allowed to ask questions as needed. Discrepancies were discussed between coders until an agreed upon code could be determined. Following this training, the second coder completed coding for 30% of participants. Analysis of reliability revealed a kappa value of .895 between coders.

**Identification of Drawings Task**

Similar to the identification of PCS task, this task was evaluated based on the percentage of pictures the participant identified correctly. This task was different in that it used the child’s own illustrations to assess how well participants recalled their intentions from the time they created the drawing. All participants completed this task with the exception of participant 3, because he did not complete the drawing task. Partially correct answers were not coded in this task, because participants had been given explicit target words. Patterns of correct and incorrect identification were evaluated and discussed. Results from this portion evaluated the ability of children with autism to recall and identify their own intentions from their drawings.
Reliability was assessed by a second coder utilizing the videos and transcripts who coded the responses of 33.3% of participants that completed this task (3 out of 9). The first and second coders completed one participant’s responses together and discussed codes as they appeared. Following this training, the second coder completed one participant’s responses independently and was allowed to ask questions. The first and second coders then discussed any discrepancies until a code could be agreed upon. Following these steps, the second coder completed the coding for one-third of the participants. Kappa analysis revealed a value of 1.00, indicating that there were no disagreements for the identification of drawings task.
CHAPTER 3: RESULTS

Overview of Results

Results are reported according to each of the three tasks, identification of PCS, drawing, and identification of drawings. The identification of PCS task was measured based on percent accuracy. The percent correct and partially correct is reported for each participant. The drawing task contained 10 codes.

The number of colors each child used was averaged across all 10 of his or her drawings. The other nine codes were assessed based on their presence or absence in each drawing. The results reported for these codes represent the number of drawings which contained each code for each of the 10 participants. Finally, the identification of drawings task was analyzed based on the percent correct, and accuracy scores are presented for each participant in this task as well.

Drawing Task

Overview of Findings

Drawings were analyzed based on the presence of themes, such as use of color, use of self in picture and use of entire scenes. These themes emerged based on common features among participants’ drawings. Codes established a priori were listed in the method section. Seven additional codes emerged after participants had completed the study and investigators examined themes within the drawings. Those codes were the number of colors used, the use of symbols, the use of words, the use of high interest subjects, the use of people and the use of animals. All codes and their descriptions are listed in table 3 with descriptions of each code. It should be noted that high interest
subjects overlapped with other codes, due to the fact that high interest subjects were
generally either objects or people, and so these items were double coded. See Appendix
D for complete coding manual

Table 3

*Codes and Descriptions*

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of colors</td>
<td>How many colors were used in each picture</td>
</tr>
<tr>
<td>Entire scene</td>
<td>Three or more objects or people <em>related</em> together in a scene.</td>
</tr>
<tr>
<td>Conventional symbols and notations</td>
<td>Something representative of an idea; e.g., a “?”; a thought bubble, motion lines</td>
</tr>
<tr>
<td>Self</td>
<td>Child includes himself/herself in the picture</td>
</tr>
<tr>
<td>Isolated parts</td>
<td>Includes just pieces of an object to represent the whole object (NOT a piece of a toy because the toy is broken); e.g., a hand that implies there is a person.</td>
</tr>
<tr>
<td>High interest subjects</td>
<td>Includes the same themes more than twice; e.g., many pictures have robots</td>
</tr>
<tr>
<td>People</td>
<td>Any people, robots or monsters</td>
</tr>
<tr>
<td>Animals</td>
<td>Any animals or creatures</td>
</tr>
<tr>
<td>Inanimate objects</td>
<td>Any objects that are not alive, symbols do not count as objects; Do not count clothing/adornments on objects unless they are an important part of the meaning. e.g., a cape for “up”; A group of undetermined amount is 1 object; e.g., a plate of cookies: the plate is 1 object, the cookies are one object</td>
</tr>
<tr>
<td>Words</td>
<td>Written words, attempts at writing words numbers</td>
</tr>
</tbody>
</table>
Nine out of 10 participants completed this task; participant 3 was excluded from analysis. During the drawing task, prompts were allowed to encourage participants to draw. These prompts were rarely required. When prompts were utilized, such as “Is there anything else you would like to draw? There is a lot of white space,” participants frequently said they were done and did not include any more details. The prompt “is there anything else you want to add?” was used an average of 4.2 times per participant. This prompt was employed when children appeared to be done with their drawing but did not indicate completion to the investigator. Other prompts were used only one time each, as needed when participants were reluctant to start drawing or were distracted (see Appendix B).

While there was a wide variety of individual differences in children’s drawing and language skills, some general results emerged for the drawing task. Themes were determined by examining all drawings and noting basic observations. Use of color was noted initially, as this was a theme that emerged in the drawings of many participants. Since the use of people and objects was of interest based on previous research, drawings were also analyzed with regard to these characteristics. Many participants used only a small number of colors to illustrate their concepts, very few children chose to include themselves in their drawings, and approximately one-third of all participants used subjects which were of high interest to them (e.g., trains, robots) to depict given concepts (see Table 4 for frequency of attributes represented by the set of drawings of each participant). Further, some concepts seemed to lend themselves to particular attributes
such as the use of people or symbols. See Table 5 for the frequency of codes organized by concept.

Table 4

*Frequencies of All Codes by Participant Number*

<table>
<thead>
<tr>
<th></th>
<th>Participant Number</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entire Scene</td>
<td>0 3 * 6 6 5 8 10 2 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of People</td>
<td>0 0 * 1 8 9 9 8 6 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Self</td>
<td>0 0 * 0 0 0 1 6 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolated Parts</td>
<td>0 0 * 0 2 1 0 0 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Objects</td>
<td>7 10 * 9 9 7 9 8 7 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Animals</td>
<td>0 0 * 0 1 1 1 5 1 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Interest Subjects</td>
<td>0 6 * 7 0 0 4 0 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Symbols</td>
<td>0 0 * 0 0 6 2 9 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Words</td>
<td>0 1 * 0 1 6 0 8 4 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Colors</td>
<td>1.2 2.4 * 1.4 3.1 1.0 1.4 6.1 1.5 1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Participant 3 did not complete this task.
Table 5

*Frequency of Codes Organized by Concept*

<table>
<thead>
<tr>
<th></th>
<th>All gone</th>
<th>Big</th>
<th>Come</th>
<th>Eat</th>
<th>More</th>
<th>Open</th>
<th>Up</th>
<th>Want</th>
<th>What</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire scene</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Use of people</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Use of self</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Isolated parts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Use of objects</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Use of animals</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>High interest subjects</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Use of symbols</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Use of words</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><em>M</em> number of Colors</td>
<td>1.89</td>
<td>2.22</td>
<td>1.56</td>
<td>2.78</td>
<td>2.67</td>
<td>2.00</td>
<td>2.78</td>
<td>1.33</td>
<td>1.78</td>
<td>2.33</td>
</tr>
</tbody>
</table>

The following sections will delve more deeply into results that were the most robust, organized by either attribute or by attribute and concept.
Thematic Analysis

Entire Scene

Previous research has indicated that typically developing children frequently choose to depict concepts using entire scenes (Light & Drager, 2007), and so this code was included as a means of comparison. An entire scene required the participant to draw at least three items which were related in some way. The use of an entire scene ranged from zero to 10 out of 10 possible drawings. Participant 1 did not include any scenes, whereas participant 8 drew an entire scene in each of her drawings.

When analyzed by concept, the use of an entire scene was more prevalent in certain concepts. Five or more participants illustrated the concepts of “eat,” “more,” and “up” using entire scenes. Seven participants chose to illustrate “eat” in this way. These illustrations frequently included details such as tables, utensils, multiple food items and people (see Figure 1). Many of the participants seemed most readily able to complete this concept with a significant amount of details.
Use of People

Because social communication is a particularly important facet of ASD, the use of people in drawings was of interest to the researchers. The use of people ranged from zero to nine pictures out of ten across participants (see Figure 2). Two participants (1 and 2) did not include any people in their drawings. When analyzed by concept, five or more participants used people to depict “come,” “eat,” “want,” “what” and “who.” Six participants used people illustrate “come,” “eat,” “what,” and “who.” Five participants illustrated “want” using people. The quantity of people included varied from one to many, depending on the participant. Many children illustrated “eat” using only one person eating food. In contrast, participant 7 illustrated “eat” by drawing an animal at the zoo eating meat and included many people surrounding the pen watching. All participants
were asked “who is this?” any time he or she indicated there was a person in the drawing. For nearly all participants in nearly all of their pictures, the people were “just people” and rarely were given a name or context beyond the drawing. The exception was participant 8, who often included personally relevant details about the people in her drawings. The majority of children, however, did not indicate who the people were in their drawings.

Figure 2. Use of people to depict the concept “come.”

Use of Self

Children rarely used images of themselves in their drawings (see Figure 3). In fact, only two children (participants 7 and 8) chose to depict concepts in a way that included themselves. Participant 7 only did so in one drawing, whereas participant 8 used
herself in six drawings. The drawings by participant 8 contained more detail and more personally relevant information than many other participants in the study. Her drawings also frequently included her mother, and parts of their home, which highly contrasted the majority of other participants (see Figure 4). All seven of the other participants did not use themselves in their drawings.

**Figure 3.** Participants did not use themselves in drawing of “open.”

**Figure 4.** Participant 8 using herself to depict “more.”
Use of Isolated Parts

While isolated parts such as hands or a head are used frequently in many PCS, Light and Drager (2007) found that typically developing children rarely used this technique to illustrate concepts. Similarly, children with social communication impairments rarely chose to depict abstract concepts using isolated parts (see Figure 5). The number of drawings each participant used isolated parts in ranged from zero to two, and only two participants used any isolated parts at all. It may be the case that the use of isolated parts is infrequent in both typically developing and social communication impaired populations.

Figure 5. Lack of use of isolated parts to depict the concept “want.”
Use of Objects

This code included any inanimate objects not specified by “people” or “animal” codes. Overall, objects were used by all participants in drawings, ranging from seven to ten drawings. Objects that participants included ranged from food to balance beams to machines (see Figure 6). When analyzed by concept, the number of participants who used objects ranged from five to nine (out of 9 total children) for each of the ten concepts. In other words, all concepts were depicted using objects by at least five participants. This was the most frequently used code and participants used objects for a variety of purposes.

*Figure 6. Use of objects to depict “all gone.”*
Use of Animals

The use of animals ranged from zero to five out of ten possible drawings across the nine participants. Children in this study used animals in a variety of ways (see Figure 7). For example, participant 10 drew a dog in his depiction of the concept “want” to illustrate pets because “pets are something you want, not something you need.” Participant 8 illustrated the concept “up” using birds to show that they were flying upwards. Similar to the use of people, even though there were animals in children’s drawings, the animals were not personally relevant. These children did not draw pictures of their pets or animals they knew, but rather “just a dog” (participant 10).

Figure 7. Participants’ use of animals.

Use of High Interest Subjects

The use of high interest subjects was coded based on whether a subject was used in at least two drawings. These high interest subjects had been mentioned by the parents of the participants to be of particular interest to the child during phone interviews; however, this was not an explicit question asked. Use of high interest subjects ranged
from zero to seven out of 10 possible drawings. Three out of nine participants used high interest subjects (see Figure 8).

Participants using high interest subjects varied in their ability to utilize these subjects as an effective means of depicting concepts. Participant 7 was able to use his high interest in robots to illustrate concepts such as “big,” and “what.” In order to draw “big,” participant 7 drew a very large robot in comparison to smaller objects on the page. He was able to explain the relationship in size amongst the pieces in the drawing. To depict “what,” the participant drew a robot holding and examining a person, trying to figure out what it was. Participant 7 explained the use of the robot in the picture as follows: Child: “so there is a robot. Got him [the man] and he doesn’t understand him.” Experimenter (pointing at thought bubble with a question mark): What’s this?” Child: “That he’s thinking.”

Similarly, participant 2 also used many high interest subjects. He utilized a pattern of machines which performed different actions. Particularly for concepts which were more difficult for him to depict, he was able to draw a machine to attempt to explain the concept. For example, for the concept “more,” he drew a machine which made more of things. In this way, he was able to use high interest subjects to assist him in explaining difficult concepts.

Conversely, participant 4 used many trains throughout his drawings, however the use of these high interest subjects was less helpful for this participant in depicting concepts. This participant used a train to depict “up” by drawing a train going up a mountain. However, once he began drawing the train, he continued focusing on the train
motif and seemed to lose the ability to focus on the stimuli word. This effect was variable throughout drawings, and the length of the study may have played a role in his difficulty staying on task. His use of high interest subjects may likely have detracted from his ability to conceptualize target words.

Figure 8. Use of high interest subjects including trains, robots, and machines.

Use of Conventional Symbols and Notations

The use of symbols was categorized as any item in a drawing that was representative—motion lines or a question mark, for example. Use of symbols ranged from zero to nine drawings. Older participants (6-10) used symbols much more
frequently (see Figure 9) than younger participants (1, 2, 4, and 5) who did not use any symbols in their drawings. It should also be noted that a similar pattern existed in the use of words in drawings.

Participant 10 frequently used symbols in his drawings, including motion lines, question marks and arrows. He used motion lines to depict the target “come.” He drew a person moving from one point to another, and implied movement through lines. He utilized a question mark in multiple drawings to illustrate the wh-question words (“what” and “who”). Finally, he used an arrow by itself to depict the concept of “up.”

The use of symbols was also analyzed by concept. Five participants depicted “what” using a symbol, namely, that symbol was a question mark. This concept was often illustrated with people who had questions (e.g., about what a creature was). Participant 10 illustrated “what” by drawing a person, a bird and a monster, and placing a question mark next to the person to depict that the person did not understand what the monster was (see Figure 9). Other participants chose to use question marks in a similar manner.
Use of Words

Similar to the patterns noted in the use of conventional symbols, the use of words was more frequent in older participants than in younger ones. The use of words ranged from zero to eight pictures. Three participants (participants 1, 4 and 7) did not use any words. Most children who used words in their drawings used them to demonstrate people talking or to identify what part of the picture was doing (e.g., participant 6 labeled arrows in his drawings with “to” to indicate the arrow was changing something) (see Figure 10).
Participants were given a choice between nine crayons or nine markers. All participants chose markers. The mean number of colors used across all 10 drawings was assessed. The mean number of colors ranged from 1 to 6.1. Six out of nine participants used an average of one to two colors on their drawings (see Figure 11). Many participants used more than one color throughout their ten drawings, they frequently only used one or two colors in each drawing.

Participant 6 exemplified the use of limited colors across all of his drawings. While he used two different colors throughout the session (blue and red) he used red in...
nine of his ten drawings, and each drawing contained only one color. Using only one color, he was able to draw thoughtful and concise depictions of concepts, and was able to easily describe each drawing as well as his rationale for drawing each one.

![Figure 11](image)

*Figure 11. Use of one color across four participants.*

There were, however, participants who used more than one color. For example, participant 8 used an average of 6.1 colors across her ten drawings. Her drawings were extremely detailed and included large amounts of personal information such as tablecloths (concept of “eat”) and clothes in the washing machine in her house (concept of “open”; see Figure 12). These details included using many colors to differentiate objects. It should be noted that drawing was a highly preferred activity for participant 8.
Identification of PCS Task

The symbol identification task was analyzed based on the percent accuracy and percent error for each participant. Overall, all participants demonstrated a large number of errors when identifying selected PCS. Performance on this task ranged from 0-45% for correctly identifying items and 0-25% for partial identification of items. Again, “partially correct” means responses contain the basic meaning of the picture without explicitly saying the actual target word (e.g. “putting stuff away” instead of “clean up”). Two participants (1 and 3) were unable to identify any of the PCS symbols shown. The highest percentage of accuracy was achieved by participant (8), at 45% correct and 15% partially correct. Figure 13 depicts the performance of all participants on the symbol identification task including correct and partially correct responses.

Figure 12. Participant 8’s use of many colors to depict “open.”
When examining percent correct by concept, results emerged regarding ease of identification of concepts. The concepts “eat,” “open,” “up,” “clean up,” “loud,” “first,” and “goodbye” were identified correctly or partially correct by at least 30% of participants. In fact, 80% of participants correctly identified the symbol for “eat,” and 50% of participants gave partially correct answers for “clean up.” Other than these two concepts, no other item had 50% or greater combined accuracy of correct and partially correct responses.

Identification of Drawings Task

Participants’ ability to recall the concepts they had drawn was analyzed based on the percent accuracy. This task occurred approximately 5-10 minutes following the end of the drawing task. Performance on this task ranged from 0%-100% accuracy at
identifying their own drawings. Figure 14 contains the percent accuracy of each participant for the identification of drawings task.

![Bar chart showing percent accuracy by participant number on the identification of drawings task.](chart.png)

*Figure 14. Percent accuracy by participant number on the identification of drawings task.*

Overall, there appeared to be an age threshold which determined most participants’ ability to correctly identify the concept they had attempted to draw. Participants who were older than 6 years (participants 5-10) were able to identify their own drawings with high accuracy.

Further, with the exception of participant 2, all participants who were able to correctly identify drawings, achieved an accuracy of 60% or greater. Five of those participants demonstrated 80% or higher accuracy. On the other hand, three participants (1, 3 and 4) were unable to identify the concepts illustrated in any of their drawings. These participants did not label the concept they had drawn, but instead, often described
the picture (e.g., “it’s a balance beam” instead of “want”). These descriptions were generally consistent with their descriptions in the drawing task, but did not include the target concept.
CHAPTER 4: DISCUSSION

Summary of Major Findings

Based on the abovementioned results, selected abstract PCS are difficult for children with social communication difficulties to interpret, and significant individual differences arise when children depict their own versions of symbols. However, patterns do arise when examining overarching themes among participants.

The identification task provided insight into the fact that the PCS chosen are not readily transparent, particularly for children with social communication difficulties. During the drawing task, the most robust findings indicated that children with social communication difficulties frequently used limited colors, and rarely included themselves or personally relevant information in their drawings. This did not hold true for every participant, but was true for the majority of the group. Approximately one-third of the children included high interest subjects in their drawings. These subjects included robots, trains and machines. These subjects served as both aids and potential hindrances to the participants’ ability to represent concepts on paper. These findings point to theoretical and clinical implications which will be discussed below.

Identification of PCS Task

The identification task was used to assess the transparency of 20 PCS that represent abstract concepts. Previous studies have indicated that PCS and other symbol sets are difficult for children, particularly those with social communication difficulties such as ASD, to understand and identify (Mirenda & Locke, 1989; Mizuko, 1987). The present study supported these findings. The ability to understand these symbols requires
social understanding, and executive function including theory of mind and inferencing abilities. Children with ASD have traditionally demonstrated difficulty with these skills (Hughes, 2011; Ozonoff, Pennington, & Rogers, 1991). Additionally, children’s own meanings of these abstract concepts may be distinctly different than adults’ meanings, leading to an even larger disconnect between commercially available symbol sets and those which might be more meaningful.

Among the stimuli selected for this study, concepts such as “eat,” “up,” and “more,” were more readily identified by participants and may point to more transparency in their depictions. In these symbols, participants have less to infer as opposed to other symbols which include more abstract artifacts such as motion lines or question marks. These concepts are also among children’s earliest, and most frequently used words (Beukelman, McGinnis, & Morrow, 1991).

Symbolic understanding is important in the context of literacy development (Whitehouse, Line, Watt, & Bishop, 2009). Experience with letters, words, and writing may aid some participants in understanding symbol-referent relationships. As such, young participants and those that have had limited exposure to or understanding of these tasks may be at a disadvantage for understanding these highly abstracted symbols. Consequently, individuals using AAC systems are frequently individuals who are at risk for the delayed acquisition of literacy skills (Kelford Smith, Thurston, Light, Parnes & O’Keefe, 1989; Light & McNaughton, 1993) and thus may demonstrate more difficulty at grasping the full meaning of the symbol-referent relationship.
Drawing Task

The drawing task was used as a way to investigate how children with social communication impairments depict abstract concepts. While this was a relatively small number of participants, interesting results emerged regarding performance on this task, and implications are discussed below.

Use of Colors

The majority of participants used an average of between one and two colors in each picture. This limited use of colors is somewhat surprising considering preliminary findings from Light and Drager (2007) regarding typically developing children. However, Selfe (1977) detailed drawings by Nadia, a young child with autism who demonstrated drawing abilities far beyond those of her peers. Besides her incredible skills, Nadia chose to draw using extremely limited colors. Other than this single case study, there is relatively little research documenting use of color in drawings by children with autism. It should be noted that no model was given during the drawing task. Had the experimenter modeled the use of many colors, this may have had an impact on results. Use of color should continue to be investigated because it may have implications for construction of symbols for clinical uses such as AAC systems and visual supports. However, it should be noted that construction of symbols is not a direct demonstration of preference, thus a measure of preferences for use of colors or monochromatic palettes is warranted.

High Interest Subjects

Many children with ASD have restricted, repetitive interests in particular topics or objects (American Psychiatric Association, 2000). As such, whether or not children
included high interest subjects in their drawings was of particular concern in this study. One-third of participants used these themes, pointing to the heterogeneous population of children with social communication impairments. Of the participants who used high interest subjects, some were able to utilize these high interest themes in a way that was helpful for explaining or organizing their thoughts around stimulus words. On the other hand, the entrance of high interest subjects into their focus of attention made it difficult for one participant to maintain attention to the task and had difficulty controlling impulses to discuss these themes instead of target concepts, a documented executive function deficit in the ASD population (Sturm, Fernell, & Gillberg, 2004).

If a child has high interest in a particular subject, it may be worth experimenting with using the high interest subjects in communication symbols. This may provide a means of motivation or an opportunity for shared interest between a child and a communication partner, especially when first beginning to introduce symbols. If an individual who requires AAC is especially reluctant to engage with others, utilization of a high interest subject may serve as a bridge towards shared interest and communication.

Conversely, as was seen in one participant, the inclusion of high interest subjects may not be facilitative. For participant 2, it may be the case that the focus of the drawing shifted from the target word to the high interest subject (trains) because of an inability to stop drawing. Instead, he continued focusing on the trains and departed from his initial plan for depicting the stimuli words. Facilitation of attenuating a task when individuals may begin fixating is an important clinical consideration, particularly when dealing with the ASD population.
**Entire Scenes**

When investigating the use of entire scenes by participants, it is helpful to compare commercially available symbol sets. Traditional PCS often include limited details and information in order to make symbols as “universal” as possible. Children may have difficulty understanding these distilled versions of concepts (Mizuko, 1987), and, therefore, one hypothesis regarding improving ease of understanding is to include more personally relevant details to create an entire scene. The inclusion of entire scenes by participants was most robust for certain concepts (i.e., eat, more, up). These are words are used frequently with young children, and may be chosen as words for an initial AAC lexicon (Musselwhite & St. Louis, 1988) if speech and language therapy is indicated. As such, many children may have a greater understanding and may use these concepts more frequently in their day to day communicative interactions. Concepts that are less familiar to children are more difficult for them to fully depict. This may not be because they are choosing to include fewer details, but rather because they are less equipped to fully depict the concept.

**Use of Conventional Symbols and Notations**

The overarching topic of this study was symbolic understanding, thus how participants utilized symbols was a key aspect to the task. The ability to understand the nature of symbols and the symbol-referent relationship is a cognitively demanding charge (DeLoache, 1995; DeLoache et al., 1998). The drawing task of this study itself required some amount of symbolic understanding and is metalinguistic in nature. Many of the concepts used during this task could be illustrated by drawing concrete objects, but some
required more symbolic representations. The concept of “what” was found to be most frequently depicted using a conventional symbol. This finding is not entirely surprising, because the concept itself is highly metalinguistic and symbolic in nature.

Use of People

Since the hallmark deficit in ASD is social interaction (American Psychiatric Association, 2000), the use of people was also of particular interest. The concepts of “come,” “eat,” “want,” “what,” and “who” were most commonly drawn including people. A closer look at these concepts reveals the need for at least some form of agent to depict the meaning. In other words, it is difficult to meaningfully draw the concept of “eat” without drawing a person (or at least an animal) to perform the action. These concepts are difficult to depict without some sort of animate beings, and overall, many children chose to draw people in their pictures. It is important to note that while people were present in the drawings, participants rarely identified specific people (e.g., “this is my mom”), but instead identified them more generically (e.g., “it’s just a guy”). This pattern also held true with the use of animals. Because children with autism have difficulty with social relations and pragmatics skills, relating people or animals to personally relevant details may be particularly difficult.

Use of Objects

Participants chose to include objects more often than they included people. All concepts had at least greater than 50% of children including objects in their pictures, and there was a high frequency of drawings which included objects. This code was the most frequently used, and nearly every picture included some kind of object. In fact, relatively
few drawings included people and no objects. One potential explanation for this finding is that individuals with social communication difficulties may have difficulty relating people, particularly personally relevant ones, to abstract concepts.

**Use of Self**

Finally, one code used to rate the drawings was rarely used: The use of self was coded infrequently across participants. In fact, only two participants used themselves in their drawings. Only participant 8 used herself in drawings more than once. Her drawings included large amounts of personally relevant information, including details about her house, other members of her family, and pets. She provided much more background information surrounding her drawings than most of the other participants. In this way, her participation varied from the rest of the group, and differed from what may have been expected. Overall, however, the use of self was overwhelmingly absent in the majority of participants’ drawings, and drawings had relatively few details that were personally relevant. A possible explanation for this lack of detail may include theory of mind deficits noted in children with autism (Ozonoff et al., 1991). This may have implications for clinical uses when creating symbols.

**Relationship of Cognitive Skills to the Drawing Task**

Overall, there is a discrepancy between children’s understanding, and their ability to produce a “full” depiction of a concept. As previously mentioned, the caregivers of all participants except for one reported that their children understood all 10 concepts targeted. One participant’s caregiver reported that his child understood 9 out of 10 concepts, but that he did not understand “who.” Based on these reports, a reasonable
assumption is that children had a general understanding of all or nearly all of the targeted concepts. However, when asked to produce a drawing of what the word meant, they had a difficult time including relevant details, and sometimes strayed from the focus of the task. Their abilities to conceptualize the target stimuli, plan what to draw, execute the drawings, and then explain what they drew, and why, was a difficult task. This discrepancy between participants’ ability to understand versus their ability to draw a concept can possibly be explained by impaired executive function abilities (Ozonoff et al., 1991). Further, the drawing task in this study required the coordination of a number of cognitive skills, including comprehending of the instructions and the concept, planning a drawing, executing the drawing, and producing language to explain the drawing and how it related to the target concept. At the outset, the drawing task seems relatively simple, but, in fact, there are many cognitive skills necessary to complete it. Difficulty coordinating these skills, as well as deficits in any component areas could also lead to the aforementioned discrepancy between concept formation and drawing ability.

Identification of Drawings Task

The older and higher functioning children were better able to identify the concepts they had attempted to draw. They were better able to plan and execute their own ideas regarding a concept, and as such they were able to connect what they had drawn to the target concepts. Again, knowing when to limit drawing time or limit the amount of high interest stimuli might have influenced participants’ performance.

Younger children were more fluid in their planning and drawing. They appeared to begin the task with less of a plan. These children were less able to recall the target
stimuli, though they were relatively consistent in their ability to recall the objects they had drawn. Because they began the task without proper planning, the concepts and the drawings were less fully connected, and the children were more inclined to describe the drawing as opposed to labeling the concept.

Limitations

This study consisted of 10 participants with social communication difficulties; however, one participant did not complete all of the tasks, and one participant did not have an official diagnosis of social communication impairment. A larger sample size would be beneficial in order to make generalizations about the population of individuals with ASD and other social communication difficulties. Additionally, the age range of 4 to 12 years old does not accurately represent beginning communicators using AAC. This range was chosen in order to offer insight into the group’s understanding of concepts, and this required language skills necessary to explain drawings, as well as metalinguistic knowledge in order to comprehend the task. While this age and skill range may not accurately depict the group of individuals using AAC, it was chosen in order to offer insight into symbolic understanding in this population.

A second limitation to this study may have been the procedure used to instruct the participants about what to draw. They were told to draw what a particular word means. In this way, they were not drawing with the intention to draw a symbol that others might understand, but instead were drawing a picture that had meaning to them. It is unclear if different instructions to the children might have influenced their drawing or understanding of the task. In fact, this change in procedure may make the task too
difficult to understand, particularly for younger or lower functioning children, however, it
should be a consideration. Additionally, while the not using a model during the drawing
task was an intentional procedural decision, the use of a model may have influenced the
results.

Third, the identification of PCS task was highly decontextualized. There are few, if any, instances in which a symbol would be introduced with such little context. This
method was chosen in order to assess transparency of the symbol itself; however, a more
ecologically valid means of assessing transparency may include the PCS symbols in some
sort of context (e.g., “open” next to a door).

Finally, because caregivers were not asked about specific interests of the child, no
comparison was able to be made across participants that did not use high interest subjects
in their drawings. Future studies may include this type of question prior to beginning any
drawing tasks.

Future Directions

A set of control subjects with typically developing language and social skills
should be included to fully understand the influence of ASD on the ability to represent
concepts using drawing. Another interesting comparison group might be children with
specific language impairment, in order to investigate the effects of impaired language and
word knowledge, and their interaction with performance on drawing and identification
tasks.

Additionally, work with individuals with aphasia, both fluent and non-fluent,
often utilizes drawing as a means of expressing concepts (Lyon & Helm-Estabrook,
A broader comparison between the drawings of children with ASD and individuals with aphasia may enlighten our understanding of the relationship of language comprehension and production to concept recognition and production through drawing.

A child-centered language measure may be beneficial in order to contextualize findings in future studies. The use of the CCC-2 was helpful to provide insight into participants’ language skills, but, because this measure was completed by caregivers, it was difficult to utilize this across participants when attempting to contextualize findings from the drawing tasks. The Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord, et al., 2000) would be a valuable tool to assess language and pragmatic skills in a semistructured, yet naturalistic interactions. This scale allows for a broad range of ages and communicative ability levels. It assesses communication, social interaction, play, and imaginative use of objects. This is a standardized measure that would allow for more comparable comparisons across participants. The ADOS-G would also provide insight into play, and other language-related constructs.

In order to delve more deeply into the semantic deficits of some participants highlighted by the CCC-2, a measure of expressive and receptive lexical skill may be helpful. The Peabody Picture Vocabulary Test-4 (PPVT-4; Dunn & Dunn, 2007) would be an appropriate test for this age group to measure receptive vocabulary skills. The Expressive Vocabulary Test-2 (Williams, 2007) is the companion test of the PPVT-4, and would assess expressive language skills.

In addition, an informal communicative task would be useful to contrast the formal language measure. An informal dialogue between participants and their caregivers
about a selected topic or event would be an adequate means of gaining a language sample. Through this sample, researchers could assess pragmatic skills first-hand, as well as measure how much scaffolding is required or provided by caregivers; spontaneous vocabulary that is used; or, the amount of novel information participants provide. This task could provide a more first-hand account of children’s language skills within a laboratory setting.

A measure of executive function may also be beneficial in order to draw comparisons across participants. Many of the findings here point to individual differences in executive function abilities, and a standardized measure of this skill may be helpful. The Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy & Kenworthy, 2000) is a parent questionnaire that can be used to assess children with autism and pervasive developmental disorders. It contains two indexes: behavioral regulation and metacognition. The behavioral regulation index measures inhibition, shift, and emotional control. The metacognition index measures initiation, working memory, planning, organization, and monitoring. These areas are of interest based on results from this study.

Because this study investigated drawing, a measure to gather a baseline of drawing aptitude might be helpful in order to compare baseline to performance on the experimental task. Also, examining how children draw concrete objects may provide an interesting comparison to their drawings of abstract concepts. However, these measures would need to be carefully developed so as not to contaminate drawings in the
experimental task, particularly considering the nature of children with ASD to demonstrate repetitive behaviors.

Finally, because certain concepts seemed to lend themselves to the application of particular codes, including a more balanced list of concepts may demonstrate new patterns. For example, a comparison of drawing results between transitive and intransitive verbs may provide insight into how certain word classes are most likely to be illustrated.

Conclusions

Theoretical

The transparency of commercially available symbol sets has been shown to be limited in various populations (Mizuko, 1987). This study, in corroboration with previous studies, has demonstrated that PCS may be difficult for children with social communication difficulties to understand without explicit teaching. The results of this study can be further explained using the framework of DeLoache’s “Model model.” Recall that this model includes four features: saliency (the symbol’s characteristics), iconicity (the relationship between the symbol and the referent), experience (knowledge and skill of the symbol user), and instruction (the context of the symbol presented) (DeLoache, 1995). The present study primarily dealt with the iconicity and saliency factors of DeLoache’s “Model model” (1995). The transparency of the relationship between symbols and their referents was investigated. Overall, the chosen PCS proved difficult for children with social communication impairments. In regard to saliency, the dual nature of any symbol must be considered. In order for an individual to understand
that there is a relationship between a symbol and referent, that person must also understand the concrete properties of the symbol itself as well as the symbol’s abstract nature.

However, it is important to consider the two other factors of the “Model model” (DeLoache, 1995). Experience of the symbol user plays a very significant role in symbolic understanding. The ability of the individual to understand symbol-referent relationships is a major factor in the use of symbols within AAC systems. Further, individuals’ exposure to orthography and literacy may influence their understanding of conventional symbols and notations such as question marks or motion lines. The instruction portion of DeLoache’s model (1995) can be largely variable depending on the context of the symbols. Ultimately, though, this factor should be considered when introducing new symbols or constructing symbols for AAC systems. How symbols are presented, and how they are taught to individuals may have a significant impact on long-term communication outcomes.

The utilization of symbols in more naturalistic contexts can potentially improve utilization of AAC. Traditionally, symbols have been presented in grid formats with each symbol occupying its own space. An alternative that may be more advantageous for individuals with ASD is the visual scene displays (VSDs; Drager, Light, & Finke, 2009). In VSDs, symbols are arranged within the context of naturalistic scenes such as within rooms of the child’s house, or activities in the child’s life (Drager et al., 2009). Utilizing VSDs may increase transparency of symbols used, since they are in a more naturalistic context, however given the infrequent use of scenes in drawings and the preponderance
of objects over people, construction of such scenes needs to be carefully considered. Due to the nature of the tasks used, the present study did not assess preference for scenes, but rather assessed construction of symbols. Since VSDs are a navigational approach to vocabulary access, they should still be considered despite the lack of scenes drawn. That said, one possible modification to traditional VSDs may be to include a focus on objects, rather than people.

Clinical

This study has several potential clinical implications. Understanding of children’s personal representations of abstract concepts can assist in creating the most relevant and transparent symbol sets possible. This task is made difficult by the heterogeneous population of children with ASD and other social communication impairments. There are wide individual differences, and as such, findings such as the limited use of color or use of high interest subjects may or may not be helpful for a given child. However, these findings should be considered, particularly when commercially available symbol sets seem especially difficult for a child to comprehend.

Typically, AAC is thought of as a modality for expressive communication (Drager, 2009). In fact, AAC may be a beneficial means for supplementing other language contexts such as receptive language and organizational modes (Drager, 2009; Shane & Weiss-Kapp, 2008). Utilizing symbols as a means of supplementing language input can be a valuable model for AAC users. This use provides AAC users with models that are more consistent with their communication mode, as well provides auditory and visual modes of communication (Drager, 2009). Symbols can also be a means of
organization, and increasing transparency of symbols can improve the likelihood that individuals with ASD can interact with their environment more successfully (Shane, 2006).

Due to advances in technology, the possibility for modifying symbol sets may lend itself to producing personalized symbol sets, such as including high interest subjects or monochromatic options. Therapists’ ability to modify commercially available symbol sets could have significant implications in individualizing therapy as well as AAC vocabulary options.

This study did not seek to dismiss the value of commercially available symbol sets. They have their purpose and have been incredibly useful and important. However, clinicians and educators should consider the cognitive and linguistic demands being placed on individuals who are asked to use these symbols, and adjust expectations accordingly. When difficulties arise, findings of the present study may provide insight into possible alternative means of depicting concepts.
REFERENCES


APPENDIX A: PARENT QUESTIONNAIRE

Please complete the following questions about your child. The information will help us understand more about how individuals with autism interpret symbols. Do not hesitate to ask the experimenter if you have any questions. All information that could potentially identify your child or other family members will be kept strictly confidential.

------------------------ID Number_______

Part 1. Background

1. Child’s Name: ____________________________
2. Child’s Date of Birth: ___/____/____
3. Your child’s siblings:
   Name: ___________________________         Gender: M/F
   Date of Birth : ___/____/____
   Name: ___________________________         Gender: M/F
   Date of Birth : ___/____/____
   Name: ___________________________         Gender: M/F
   Date of Birth : ___/____/____
   Name: ___________________________         Gender: M/F
   Date of Birth : ___/____/____

4. What is the highest level of education completed by you and the child’s other parent?
   Parent 1  Parent 2
   Some High School   ______  ______
   High School        ______  ______
   Some College       ______  ______
   Technical or AA degree  ______  ______
   College degree     ______  ______
   Some Graduate School ______  ______
   Post Graduate degree ______  ______

5. Which of the following categories best describes the present occupation of you and the child’s other parent?
   Parent 1  Parent 2
   Student   ______  ______
   Office, food service, or retail staff  ______  ______
   Skilled Trade/ Technical               ______  ______
   Professional/Managerial               ______  ______
   Self-Employed                         ______  ______
   Health Services/Nursing               ______  ______
   Other (Please specify)__________  ______  ______
**Educational Information**

1. Did your child attend preschool?  Y  N  
   If so, how many hours per week?  
   __________

2. What school does your child attend?  
   _______________________________________

3. What type of classroom does your child regularly participate in (e.g. general education, inclusive classroom, special education classroom)?  
   _______________________________________

4. Child’s grade in school _____

5. Has he/she ever repeated a grade?  Y  N  
   Which grade(s)? ______

6. Does your child currently have an Individual Education Plan (IEP)?  Y  N

7. Do you have any concerns about your child’s performance in school?  Y  N  
   If Yes, please describe:

**Developmental History**

1. Were there any significant complications during the pregnancy or birth of your child?  
   Y  N  
   If Yes, please describe:

2. Has your child had any major illnesses/surgeries/medical complications?  Y  N  
   If Yes, please describe:

3. Has your child ever been referred for learning or speech problems?  
   Y  N
If yes, please describe:

4. Has your child ever been referred for hearing problems?
   Y    N
   If yes, please describe:

5. Has your child ever been referred for behavioral problems?
   Y    N
   If yes, please describe:

6. Has your child ever been referred for occupational therapy (OT) or physical therapy (PT)?
   Y    N
   If yes, please describe:

7. Does your child have any fine or gross motor difficulties?
   Y    N
   If yes, please describe:

8. Does your child have any vision problems?
   Y    N
   If Yes, is the problem corrected with glasses or contacts?
   Y    N

9. Is your child receiving any other services at school or at home (e.g. ABA therapy, reading, etc.)?
   Y    N
   If Yes, please describe:
10. Has your child ever used any kind of alternative means of communication (i.e. PECS, communication board, voice output system, etc)

Y   N

If Yes, please describe:

When and for how long did your child use it?

11. How much does your child like to draw? ___Not at all   ___ A little   ____ A lot

12. Please check all of the following concepts your child understands:

   ____ All gone   ____ big   ____ open   ____ up
   ____ come   ____ eat   ____ more   ____ want
   ____ what   ____ who

Please be sure you complete both parent questionnaires included in this packet.

Thank you for your participation!
APPENDIX B: EXPERIMENTAL SCRIPT

Let me show you what we’re going to do today.

*(While utilizing the photo schedule)* First you’re going to draw some pictures and we will talk about them. Then I want you to look at some pictures and tell me what you think they’re pictures of. Are you ready?

**Drawing Task**

*(While showing the drawing schedule)* First, you’re going to draw some pictures. I’m going to say a word, and I want you use crayons or markers and this paper to draw a picture of what I say. You will have 10 minutes to draw each picture. I will show you a timer when you have 5 minutes left. When you’re finished with your picture, you and I will talk about what you drew.

We’re going to draw 10 pictures. *(show the sheet to check off after each picture)* There are no right or wrong answers, I just want you to draw the best picture you can.

Draw a picture of __________.

**Possible prompts (as needed and indicated below)**

If the child is reluctant to draw: There are no right or wrong answers; Try your best, then we can talk about your drawing later.

If the child becomes distracted: After you’re finished with this (or X number of pictures) we can take a break; When we’re finished with this drawing you can cross this one off of our list.

If the child is not including many details, particularly when other drawings were more detailed: There’s still a lot of white space, is there anything else you want to draw?

When child appears to be finished, but does not say he/she is finished: Is there anything else you’d like to add to your drawing?

Give 30 seconds if there is no response, then: Are you all done?

**Talking about drawings (required for each drawing)**

Tell me about your picture.

Tell me about this part over here.

OK, I’m going to ask you a couple more questions about your drawing.

Who is this?

What is this?

Why is this a picture ___(concept)___?

Is there anything else you would like to tell me about your picture?

**Identification Task**

You did a great job with those. Now we’re going to look at some pictures and I want you to tell me what each one is a picture of. We’ll start with an easy one.

*Show “cat”.* What do you think this is a picture of?

*If child says “cat”:* Great job! I think this looks a cat too.

*If child does not say “cat”:* Hmm, I think this one looks like a cat. What do you think?

Let’s look at another one. *Do the same procedure with ball.*
OK, now we’ll look at some different ones. There are no right or wrong answers, I just want to know what you think these picture look like.

**If child is reluctant to give an answer:**
These are tricky, but you’re doing a great job, keep trying.
Remember, there are no right or wrong answers, just try your best to give me an answer.

**Identification of Drawings Task**

I mixed up the pictures you drew! I need your help. I’m going to show you your pictures again, and I want you to try to tell me the word that you drew.
Prompt as needed: I know this is hard, just give me your best guess.
APPENDIX C: IDENTIFICATION TASK STIMULI

The Picture Communication Symbols ©1981-2011 by Mayer-Johnson LLC. All Rights Reserved Worldwide. Used with permission. Boardmaker® is a trademark of Mayer-Johnson LLC. DynaVox Mayer-Johnson 2100 Wharton Street Suite 400 Pittsburgh, PA 15203 Phone: 1(800)588-4548 Fax: 1(866)585-6260
APPENDIX D: CODING MANUAL

**Identification of PCS Task**
Watch video and read transcript. Write child’s answers to each PCS picture. Code correct, partially correct, or incorrect

**Correct:** Child uses the target word either in isolation or in a sentence. (e.g. “The ball is on the shelf”).

**Partially correct:** Child tells the meaning of the target word without using the target word (e.g. “he’s saying see you later” instead of goodbye; “the man is in the front of the line” instead of first).

**Incorrect:** Child does not use the target word or the word’s meaning (e.g. “it’s a blob”)

**Drawing Task**
Watch video and read transcript while examining drawing. Mark the presence or absence of each of the following codes for each drawing.

*Note: High interest subjects code may overlap with other codes (e.g. robots may be high interest subjects, and are also coded as people). For reliability, since coder only sees three drawings, high interest subject will be identified before coding, and coder will determine the presence or absence of the given theme.*

**Entire Scene:** Three or more objects or people related together in a scene

**Symbols:** Something representative; e.g. a “?”, a thought bubble, motion lines

**Self:** Includes themselves in the picture

**Isolated parts:** Includes just pieces of an object to represent the whole object (NOT a piece of a toy because the toy is broken); e.g. a hand that implies there is a person.

**High Interest subjects:** Includes the same themes more than twice (e.g. many pictures have robots)

**People:** Includes any people/ include number of people, monsters, robots

**Animals:** Any animals or creatures/ include number

**Inanimate objects:** Any objects that are not alive, symbols do not count as objects (?’s arrows, etc); Do not count clothing, adornments on objects unless they are an important part of the meaning (e.g. a cape for “up”) /include group of undetermined amount=1 object (e.g. a plate of cookies: the plate is 1 object, the cookies are one object)

**Words:** Any written words, numbers

**Identification of Drawings Task**
This is very similar to the identification of PCS task. Watch the video and read the transcript. Write the child’s answers to each of his drawings. These answers are coded as correct or incorrect.

**Correct:** The child uses the target word either in isolation or in a sentence.

**Incorrect:** The child does not use the target word.