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Priming as a Means of Increasing Spontaneous Verbal Language in Children with Autism Spectrum Disorder

Michelle Louise Ivey

ACCEPTANCE

This dissertation EFFECTS OF PRIMING ON SPONTANEOUS VERBAL LANGUAGE IN CHILDREN WITH AUTISM SPECTRUM DISORDERS by, MICHELLE LOUISE IVEY, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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ABSTRACT

THE EFFECTS OF PRIMING ON SPONTANEOUS VERBAL LANGUAGE IN CHILDREN WITH AUTISM SPECTRUM DISORDERS
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A multi-element design was used to investigate the effect of priming on spontaneous verbal communication in children with Autism Spectrum Disorders (ASD). Three children with ASD engaged in 20-minute thematic activity sessions (ACT) with the investigator. Prior to the ACTs, they met with another trained researcher for 10-minute presessions. Half of the presessions incorporated the conventions of priming with materials to be used in the upcoming ACT (i.e., related presessions; RP). During the other half of the presessions, participants were not primed for the upcoming ACT (i.e., unrelated presesessions; UP). The researcher conducted presessions so the investigator was blind to the condition. Procedural fidelity checks of the presessions, based on a checklist of the critical components of priming, revealed 100% adherence to procedures.

Participants' utterances during ACT were recorded, transcribed, and coded based on functionality. The dependent variables were spontaneous comments, requests, topic initiations, social information seeking, and total. Once the criterion of a 30% increase from the mean of the first 3 UP was achieved for three consecutive sessions, priming was withdrawn and then reinstated to demonstrate a functional relation. Additionally, Cohen's d was calculated to determine effect size for the intervention. Reliability was assessed for transcription and coding. There were fewer than 10 word disagreements on any transcript,

which did not affect coding. A line by line comparison of the coding across the dependent variables yielded an average reliability of 85%.

Visual inspection of the data and statistical analysis revealed that two of the three participants reached criterion for spontaneous comments (Cohen's $d = .32$ and $.95$), one reached criterion for total utterances (Cohen's $d = 2.99$), the other achieved the goal during the reinstatement following the withdrawal (Cohen's $d = 1.00$). None increased requesting. Topic initiation and social information seeking did not occur with sufficient frequency for meaningful analyses. Similar to most interventions with individuals with ASD, priming was effective for increasing spontaneous verbal comments for some but not all of the participants. Priming was highly effective for two of the participants. This ground-breaking study creates momentum for further investigation and examination of the variables that affect benefit.

THE EFFECTS OF PRIMING ON SPONTANEOUS VERBAL LANGUAGE IN CHILDREN WITH AUTISM SPECTRUM DISORDERS

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Michelle L. Ivey

A Dissertation

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ABBREVIATIONS

ACT	Activity Session
ADOS-G	Autism Diagnostic Observation Scale-General
ASD	Autism Spectrum Disorders
APA	American Psychiatric Association
CELF	Clinical Evaluation of Language Fundamentals
CELF-P	Clinical Evaluation of Language Fundamentals-Preschool
fMRI	Functional Magnetic Resonance Imaging
FTD	Functional Thought Disorder
GABA	Gamma-aminobotyric Acid
ID	Intellectual Disability
LTP	Long-term Potentiation
NRC	National Research Council
RP	Related Presession
UP	Unrelated Presession

CHAPTER 1

MEMORY, INFORMATION PROCESSING, AND EXPRESSIVE COMMUNICATION IN AUTISM SPECTRUM DISORDERS

Pervasive developmental disorders or autism spectrum disorders (ASD; Lord, Cook, Leventhal, & Amaral, 2000) are a category of neurological and behavioral differences which result in deficits in three key areas of functioning: social interactions, communication, and behavior (American Psychiatric Association [APA], 2000). As evidenced by the name, children with ASD experience pervasive deficits in development across many systems and skills. Included among these are problems of varying severity with memory, information processing, and expressive communication (Kanner, 1943; National Research Council [NRC], 2001; Prizant, Wetherby, Rubin, Laurent, & Rydell, 2006; Wilkinson, 1998; Williams, Minshew, & Goldstein, 2008). The ability to make relevant spontaneous comments for reciprocal communication relies on the development and interaction of these skills. Interruption in these systems may result in disordered functioning in communication commonly seen in individuals with ASD, resulting in the need for intervention to address social communication deficits.

Memory in ASD

Over decades of research and discussion, memory has been conceptualized as being comprised of discrete but interacting components (Gardiner, 2008; Solso, MacLin, & MacLien, 2005). The conceptualization of memory systems has evolved from the more

simplistic model of short-term and long-term memory to a complex, organized, multi-level system which has been documented, in part, via relatively new neuroimaging techniques (Atkinson & Schiffrin, 1968; Baddeley & Hitch, 1974; Gardiner; Schacter & Tulving, 1994). The differentiated components of memory systems require synchronous organization as suggested by Schacter and Tulving (1994) and Tulving (1985) and further enhanced by Baddeley (e.g., Baddeley, 2000; Repovš & Baddeley, 1996). Current models describe two gross categories of long-term memory, imperative memory (perceptual memory, procedural memory) and declarative memory (semantic memory, episodic memory). Short-term memory, better described as working memory, facilitates connections between the components of memory to enable encoding and recall.

Perceptual memory is memory in its rawest form. Perceptions of objects or events create representation of their characteristics in the mind. Perceptual memory is rich in context. In contrast, procedural memory involves retention of motor and cognitive skills. These skills are usually learned through practice over time and can include complex procedures (e.g., riding a bike) as well as simple conditioning tasks (e.g., using past tense "-ed" on verbs). Procedural memory produces anoetic consciousness, which stems from an ability to sense and react to given stimuli (Tulving, 1985).

The first of the two forms of long-term declarative memory is semantic memory. Semantic memory includes recollection of words, concepts, rules, and even abstract ideas. Whereas procedural memory produces anoetic consciousness (ability to sense and react to stimuli), semantic memory produces noetic consciousness or knowledge of the world. This noetic consciousness is free of context but full of facts (Tulving, 1985). Therefore, this component of the memory system is involved in the formulation of

schemas and scripts. Schemas and scripts are mechanisms of organization and combinations of experiences over time. As individuals have more repeated and related experiences, the connections between these are both enhanced and generalized. The enhancement comes as meaningful associations are created between related events (e.g., snowy days and difficulty driving; hearing a "ding" and an important announcement following). Generalization results in the creation of schemas for particular events (e.g., how to shop for groceries, what to expect at the movie theater, what happens at the dentist's office). Event schemas expand over time as more experiences are added, becoming more complex and less specific as they evolve (Fivush, 1984). Schemas constitute a dynamic concept, conceived as a whole, and include a range of options which are possible in a situation (Nelson & Gundel, 1981; Shank & Ableson, 1977). This form of fact knowledge has been proposed to be mediated by the semantic memory system (Gardnier, 2008).

Episodic memory is different from, but related to, semantic memory. Episodic memory is the neurocognitive system that enables people to remember what happened in their past constituting a consciousness that allows awareness of events which happened at a specific time (Tulving, 1993). This system allows humans to conceive the past and the future; a capacity not possible in other memory components, and not observed in other living creatures (Tulving, 2002). Whereas semantic memory produces noetic consciousness (knowledge of the world), episodic memory creates an autonoetic consciousness (Tulving, 1985). Autonoetic consciousness is described as self-knowing, giving individuals an awareness of personal identity and a sense of personal time. Episodic memory builds from semantic memory, which stems from procedural memory.

The connections between the components are essential to a functioning system (Tulving, 1985, 1993, 2002). The distinction between semantic and episodic memory can seem cloudy at times, but they are generally divisible with the distinction of a particular event or episode versus a sense of what the event is like (e.g., going to an aunt's wedding in California [episodic] versus going to a wedding [semantic]; Gardiner, 2008; Tulving, 1985).

Formation of episodic memories stems from the ability to store and recall effectively. The recall of previously novel stimuli activates the limbic system with varying degree (Rekkas & Constable, 2005). A stronger neuronal response leads to a more successful recall of a particular stimulus or event (Rutishauser, Schuman, & Mamelak, 2007). In the limbic system, there is selective firing in different areas with different intensity for new versus familiar stimuli (Rekkas & Constable; Rutishauser, Mamelak, & Schuman, 2006), producing rapid learning of novel stimuli. The rapid neuroplasticity for creating memories based on single-trial learning may be due to the release of neurotransmitters which support the neurological change needed for creation of long-term memory (Rutishauser et al., 2006).

Finally, working memory, which contains multiple components for processing, holds pertinent information used during execution of complex tasks. Working memory has been conceptualized as the interface between short-term perception processing and long-term storage of information. The multiple components of working memory include four distinct and interconnected components (Baddeley & Hitch, 1974; Baddeley, 2000). First, there are two systems for processing incoming information via rehearsal for retention: the visuospatial sketchpad and phonological loop. The systems, as their names

indicate, are used to process distinct types of information, visual and spatial in the visuospatial sketchpad and phonological and verbal in the phonological loop. A control system, the central executive, appears to manipulate and organize information within the other components. The central executive has been suggested to serve as the source of attention control between the visuospatial sketchpad, the phonological loop and the long-term memory system, particularly in complex tasks (Baddely & Hitch; Repovš & Baddeley, 1976). The final component, the episodic buffer (of limited capacity), combines input from multiple memory components to create multi-dimensional codes which are unique, or episodic, based on the situation (Repovš & Baddeley). The episodic buffer supports temporary retention of integrated information. Specific strategies, such as rehearsal, allow information to be rapidly and accurately bound to the content of the long-term memory. Thus, the episodic buffer is the interface between the content of working and long-term memory (Baddeley; Tulving 1985; Repovš & Baddeley).

Substantial evidence indicates that individuals with ASD have memory difficulties (Greenberg & Rubin, 2003; Klein, Chan, & Loftus, 1999; Milwarad, Powell, Messer, & Jordan, 2000; Renner, Klinger, & Klinger, 2000; Williams, Goldstein, & Minshew, 2006b). For the most part, semantic memory (memory of facts and world knowledge) remains intact for individuals with ASD, particularly for those who are considered high functioning (Salmond, Adlam, Gadian, & Vargh-Khadem, 2008; Salmond et al., 2005; Toichi & Kamino, 2002). This relative strength may help support the functioning of the individuals with high functioning ASD because the knowledge of facts can be used as the means to relate to daily situations (Ben Shalom, 2003). Although semantic memory skills have been demonstrated to be similar in those with and without

ASD, they appear to be organized differently between these two groups (Klein et al.; Williams et al.). For example, Toichi and Kamino (2001) found that individuals who are typically developing and those with high functioning ASD exhibited similar and intact semantic conceptual relationships; however the groups used different strategies in concept formation. Individuals with ASD were more likely to use nonverbal strategies, such as visual imaging, than language-based approaches in creating their conceptualizations. In later studies, Toichi and Kamino (2003) and Toichi (2008) found that individuals with ASD did not recall abstract nouns differently than concrete nouns, as opposed to the differentiated recall seen in comparison groups. The groups without ASD recalled more concrete nouns than abstract. The concrete nouns are thought to be more meaningful, leading to better semantic associations than the abstract nouns. Individuals without ASD use this characteristic to enhance recall. However the participants with ASD in both studies had similar recollection of both concrete and abstract words, indicating that the strategy was not in place (Toichi, 2008).

Although semantic memory appears to be intact in individuals with ASD, there appears to be a relatively selective, and noteable, deficit in episodic memory (memories of experiences and personal events; Ben Shalom, 2003; Klein et al. 1999; Milward et al., 2000; Salmond et al., 2005). Deficits in episodic memory in individuals with ASD lead to poor organization of personal memories and difficulty integrating semantic knowledge to specific episodes (Bennetto, Pennington, & Rogers, 1996; Klein et al.; Minshew & Goldstein, 1993; Renner et al., 2000; Trillingsgaard, 1999). Furthermore, individuals with ASD appear to lack rapid, functional access to personal memories (Crane & Goddard, 2008; Hare, Mellor, & Azmi, 2007). Specifically, there are deficits in autonoetic

consciousness (awareness of one's own state of mind, which is imperative for the formation of episodic memories) among individuals with ASD (Bowler, Gardiner, & Grice, 2000; Toichi, 2008). When compared to those developing typically and those with developmental disorders, children with autism had reduced, rather than enhanced, memories for events they experienced while alone (Boucher & Lewis, 1989; Klein et al.; Milward et al.). Interestingly, memory scores improved for events in which the child with ASD was accompanied by another person (Milward et al.). Toichi (2008) found further evidence of individuals with ASD potentially lacking self-reference effect, an organized concept of self found in the semantic memory. The self-reference effect, in theory, allows an individual better processing of words which relate to himself or herself. This improved processing leads to more efficient encoding and retrieval of the word within the episodic memory due to a strong sense of self. The initial reduction in self-reference in the semantic sense found in individuals with ASD leads to lack of appropriate encoding in episodic memory, as connections fail to form. Participants with ASD did not demonstrate a self-referencing effect; therefore, they may not benefit from improved organization in the episodic memory (Toichi, 2008).

In a similar situation, Klein et al. (1999) assessed an individual with autism who was able to recognize his own personality traits (semantic knowledge) but could not remember specific episodes where he had exhibited a particular trait (episodic memory). This finding supports considerations of deficits in episodic memory and the connection between semantic knowledge, particularly in self awareness. The authors concluded that the man did not need to remember episodes from the past to have a sense of his personal characteristics. Hare et al. (2007) also tested differences in self awareness within the

episodic memory with adults with ASD and intellectual disability (ID) compared to those with ID alone. Adults with ASD and ID did not differ in their ability to freely recall a total number of events than those with only ID, but there were still significant differences between the groups. Participants with ASD and ID exhibited less free recall of self events than those with ID alone.

There is some question regarding the exact causation of the deficits and differences in episodic memory; however, suggestions reflect an underlying problem with interactions between different systems for higher order tasks leading to deficits in episodic memory (Toichi, 2008; Trillingsgaard, 1999; Volden & Johnston, 1999). Importantly, the use of supports improved performance in experiential tasks (Ben Shalom; Hare et al.). Millward et al. concluded that individuals with ASD were aided in future recall of events that were accompanied, while Hare et al. found that being accompanied was not sufficient to differentiate performance in individuals with ASD. Instead, cued recall stimulated better performance for episodic memory. Although the concept of supports needs further investigation, it is important to note that they were effective in one form or another.

Interestingly, memory of personal episodes requires interaction between many cortical regions, including the sensory centers, limbic system, and prefrontal regions (see Greenberg & Rubin, 2003 and Ben Shalom, 2003). These complex interconnections between cortical areas have been found to be markedly deficient in individuals with ASD (Ben Shalom; Just, Cherassky, Keller, & Minshew, 2004; Minshew & Goldstein, 1993; Minshew et al., 1997), potentially being responsible for differences in the way this population processes information from encoding to storage to recall. Additionally,

underlying deficits in language may further affect memory coding and recall, corroborating the intimate connections between memory, information processing, and language (Baddeley, 2003; Williams et al., 2006a, 2006b).

Information Processing in ASD

Information processing is a complex skill theorized to result from the interaction of multiple systems and is based on manipulation of memory. One of the most recognized models of information processing comes from Atkinson and Shiffrin (1968), who suggested that individuals receive information from external stimuli, move it to short-term memory, and then file what is relevant in long-term storage. Baddeley and Hitch (1974) introduced a more in-depth account of information processing. In their model, stimuli from the environment come to a sensory register. The input is stored in working memory for a brief time while a decision is made to attend to or disregard the stimuli. If the stimuli warrant attention, specific strategies, including rehearsal and relating to information which is already stored, are used for long-term processing. Inputs to the long-term store are encoded by filing and sorting for later retrieval. Overall, this system relies on quick, accurate storage of incoming information. New information needs to be stored with other relevant contextual information for future rapid recall from the long-term store (Atkinson & Shiffrin; Baddeley & Hitch; Montgomery, 2002; Solso, MacLin, & MacLin, 2005). Better the associations within the connections lead to better retention and subsequent recall (Rutishauser, Schuman, Mamelak, & Adam, 2008). For the two systems of encoding and recall to work efficiently, they must be interrelated (Baddeley & Hitch; Gardiner, 2008). In addition, information may be stored in several different, but related, contextual locations. These may include sorting for time and sequence

information, location, meaning, and emotional saliency (Ben Shalom, 2003; Minshew & Goldstein, 1993).

The synchrony between activity at different cortical levels has been shown to indicate integration of processing across neural regions (Kveraga, Ghuman, & Bar, 2007; Rekkas & Constable, 2005; Rutishauser et al., 2008). This results in a unified cognitive reaction involving information from multiple locations within the brain (Ghuan, Bar, Dobbins, & Schnyer, 2008). For example a neural loop between the prefrontal lobe and the hippocampus has been proposed to serve as the mechanism to formulate and retrieve memories (Ghuman et al.; Varela, Lachaux, Rodriguez, & Martinerie, 2001). Interestingly, information processed at higher cortical levels, such as the prefrontal cortex (responsible for decisions, planning, and other executive functions), has more numerous connections to other areas throughout the cortex and with lower level systems, such as those involved with memory and sensory perception. Information processed at less complex levels has less interconnectivity to other cortical regions (Kverga et al., 2008). The advantage, however, is to top-down processing strategies (starting with the prefrontal regions) due to the increased and varied connections (Kverga et al.). Again, this efficiency in communication allows the brain to rapidly process new information, relate to current knowledge across vast experiences, and formulate a plan for further action (Kuperberg, Dechersbach, Holt, Goff & West, 2007; Rutishauser et al., 2006).

Several experts in the field of ASD have suggested that information processing difficulties, particularly with complex information, are the key deficit in ASD, resulting from poor interaction and connection between multiple cognitive components (Just et al., 2004; Williams, Goldstein, & Minshew, 2006 a, b). Minshew, Goldstein, and Siegel

(1997) investigated a multi-model account of autism spectrum disorders. They described a comprehensive test battery which was administered to adults with and without autism who all had IQ scores within the normal range. The series of tasks assessed both simple and complex skills across multiple domains including motor, language, memory, sensory, and visual-spatial processing tasks. Their general hypothesis was that by controlling difficulty, components and modalities, a profile of cognitive functioning in ASD would become apparent. They also hypothesized that deficits would relate to poor organization of skills which are necessary in complex cognitive operations (Minshew et al.; Williams, Minshew, & Goldstein, 2008).

A clear profile emerged when comparing results between carefully matched cohorts with and without autism. Individuals with autism performed consistent with or better than their matched counterparts on all of the simple forms of the profile testing (i.e., attention, simple memory, simple language, and visual-spatial skills). However, there were significant differences between the groups in all areas of complex processing except for visual spatial processing (i.e. skilled motor, complex memory, complex language, and reasoning). The complex task of organizing and storing information in a manner that supports future recall is one of the most prominent deficits found in the group with ASD (Minshew et al., 1997). This profile indicated a selective impairment in complex processing, evidencing a primary deficit within and across cognitive domains (Minshew et al., 1997).

In a follow-up study described in two reports, Williams et al. (2006a, b) completed similar testing on children with high functioning autism and children who were developing typically. The results of this analysis yielded similar but not identical

results to the study with adults. The children with ASD exhibited skills equal to their peers in attention, simple language, simple memory, reasoning, and visual-spatial skills. The tasks which discriminated them from their peers were sensory-perceptual, motor, complex language, and complex memory (Williams et al., 2006a). Williams et al. (2008) summarized these findings by explaining that there are areas where individuals with ASD (in their research considered high-functioning with IQs within normal limits) have performance comparable to matched cohorts, and at times their performance differs from that of matched cohorts. The lack of a system, or schema, for effectively encoding material leads to problems facilitating learning and memory as the information increases in complexity (Williams et al., 2008).

Continuing the study of the cognitive profile of individuals with ASD, cognitive organization in 137 children and 117 adults with ASD were tested with a general intelligence test with results analyzed in comparison to a national normative sample (Goldstein et al., 2008). There was no difference between groups for the general structure of intelligence, but there was a difference in the correlations of various abilities between the various skills tested. The authors suggested that these weak correlations may be due to more modular forms of cognitive operations, meaning that specific cognitive abilities across various areas are not associated with each other as would be expected to create connections for a larger picture of intelligence. Once again, the possibility of reduced connectivity between cortical regions served as a possible explanation for this behavioral difference (Goldstein et al.). The idea of modular learning is reflected in the lack of gestalt processing (the ability to take singular information and relate it to a larger, more global picture; Prizant, Weterby, & Rydell, 2000). In one investigation of processing,

children with ASD who were low functioning were asked to complete a series of tests. Their tendency was to process at local, or individual element levels, instead of global or to systematically relate concepts more so than ability matched peers (Brosnan, Scott, Fox, & Pye, 2004). Children with ASD did not spontaneously incorporate inter-element processing to make associations regarding individual characteristics of items in the tests. In another example, Minshew, Meyer, and Goldstein (2002) found that children with ASD demonstrated a significant difference in concept formation versus concept identification. Concept formation skill is thought to cross multiple domains of cognitive functioning, which is suspected to be problematic for this population. Furthermore, the deficit suggests an inability to spontaneously form schemata to organize information (Minshew et al.) again, demonstrating differences in the coding of information in the semantic memory system for noetic consciousness.

Differences and deficits between those with ASD and those who are typically developing become apparent as information increases in complexity and higher order processing skills are necessary (Kanna, Keller, Cherkassky, Minshew, & Just, 2006; Minshew et al., 1997, 1998; Williams et al., 2005a, 2005b, 2006b). These higher order skills rely on intact interactions between various centers in the brain including the prefrontal regions, limbic system, visual cortices, and face processing center. There are suspected difficulties with the functioning and interconnections between lower and higher order systems of the brain in individuals with ASD as well as between specialty areas such as those for sensory processing, language, memory, and problem solving (Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Kanna et al., 2006; Minshew et al., 1997; Williams et al., 2006a, b). Although the exact mechanisms resulting in decreased connectivity are

unknown, there are confirmed volume differences in the brains of individuals with ASD (Courchesne, Karns, Davis, Ziccardi, Carper, Tigue, et al, 2001; Stevenson, Schroer, Skinner, Fender, & Simensen, 1997). The pattern appears to be a postnatal event which crosses cortical lobes and tissue type, where the brain is initially a normal size, increases to a large volume, potentially due to reduction in expected neural pruning during early development, and then has a leveling toward more typical size after age 4 (Courchesne et al., Courchesne, 2003; Just et al., 2004; Mosconi, Zwaigenbaum, & Piven, 2006; Stevenson et al.). The diverse nature of the structural differences may affect neural circuitry and multiple cognitive mechanisms (Cody, Pelphrey, & Piven, 2002). The result is a breakdown of skills for higher order processing which presents as deficits in understanding.

The results of these investigations and structural findings lead to the suggestion that autism results from a complex information processing disorder and not as the result of a single primary cognitive deficit (Williams et al., 2006a). The skills that are most affected in ASD are those which require the greatest integration and processing (Williams et al.). This theory accounts for the apparently preserved basic, factual skill abilities (semantic memory or noetic consciousness), which are necessary for acquiring general knowledge and typically critical in measuring IQ. In addition, the fact that processing abilities decline when they involve complex demands explain how an individual with ASD wanes in daily life situations requiring integration of various systems, world knowledge (noetic consciousness), and expectations for the future (autonoetic consciousness).

Complex information processing between the frontal cortex and limbic system is not the only cortical skill which appears to exhibit deficits in associations in individuals with ASD. Recently, face processing abnormalities in individuals with autism have been studied in relation to abnormal neural connectivity. The fusiform gyrus is known to be a key cortical region for processing faces. Kleinhans et al. (2008) completed functional magnetic resonance imaging studies on individuals with ASD during face identification. The analysis revealed abnormal functional connectivity between the fusiform face area in the fusiform gyrus and the amygdala in the limbic system. Hadjikhani et al. (2004) demonstrated that the fusiform gyrus is activated similarly in people with and without ASD and concluded that deficits in face processing was a result of a breakdown within the network of interrelated cortical skills necessary for understanding facial cues. Since face processing is part of social cognition on many levels, this abnormal neural connection may be responsible in part for the behavioral manifestations in social cognition evidenced by people with autism (Hadjikhani et al.; Kleinhans et al., 2008; Schultz, 2005). Furthermore, these deficits may be the impetus for other social cognitive deficits which require facial processing such as joint attention, eye gaze, and response to emotion (Dawson, Webb, & McPartland, 2005).

The complex information processing deficit proposal argues that the more simple processing skills relate to the strength in the procedural types of activities such as rote motor movements (anoetic consciousness), ordering from a menu (noetic consciousness), and simple memory tasks. Deficits in higher order processing are related to other higher order cognitive skills (e.g., episodic memory [autonoetic consciousness], receptive language; Minshew et al., 1997; Williams et al., 2006 a, b). These skills develop from

intricate and efficient interactions between multiple cortical systems. Breakdowns in these systems lead to diminished performance (Just et al., 2004; Minshew et al.; Williams et al.).

Although the explicit underpinnings of the complex processing deficits in autism are not clearly understood, insights are emerging as to the possible mechanisms influencing the condition (Akshoomoff, 2001). The hippocampus as well as the amygdala, both parts of the limbic system of the brain, are known to play key roles in acquisition and retention for memories, complex language, and emotional processing (DeLong, 2008; Mercolante et al., 2008). Additionally, both of these structures have multiple connections throughout the other cortical regions, necessary for complex processing and have been suspected of having structural or functional disorders in ASD (Aylward et al., 1999; Bauman & Kemper, 1985; Howard et al., 2000). Deficits in complex processing in ASD may be mitigated by poor interactions within these cortical systems as seen on functional magnetic resonance imaging studies (fMRI; Goldstein et al., 2008). This integration between the systems for memory and subsequent processing are becoming clearer as functional research leads to learning more about the neurological structural and functional components of the systems.

Researchers have suggested that memory and information processing systems are dynamic and can be reshaped; however individuals with ASD may not be able to benefit fully from this reshaping due to deficits in neurotransmitters. Long-term potentiation (LTP) is a post synaptic occurrence associated with neural plasticity resulting in strengthened synaptic connections for creating memories (Bruel-Jungerman, Davis, & Laroche, 2007). LTP is involved in the creation of memory, which is maintained by

neurogenesis, particularly in the hippocampus (Eriksson et al., 1998; Mercaolante et al., 2008). These new neurons have been suggested to be better suited for integration of information from cortical connections to the hippocampus due to their reaction to neurotransmitters such as gamma-aminobotyric acid (GABA; Bruel-Jungerman et al.). Complex processing from the higher level cortical regions to the lower centers such as the limbic system uses the neurotransmitter system of GABA and glutamate receptors. Deficits in GABA have a negative effect on cerebral organization, due to the impact on neurogenesis and connectivity (Levitt, Eagleson, & Powell, 2004). Furthermore, deficits in GABAergic system are suspected in ASD (DeLong, 2008; Hussman, 2001) This leads to a functional picture of decreased stimulation from the neurotransmitters resulting in deficits in neurogenesis, particularly in the area associated with complex memory and language (the hippocampus), which is connected to other higher level cortical regions, resulting in deficits in complex processing (DeLong; Hussman; Mercaolante et al.). In addition, other aspects of neurogenesis appear to be impacting plasticity but are less understood. An example of this is evidence of experiences and learning increasing dendritic branches of neurons and the subsequent connections between neurons.

Interventions which increase neurogenesis are therapeutic (Akshoomoff, 2001; Bruel-Jungerman et al., 2007). Several types of interventions have been demonstrated to be effective in increasing neurogenesis and subsequently memory and complex processing (Akshoomoff; Dong & Greenough, 2004). Among these are physical exercise, environmental enrichment, with the associated learning opportunities from being in new complex situations, and acquiring novel information (Brown, Cooper-Kuhn, Kempermann, van Pragg, Winkler, Gage, & Kuhn, 2003; Bruel-Jungerman, Laroche, &

Ranpon, 2005; Snyder, Kee, & Wojtowicz, 2001). The potential for increasing synaptic strength, neurogenesis, and potentially dendritic complexity leads to "behavioral plasticity" or overall changes in adaptive functioning (Dong & Greenough).

Expressive Communication and ASD

Form, content, and use represent an interacting network which formulates the multiple aspects of the expressive language system (Bloom & Lahey, 1978). Language form includes the syntactical and morphological components of utterance construction. These grammatical skills require knowledge and understanding of case, gender, sequencing and so forth. Morphology structures are used to give information regarding specifics of language. For example, in English, quantity (plurals) as well as possession and time (verb endings; Brown, 1973) are distinct types of morphology. In other languages, including sign language, there are different forms and components needed to create meaning. Through maturation, models, and practice, children acquire the necessary skills to refine their utterances to indicate precise meanings in these rule-based systems.

The content of language includes the semantic representations for what is seen, done, and conceptualized. Words can have subtle nuances and multiple meanings, which are developed through interaction and teaching activities. Over time children's language becomes more sophisticated as they emulate adult models. Their categorical knowledge and use of abstract words expands (Ameel, Malt, & Stoms, 2008). Of course, as stated above, the role of syntax and semantics, or form and content, cannot be separated. In order to understand and use language, each individual component (word, morphological marker) must be retrieved and then applied to a structural framework to achieve meaning (Friederici & Weissenborn, 2007; Gowie, 1976)

Language use involves multiple aspects of communication which are mediated by form and content. There are many functions or intents for communication including those which modify the environment (e.g., requesting, seeking comfort, protesting) and those with social, interactional components (e.g., greeting, seeking attention, showing-off, commenting; Wetherby & Prutting, 1984). These functions are approached differently, with different form for casual versus formal situations or different content such as speaking to an adult versus a child. Again, this demonstrates the interface between among language components. Other subtle cues which, although nonverbal, fall in the realm of pragmatics, or language use, include understanding body posture, facial expression, and tone of voice. Of course, at times, tone of voice is a necessary component of semantics (e.g., sarcasm and humor), again demonstrating the connections between the elements.

Development of these interconnected expressive skills is correlated with other early developing sills such as communicative intent, tool use, play, and imitation, an integrated and complex system (Bates, 1979). Ultimately, language development is negatively affected if any of the precursors of the system do not function correctly (Bates). However, when working in synchrony, spontaneous verbal communication appears effortless and natural. Young children begin to imitate and soon spontaneously initiate using language skills of increasing complexity to manipulate their environments and share experiences.

Although initiation and spontaneity are critical components of effective communication and reciprocal interaction (Prizant et al., 2006), there is some debate in professional literature regarding the best way to conceptualize them. Researchers have promoted varying operational definitions of spontaneous language. In general,

spontaneous communication (including initiations) stems from behaviors occurring without prompts or instructions (Chiang & Carter, 2008). Using the concept of antecedent relationship, there are two possible perspectives for consideration of the utterance: binary or continuum framework (Carter & Hotchkis, 2002). The binary condition is an all-or-none perspective. In this case, communication which occurs following a prescribed antecedent, such as someone asking a question, is reactionary, and not spontaneous. However in the absence of the antecedent, the utterance is considered to be spontaneous or initiated (Carter & Hotchkis, 2002). In general, the binary classification requires that spontaneous communication occur in the absence of questioning or partner prompting. However, there has been substantial inconsistency in the literature regarding the precise meaning of the necessary terms, such as prompting, within the operational definition of different investigations (Chiang & Carter, 2008).

Alternatively, spontaneous (initiated) speech can also be placed upon a continuum in which controlling stimuli serve as antecedents (Carter & Hotchkis, 2002; Chiang & Carter, 2008; Charlop, Schreibman, & Thibodeau, 1985). The continuum model acknowledges that each communicative act has some degree of spontaneity, from minimal to most intrusive to the speaker. Carter and Hotchkis' four level model accounts for a wide variety of antecedents and the communicative complexity represented in each. At the top of this continuum are behaviors in response to natural cues. This simply refers to the presence of a communication topic or referent and the presence of a listener. These interactions would be considered the most spontaneous as they are internally driven from the initiator where the environment alone evokes the communication. An example in this level could be a person looking through the entertainment section of the newspaper and

commenting to a friend that she would like to see a particular movie. The next level allows for stimulus highlights. In this level, a communication partner may make comments to help draw attention to particular targets, thus increasing their saliency in the environment and potentially influencing the possibility of a communicative act. Parents do this when they draw their toddler's attention by saying, “Oh, look!” The parent does not explicitly tell the child to ask, “What is that?” or say, “Ball,” but he may after prompt. The third level is referred to as generalized communicative cues. In this case, a communicative response is implied, but the specific content is not specified. A question such as “Tell me what you want” would result in a response at this level. The final level is most restrictive and therefore the least spontaneous. These are behaviors following specific direct prompts which are designed to elicit a discrete target response (Carter & Hotchkis, 2002). This level, would have directives such as a teacher saying, “Tell me your favorite book.” These four levels represent the two components of the binary framework along with more detailed classification to better describe different factors influencing utterances. The continuum framework allows for more precise information and consideration of the various ways the environment plays on communication.

Individuals with ASD exhibit disruptions in the form, content, and use of expressive communication. In general, they exhibit language form (i.e., grammar, syntax) at expected levels (Tager-Flusberg, 1996); however, there are some exceptions. Eigsti, Bennetto, and Dadlani (2007) found that children with ASD had less complex language and shorter mean length of utterances than comparison children. Additionally, those with ASD make errors in first and second case pronoun usage, such as saying, “You want” rather than, “I want” more frequently than those who are developing typically. This

common error has been theorized to reflect an echolalic response rather than internal processing of the language form (Schuler & Prizant, 1985; Wetherby, Prizant, & Schuler, 2000). Echolalia is one manifestation of a gestalt learning style. In this style chunks of language, such as multi-word utterances, are memorized without consideration or analysis. Storing and processing information using this method is not as effective as an analytical style, in which a person extracts the meaning of an utterance and relates it to other relevant information for effective storage and recall (Wetherby et al.). Echolalia can be viewed as an example of a disordered interaction between language, memory, and processing.

Individuals with ASD also demonstrate consistent deficits in expressive language content. For example, they are more likely to use neologisms, or non words, which are not in the standard lexicon, than those who are developing typically or those with other disabilities (Cantwell, Baker, & Rutter, 1978; Werth, Perkins, & Boucher, 2001; Wetherby & Prutting, 1984). Examples of neologisms from Volden and Lord (1991, p. 118) include utterances such as, “and so he's seriously wounded like cutses and bloosers” which they interpreted to mean “cuts and bruises” and “turken” to mean “turkey.” The researchers found that neologisms in those with ASD did not represent a developmental stage in communication because they were not present in the speech of children who are developing typically or those with mental retardation. Volden and Lord also found that children with ASD used more idiosyncratic language than the comparison groups. Idiosyncratic language refers to using true words or phrases in nonstandard forms for specific meaning. Examples of idiosyncratic language include, “That woman is wiping her hair” to mean that she is drying her hair and “It's ready to come and ready to go” to

mean “easy come, easy go" (p. 118). This idiosyncratic use of conventional and non words can be a barrier to effective interactions, as communication partners are not sharing a common vocabulary (Volden & Lord); however, they reflect creative use of language (Werth et al.).

Semantic problems, such as general receptive and expressive vocabulary deficiencies, may be associated with attention and social interaction deficits such as joint attention. If a child is not sharing attention with an adult as a new word is presented, inappropriate associations between meaning and label may be formed leading to a subsequent vocabulary disorder (Baron-Cohen, Baldwin, & Crowson, 1997; Hale & Tager-Flusberg, 2005; McDuffie, Yoder, & Stone, 2006). Memory skills are necessary for semantic development and analytical language processing, including relating new information to previously stored knowledge.

Finally, per definition, deficits in language use (pragmatic language), are found in all individuals with ASD (APA, 2000). Examples of these pragmatic differences include limited initiation of spontaneous remarks, odd prosody, off topic responses, limited communicative functions, and irrelevant comments (Cantwell et al., 1978; Capps, Kehres, & Sigman, 1998; Hale & Tager-Flusberg, 1995; Tager-Flusberg, 1996; Tager-Flusberg & Anderson, 1991; Wetherby & Prutting, 1984). Deficits in these basic interaction skills lead to decreased skill in interpersonal interactions, particularly in sustained communication and conversation abilities.

Recently investigators have confirmed that part of the pragmatic difficulty found in conversation with those with ASD is that they engage in more illogical thinking, use abrupt topic changes, and make fewer salient associations when speaking to others

(Prizant et al., 2006; Solomon, Ozonoff, Carter, & Caplan, 2008). This pragmatic deficit, qualified as formal thought disorder (FTD), has been compared to the unorganized speech of other disorders, such as schizophrenia (Solomon et al.; van der Gaag, Caplan, van Engeland, Loman, & Buitelaar, 2005). However, careful study of the characteristics of FTD in people with ASD indicates that the underlying association problem is distinctly different from schizophrenia and represents a context processing deficit in executive function. Deficits in organized and on-topic interactions represent impairments in executive control. These problems can be theorized to be the result of abnormal neural connectivity between the frontal cortex, involved in complex processing, and other posterior cortical areas responsible for language and recall, reflecting problems with higher order top-down control of processing (Kuperberg et al.; Solomon et al.). Without benefit of executive control in a top down construct, all information is processed with equal intensity; unnecessary and irrelevant information are not filtered from the system. Rather than representing a FTD, abrupt topic changes and irrelevant comments provide further evidence of information processing deficits in the population.

Possibly the greatest expressive communication deficit in ASD relates to deficits in spontaneous initiations. Spontaneous communication allows a speaker to control the interaction (Charlop, Schreibman, & Thibodeau, 1985), maintain context-specific interactions (Krantz, & McClannahan, 1993), and achieve control over the environment while learning about the world (Kaczmarek, 1990). If spontaneity is viewed as expression in the absence of a prompt from a communication partner, then it is worth noting that individuals with ASD present with an increased reliance on cues and prompting from others in comparison to those without ASD (Charlop et al.; Odom & Strain, 1986).

Individuals with autism rely more on verbal cues such as stimulus highlights, generalized communication cues, and specific direct prompts from communication partners than information from the environment (i.e., natural cues) for producing language (Carter & Hotchkis, 2002; Charlop et al.).

Functional expressive communication, including spontaneous initiations, provides a more socially acceptable means for children to express themselves as opposed to using challenging behavior, such as self injury, to escape demands or gain access to desired attention or items. Initiation allows for increased overall independence in communication (Carr & Durand, 1985; Charlop et al., 1985; Kaczmarek, 1990). Furthermore, skills in language use allow children to express thoughts via conventional communication, such as speech or communication devices, so that others can understand and respond (Koegel, Bruinsma, & Koegel, 2006; Wetherby et al., 2000). This leads to opportunities for extended interactions, decreased behavior problems, and greater comprehension. Overall, the complexity of language and its components, plus the social constructs of the requisite skills, contribute to the difficulty individuals with ASD experience in mastering this core ability. Since initiation and spontaneity are critical for independent communication, and they are an area of need for children with ASD, many programs for individuals with ASD recommend teaching spontaneous communication and initiation with others (Chiang, & Carter, 2008; NRC, 2001; Prizant & Wetherby, 2005).

Language Interventions for Children with ASD

Spontaneous communication, which is creative, generative, and conventional, is a target for many language interventions involving children with ASD (Prizant et al, 2000). Select examples of some of these interventions include adult-mediated or peer-mediated

approaches, video modeling, Picture Exchange Communication System (PECS), and Social Stories™. These interventions target improved functioning via better retrieval of information, connections between cortical centers, and emphasis on salient targets for top-down information processing.

The adult-mediated approaches typically utilize behavioral techniques and structured procedures followed by systematic fading of prompts during generalization phases. Charlop et al. (1985) demonstrated the efficacy of using a time delay procedure to increase spontaneous requesting for seven boys with autism diagnoses. The participants learned to request a desired object without a verbal stimulus. This skill was generalized to different settings and communication partners through a carefully monitored behavioral paradigm. Although the request may not be considered to be completely spontaneous, the skill provided the participants with a new level of personal control (Charlop et al.). In a different type of intervention, Krantz and McClannahan (1993) used written scripts to help children with autism participate in structured conversations with peers. The written scripts provided a scaffold for communication which was eventually faded. In addition, the children were able to make some linguistic generalizations by generating variations of the script topics in their interactions. In another application of behavioral technology, McGee and Daly (2007) used incidental teaching to teach social phrases to three children with ASD. The children incorporated the target phrases in structured settings using a prescribed methodology of child focused requests and comments for preferred items. Upon acquisition of the target skill, there was some generalization to less structured activities without prompts. Although, the researchers observed tendencies for echolalic

speech and limited use (i.e., only using the phrases for requesting for two of the three children), there were, nonetheless, changes in the spontaneous use of the targeted phrases.

Peer-mediated strategies (Owen-DeSchryver, Carr, Calse, & Blakeley-Smith, 2008) offer an alternative to adult-directed strategies for increasing spontaneous communication and are frequently taught in applied settings (Laushey & Heflin, 2000; Owen-DeSchryver et al, 2008). Pierce and Schreibman (1995, 1997) utilized peers who had been trained to increase social interactions to participate in interventions with children with autism in order to increase complex social behavior such as initiation and increased attention. Classroom (familiar) and unfamiliar peers were trained to promote appropriate social engagement and how to reinforce communication when playing with classmates with autism. The peer trainers used pivotal response training by incorporating motivating situations in natural contexts, thereby promoting generalization. In both studies the participants exhibited increases in the social skill of initiating conversation without a prompt. In addition, the frequency and length of verbalization increased over the course of intervention. The authors theorized that the intervention was effective because the frequency of choice and variation helped create an expectation, or establishing operation, for the situation. Also, peers provided many examples of the target skills, and the participants were frequently reinforced for any attempt of communication so they had a high success rate (Pierce & Schreibman, 1995). With the success, a cyclical pattern of positive reinforcement began. More success in communication increased the likelihood of more spontaneous use. More use increases the strength of the neural connections mediating the target behavior. Stronger connections make the communication pattern easier to use.

Similarly, other interventions have used trained peers as facilitators to increase general social skills of children with autism in integrated school settings (Laushey & Heflin, 2000; Owen-DeSchryver et al., 2008). In these programs peers or peers and target children with ASD were taught specific strategies to promote understanding of and interaction with others who were different is some way. Both programs included spontaneous initiations by children with ASD as part of their data collection; however, neither separated verbal from nonverbal initiations, and both combined requests and comments into a single dependent variable. The results of both, however, indicated an increased number of initiations from the target children. Peer-based research demonstrates the benefit of structured training of classmates as a means to offer children with ASD a more socially viable environment for communication. This may be attributed to increased opportunities to communicate and more successful interactions leading to a reinforcing situation where the target child is self motivated to continue the interaction (Owen-DeSchryver et al., Peirce & Schreibman, 1995). Providing an enriched environment is one of the means of increasing neurogenesis and creating long-term neurological change. There are documented benefits to using peers for language models; however, training must occur separately from the regular curriculum, dictating the need for additional effort and time to implement (Laushey & Heflin, Owen-DeSchryver et al.).

Video modeling is another intervention for children with ASD which has demonstrated efficacy for increasing spontaneous communication skills (Bellini & Akullian, 2007; Sansosti & Powell-Smith, 2008). In an intervention targeting spontaneous requesting skills, four children with autism increased their requesting upon the introduction of video models. For three of the participants, the change was rapid. The

fourth, who did not appear interested in watching himself on screen, took longer to demonstrate the skill but still increased (Wert & Neisworth, 2003). Similarly, Charlop and Milstein (1989) used video models of social conversations to teach three children with autism successful methods to maintain conversation with adults and peers. Following the video tape viewing, children reenacted the scripted scene to help prepare in the upcoming encounter with a different conversation partner. This aspect is similar to priming, which is discussed later in this document. In a similar intervention, Sherer et al. (2001) demonstrated the benefit of using a video modeling system prior to interaction to increase sequential verbalizations of children with ASD and a clinician. Although this approach was not effective for all students, several increased their use of conversational questioning. The children who exhibited success did not show a preference for watching videos of themselves or others as the models. This may be beneficial as video models generally can be created more quickly using peers with typically developing language skills. However, more research is necessary to fully determine the extent of influence the model has over the specific behavior (Sherer et al.).

Video modeling was included as part of package interventions targeting verbal behavior. Apple, Billingsley, and Schwartz (2005) found that video modeling produced slight increases in the number of compliments children with ASD gave to their peers. However, the intervention was more successful when a verbal contract or self-management technique was added to serve as a frame for the spontaneous social interactions. Sansosti and Powell-Smith (2008) and Thiemann and Goldstein (2001) used video models along with a Social Story™ (see below) to increase social communication such as maintaining a conversation, initiations for comments and requests, and answering

questions from peers. Prompting prior to the event was added for some of the children. The results reflected improvements in the target behaviors; however, due to the intervention package, the contribution of each component if unclear. The use of video models can serve as a staring point for semantic recall via an event script or general schema. This in turn can prime the child for the upcoming event.

Augmentative systems such as the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) have been used as an alternative to spoken language for children with ASD who do not use functional expressive speech. PECS is unique among these systems as it targets requesting, not labeling as the first skill, does not require the user to match a target to a sample, and uses physical, rather than verbal prompting. The premise behind PECS is that the child learns to make spontaneous requests following a systematic implementation and subsequent reduction in supports from a training assistant, but not a verbal request from the communicative partner (Bondy & Frost, 1994, 1995). Therefore, pragmatic intent is not reliant on verbal cuing, leading to more natural acquisition of spontaneous initiations. Following successes with basic requests, the PECS protocol specifies steps for increasing participant independence, utterance complexity, and communicative functions. Additionally, independent initiations continue to be a target goal, as the users learn to gain attention and make comments about the environment (Frost & Bondy, 2002). PECS has been successfully used to increase spontaneous requesting for individuals with ASD and other impairments from preschool to adulthood (Bondy & Frost, 1994, 1995; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz & Simpson, 2004; Stoner et al., 2006) and has been demonstrated as

an efficient tool for most, but not all, of the research participants (Ganz, Sigafoos, Simpson, & Corbin-Newsom, 2008; Stoner et al.).

Charlop-Christy et al. (2002) conducted the first carefully designed empirical study of PECS. All three participants were able to acquire all six phases of PECS. Additionally, the investigators documented benefits of increases in social skills such as joint attention and initiation and decreases in problem behaviors. Since this initial investigation, many others have demonstrated both success with communication and increases in socialization skills when using PECS with children with ASD (Buckley, & Newchock, 2005; Tien, 2008). PECS offers a systematic means to address beginning communication beyond spontaneous requests. Some PECS users who advance to the later phases of the system acquire responding to questions and spontaneous commenting skills (Charlop-Christy et al.; Kravits, Kamps, Kemmerer, & Potucek, 2002).

There are some potential limitations with using PECS. First, individual characteristics appear to influence the benefit of PECS over other communicative systems (e.g., signing) for some children (Tincani, 2004). Additionally, this system can be potentially expensive, as it requires two trainers for the initial phases. Of course, the cost of other augmentative devices may negate this concern. These concerns aside, PECS has been found to be widely effective and efficient for acquisition of functional communication for many children with ASD (Tien, 2008).

PECS has been theorized to be beneficial in increasing spontaneous communication for several reasons. It is concrete, visual, and highly reinforcing (Bondy & Frost, 1994; Charlop-Christy et al.). Children are motivated to request preferred items and the presence of the picture for exchange reduces not only memory demands but also

simplifies information processing. Furthermore, students generally acquire the skills of PECS rapidly and effectively (Lancioni et al., 2007) and it does not require extensive training or motor skills from the participants (Bondy & Frost, 1994). PECS and similar picture-based communication systems have been successfully generalized across various communicative partners and situations (Carr & Felce; Ganz, Sigafoos, Simpson, & Cook, 2008; 2007) resulting in it being an appropriate choice for allowing non- or less-verbal individuals with ASD opportunities for spontaneous communication.

Social Stories™ (Gray, 1994, 2000; Gray & Garand, 1993) are individually constructed stories which help explain social expectations and expected behavior. Social Stories™ are presented to a child in an individual and relaxed fashion prior to a targeted situation or event (Gray & Garand). They are repeated frequently (based on the individual needs of the child) and help organize recall and memory for the targeted skills. Social Stories™ have been used to introduce many different skills to children with autism including social engagement, initiation of comments and requests, and contingent responding. Delano and Snell (2006) completed a carefully designed intervention which explicitly introduced social language goals as a variable. The target students listened to a Social Story™ which contained information regarding the specific activity of the session as well as examples of the four social goals targeted in the intervention: securing attention, initiating a comment, initiating a request, and making a contingent response. Following the story, the participants answered a few comprehension questions before participating in a 10-minute play session with a peer. Results revealed improvement in attending, spontaneous requests, and contingent responses to a peer who was trained to

respond as well as to an untrained peer. Two of the three participants demonstrated generalized improvements in other classrooms.

Thiemann and Goldstein (2001) and Scattone (2008) used an intervention package which, among other strategies, included Social Stories™ to target similar social skills in children with ASD. Thiemann and Goldstein created stories which described specific skills of securing attention, initiating comments and requests, and making contingent responses. Prior to each activity session the children read Social Stories™ and participated in a role play based on a picture with a cue about using target social goals. Parents also read the stories to the children nightly during the intervention. Next, children with ASD and peers who were typically developing participated in a 10-minute social activity. Following the activity, the children reviewed video tapes of their interactions and critiqued their use of the targeted social skill. Scattone also used a package with both Social Stories™ and video modeling to increase social-conversational skills for a student with Asperger's syndrome. The intervention demonstrated efficacy for improvement of spontaneous initiations including social comments and questions, along with eye contact. In sum, the exact impact of each aspect of these package interventions cannot be determined, however, Social Stories™ were a component of a successful increase of social communication skills in each.

Ivey, Heflin, and Alberto (2004) introduced various attending and participation skills for children participating in novel events via Social Stories™. Included in these was a target of spontaneous requesting of key materials needed for completion of the activity or requesting information of the adult communication partner. Other participation skills included remaining on task, completing a key element of the activity, and using

targeted vocabulary. Overall, each of the participants exhibited an increase in the social participation skills addressed in the Social Stories, although spontaneous requesting data were not explicitly documented. This study introduced a new use for Social Stories™: priming for novel situations.

Social Stories™ have been demonstrated to be an effective intervention for increasing play and choice making (Barry & Burlew, 2004), decreasing inappropriate or undesired behavior (Croizer & Tincani, 2005; Kuttler, Myles, & Calrson, 1998), and recognizing emotions (Bernad-Ripoll, 2007). Of course, they have been demonstrated effective in increasing social skills more than any other target. Within these social skills, initiation is frequently improved. Social Stories™ were first introduced over a decade ago. However, the underlying mechanism for their efficacy has not been clarified. The stories appear to present a means for organizing a complex social event or skill that the child has substantial difficulty processing and reacting with age or socially appropriate skills.

Several communication interventions are demonstrating effectiveness for increasing initiations and other forms of social language for children with ASD. However, many of these require extensive preparation (video modeling, Social Stories™) or specialized materials (PECS) or training (time delay/behavioral strategies). Intervention options which require less time and preparation are needed for helping children with ASD improve their use of expressive social language (Licciardelo, Harchik, & Luiseli, 2008; Zanolli, Daggett, & Adams, 1996). A targeted approach should take into account specific needs of children with ASD, including their deficits in processing complex information, memory, and communication.

Priming

One strategy, priming, is emerging as an intervention designed to reduce memory and information processing demands by increasing prior knowledge of a task or situation, leading to improved functioning (Wilde, Koegel, & Koegel, 1992). The fundamental aim of priming is to allow a child to become familiar with novel materials, processes, vocabulary, skills, and goals of upcoming activities before their introduction in the relevant context. This gives the child an opportunity for exposure to basic information before being expected to use it in functional situations (Wilde et al.). The priming described in this model is considered "conceptually driven priming" (Tulving & Schacter, 1990; Vriezen, Moscavitch, & Bellos, 1995). Conceptual priming occurs with conceptual tasks and requires semantic processing. So, conceptual priming reflects semantic learning, which includes adding to or modifying information in the semantic memory system (Gardiner, 2008; Tulving & Schacter). Information stored in semantic memory is reactivated for recall for a specific event. Subsequently, it will be stored as an event in episodic memory, while enriching semantic knowledge.

In the field of education, priming, or preteaching as it is also called, has been effective in helping children with and without disabilities improve academic skills. Burns, Dean and Foley (2004) used preteaching of unfamiliar words to improve reading fluency and comprehension for children identified as having reading disabilities. Additionally, Kameenui and Douglas (1986) introduced concepts of subtraction prior to direct instruction to second grade students who were not meeting standards for math.

The effects of priming, per se, are not impaired in individuals with ASD (Bowler, Matthews, & Gardiner, 1997; Gardiner, Bowler, & Grice, 2003; Minshew, Goldstein, Taylor, & Siegel, 1994). Gardiner et al. demonstrated that responses to both perceptual and conceptual priming are intact in individuals with Asperger's syndrome. Indicating semantic and perceptual systems are intact. However, there seems to be a deficit in applying the concepts to formulate complex connections to stimulate recall via episodic memory (Bowler et al.; Gardiner et al.; Minshew et al.). This is consistent with the findings of Minshew et al. (1997) and Williams et al. (2006b) regarding decreased application of skills in adults and children with ASD for tasks as they became increasingly more complex. One possible way to help enhance episodic memory formation may be adding components to the priming which relate the current task to the individual's prior knowledge.

Priming is an intervention which addresses specific needs of children with ASD and addresses some of the concerns raised regarding other intervention programs. Priming requires only a brief time to implement, uses authentic materials, and is relatively easy to accomplish (Licciardello et al., 2008). It is well suited for children with ASD as it specifically targets memory and information integration, key deficit areas in this population, while using underlying systems which are intact (semantic memory and simple recall from priming; Bowler et al.1997; Minshew et al., 1994). Novel information becomes more familiar in subsequent presentations if it has been primed. The repetition is beneficial for increasing processing by using recall strategies from long-term memory, rather than having all novel inputs going into the sensory register and central executive system. Subsequently, a person can use top-down processing to help integrate

information, potentially increasing organization and alleviating the likeliness of characteristics of FTD. Furthermore, priming is customarily done as a discrete event prior to an activity, facilitating memory. Priming is beneficial in helping with memory organization and processing subsequent repetitions of a task. Priming specifically targets enhanced predictability for improved functioning, because novel materials are now familiar in the targeted context. Priming serves as a precursor to upcoming activities, both academic and social.

Wilde et al. (1992) describe the procedure and some outcomes of using priming for children with special needs, particularly those with ASD. This frequently referenced manual describes a basis for the procedure and expectations for using a preparation strategy to help children increase their prior knowledge of upcoming demands in order to facilitate their participation in the actual event. According to the suggested protocol, children are introduced to new material the night before it will be presented at school. The new information is presented in an interesting, fun, and non-threatening manner, generally by their parents. The children should guide the interaction and be offered choices about how they would like to approach the materials. The adult should not be judgmental or forceful during priming. This brief interaction is intended to be an introduction, not the complete lesson. The children become familiar with the information such as a book or activity, so that the memory of the content can facilitate increased retention and participation in the actual task. Priming is used in a low demand, highly reinforcing environment to facilitate introduction of novel information before it is used in a functional setting (Wilde et al.).

In a case study from the initial manual specifically naming priming as an intervention for children with ASD (Wilde et al., 1992), priming is described as an effective means of helping the child decrease disruptive behavior and increase story comprehension. Furthermore, this particular child's family found the intervention to be so successful that they applied it to other activities throughout his day (Wilde et al.). Since that time, several researchers have used priming strategies to help children with ASD accomplish different tasks. In many cases, the intervention was not specifically called "priming," however the concepts were similar (Luscre & Center, 1996). Frequently, priming was used as part of a package intervention (Boettcher , Koegel, McNerney, & Koegel, 2003; Licciardello et al., 2008). Unfortunately, studies on priming interventions have not always been conducted using research designs capable of demonstrating a functional relation between the intervention and the observed improvements (Boettcher et al., 2003). However, the priming interventions, both independently and in a package, provide some evidence of effectiveness for this method.

Several authors describe examples of the benefits of priming in specific targeted behaviors. Bainbrige and Myles (1999) introduced toilet training to a young child with autism by using a commercially available video tape as a means of priming. After not watching the video tape during baseline, the child watched the tape three times a day during intervention. Following the viewing, he was told to go to the potty. During the sessions with priming by the video tape, the child increased his initiations of toileting (getting up to go to the bathroom without a physical prompt) and decreased the number of wet diapers during the day. This intervention was effective but limited to only one child and one skill. Additionally, Luscre and Center (1996) used systematic

desensitization to decrease dental fears in children with autism. By using a package which included a video of models in the dental chair, reinforcement, and practice tolerating the components of the dental visit (a mock waiting room, being near the dental materials), the children in the study were able to complete many steps of the dental visit in the mock chair, with some generalization to the actual dentist's office. Although this procedure was not called priming, the concepts in the systematic desensitization were similar to those used in other priming research, as the children had multiple exposures to authentic or similar materials before the actual dentist visit.

Decreasing challenging behavior is one of the more common targets of priming. Boettcher et al. (2003) describe a multi-component intervention to help a child with autism prepare for an upcoming disruption. Through the careful preplanning, which included priming with a calendar, having family meetings, and coordination of service needs, the child exhibited no problem behaviors on observation at home or based on reports from school. This informal discussion describes the benefits of priming with careful consideration of a child's specific needs in a stressful situation. In more formally designed interventions, priming of school assignments and multiple transitions decreased problem behavior and increased academic responding and general language. In one intervention, two children with ASD and distinctly different ages (5 and 15) both responded more frequently in class and had fewer problems when their academic material was primed either the night before or a class period before it was introduced by a teacher (Koegel, Koegel, Frea, & Green-Hopkins, 2003). Schreibman, Whalen, and Stahmer (2000) created specifically designed videos of transitions from one place to another (within the home, a mall, and other community locations). Not only did the video priming

lead to virtual elimination of the problem behavior, but the families observed an increase in expressive language for the participants. Additionally, the authors noted that one of the participants did not particularly enjoy watching the video and needed frequent reminders and external reinforcement for attention. Nonetheless, his behavior improved substantially, similar to the others. This led the authors to question if the priming activity need be reinforcing to be effective.

Sawyer, Luiselli, Ricciardi, and Gower (2005) used a multi-component package to increase verbal and physical sharing for a four-year-old boy with autism. This package consisted of priming via a demonstration of targeted sharing skills, prompting to use skills during play, and verbal praise when the skills were observed. In an ABCB design, priming with the in vivo components proved successful for increasing the social target more than no intervention or prompt and praise alone. Priming was not used independently of the other components.

Finally, priming has been used to increase social skills, particularly social interactions and initiations to peers. Hetzroni and Tannous (2004) used a specifically designed interactive computer program depicting simulations of familiar daily life activities for children to watch before participating in the activities. Following the video viewing, the children engaged in play, food, and hygiene activities in the natural environment. Measurements of language function documented less delayed echolalia and irrelevant speech, increases in related speech, and more initiation of spontaneous communication. Following priming within a 3-part package including preteaching from a classroom paraprofessional or priming via participation in a 10-minute training session prior to a play session, seven children with ASD increased frequency of initiations,

responding, greeting, complimenting, and sharing with peers. Multiple baselines were used to demonstrate functional relations between the intervention and outcomes (Kamps et al., 1992; Licciardello et al., 2008). These essential skills, both verbal and nonverbal, add to children's social abilities and lead to longer episodes of both receptive and expressive interactions. Zanolli et al. (1996) also addressed the need for children with ASD to increase initiations in communication, particularly with peers. Their intervention followed the premise of Wilde et al. (1992). Two children with ASD practiced specific social skills just before participating in a play session with classroom peers, some of whom had been trained for responding and offering a token for social language. Both children increased their use of socialization skills such as looking at peers, smiling, requesting toys, saying the peer's name, and requesting attention. These skills were not prompted once the activity (play) session had started.

Overall, priming and activities that offer prior exposure or practice of new concepts have been beneficial in learning new skills, decreasing problem behavior, and increasing desired behavior for children with ASD. Several of these studies used complex mechanisms such as individually created videos (Schriebman et al. 2000) and computer programs (Hetzroni & Tannous, 2004), while others simply involved previewing class material (Koegel et al., 2003). These interventions documented the use of priming a specific target and measuring the outcome, but several researchers observed collateral benefits which were not specifically documented, such as increased language use (Hetzroni & Tannous; Schriebman). Therefore, further research involving priming and subsequent changes in language during typical childhood activities may yield interesting information to this line of work. Furthermore, priming has been theorized to be effective

as part of a reinforcement system (Koegel et al.). This may be part of the reason that children with ASD respond to the technique. It has low demands, is child driven, and may give a child increased attention to target tasks (Koegel et al.). As such, the potential for neurological changes due to LTP in the structure and function of the memory system enhance the benefit of this intervention. Priming also supports memory recall by providing repeated exposure to materials and activities.

Repeated exposure has been demonstrated to result in faster and more accurate responses in recognizing and making judgments regarding items which have been previously viewed (Dobbins, Schnyder, Verfaellie, & Schacter, 2004; Wig, Grafton, Demos, & Kelly, 2005). Research in priming, specifically repetition priming, has given insight into the neurological underpinning of this construct. Priming allows for increased processing of information by way of reduced speed for access to information, which in turn facilitates observable behavioral performance regarding primed targets. This process occurs rapidly and distinctly. Additionally, research in functional imaging has demonstrated that priming effects are observed in the same neocortical regions responsible for the response (Henson, 2003). Furthermore, the mechanism for priming has been demonstrated to cross cortical regions leading to integration of these areas within a task and result in a top-down direction of information flow (e.g. processing originates in the prefrontal cortex, one of the primary cortical regions for making decisions, sending information to the temporal lobe, where memory systems are housed thereby optimizing processing efficacy; Ghuman et al., 2008). Priming results in changes in interaction between these cortical centers.

Interaction of Information Processing, Memory, and Language

One of the important aspects of priming relates to the semantic memory system (Henson, 2003; Tulving & Schacter, 1990). The semantic memory system relies on efficient storage and recall of information from the sensory registers and formulation of related representations which leads to noetic consciousness. The semantic memory system provides the basis for episodic memories, which are highly individualized and specific, creating autonoetic consciousness (Tulving, 1985). Deficits in comprehension of language or social information and reduced expressive language skills, particularly for complex information, lead to poor memory formation (Boucher, Bigham, Mayes, & Muskett, 2008). The processing deficits tend to surface as situations become increasingly complex and lead to deficits in other measurable behaviors, including language and related pragmatic skills. Verbal language and pragmatic skills require integration of information from multiple cortical locations for effective functioning (Goldstein et al., 2008; Ghuman et al., 2008; Harris, 2003; Minshew et al. 1997; Mundy, 2003). In some situations, supports such as prompts and being accompanied by another person serve as scaffolds to better performance (Hare et al., 2007; Milward et al., 2000; Volden & Johnson, 1999). However, in unpredictable situations, children with autism have exhibited decreased behavioral skills, language use, and interactions. Similar to memory-based tasks, these skills improved when the environment was more predictable (Ferrara & Hill, 1980; Flannery & Horner, 1994; Ivey et al., 2004). Therefore, providing supports in the environment that allow for increased predictability may help with integration of new information and subsequently lead to measurable improvements in key communication skills including spontaneous verbal language. In this case, the long-term

memory store may provide a link to relevant information which is intentionally related to the new situation (Ghuman et al). By decreasing the amount and complexity of processing necessary to function in the environment, the individual's processing channels may be better used for more complex skills, such as difficult social communication. The associations between past memories and novel experiences help formulate predictions of what to anticipate and allow for efficient activations of neural mechanisms leading to improved behavioral performance (Ghuman et al.; Kveraga et al., 2007).

Conclusion

Children with ASD may have difficulties with many areas of development, three of which are the interrelated skills of information processing, memory, and expressive communication (Boucher et al. 2008; Williams et al., 2006a). Priming can be used as an intervention to improve functioning in these areas. Once an event has been primed, there is an opportunity to integrate previously primed, now more familiar, information with more advanced or newly acquired skills. Some of these more advanced skills are initiation of interactions, comments, and reciprocal communication, such as conversations. Information regarding neurological constructs of cortical connectivity, neuroplasticity, and single-trial learning for episodic recall all support the functionality of using a priming procedure to increase processing of new material. In addition, use of scaffolds such as priming are a means of support which offer individuals with ASD an opportunity to prepare for novel situations with less perturbation. During recall, the priming task can be used as a cue which may facilitate recall of self-experienced events (Hare et al., 2007; Millwood et al, 2000). The increased attention and participation may improve ability to formulate new neural associations and use further complex processing.

At this time, improvements in initiation such as spontaneous requests, comments, and reciprocal communication following priming have not been investigated within a learning environment, but have been suggested anecdotally. Research is needed to explore the potential benefit of priming before activities for increasing spontaneous verbal language in children with ASD.

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CHAPTER 2

EFFECTS OF PRIMING ON SPONTANEOUS VERBAL LANGUAGE OF CHILDREN WITH AUTISM SPECTRUM DISORDER

Pervasive developmental disorders or autism spectrum disorders (ASD; Lord, Cook, Leventhal, & Amaral, 2000) are a category of neurological and behavioral differences which result in deficits in three key areas of functioning: social interactions, communication, and behavior (American Psychiatric Association [APA], 2000). As evidenced by the name, children with ASD experience pervasive deficits in development across many systems and skills. Included among these are problems of varying severity with memory, information processing, and expressive communication (Kanner, 1943; National Research Council [NRC], 2001; Prizant, Wetherby, Rubin, Laurent, & Rydell, 2006; Wilkinson, 1998; Williams, Minshew, & Goldstein, 2008). The ability to use spontaneous communication, an important aspect of social interaction, relies on the development and interaction of these key skills. Interruption in these systems may result in the communication deficits commonly seen in individuals with ASD resulting in the need for intervention to address social communication deficits

Memory in ASD

Over decades of research and discussion, memory has been characterized as being composed of discrete but interacting components (Gardiner, 2008; Solso, MacLin, & MacLin, 2005). This complex, organized, multi-level system has been documented, in

part, via relatively new neuroimaging techniques (Atkinson & Schiffrin, 1968; Baddeley & Hitch, 1974; Gardiner; Schacter &Tulving, 1994). The differentiated components of memory include two gross categories of long-term memory: imperative memory (perceptual memory, procedural memory) and declarative memory (semantic memory, episodic memory).

Long-term imperative memory includes perceptual memory (lasting perceptions of the characteristics of objects and events) and procedural memory (retention of motor and cognitive skills learned through practice over time). The ability to sense and react to a given stimuli within procedural memory is referred to as anoetic consciousness (Tulving, 1985). The two forms of long-term declarative memory include semantic memory (recollection of words, concepts, rules, and even abstract ideas) and episodic memory (the neurocognitive system that enables people to remember what happened in their individual past; Schacter & Tulving, 1994; Tulving, 1993). Whereas procedural memory produces anoetic consciousness, semantic memory produces noetic consciousness, or knowledge of the world. Noetic consciousness is free of context but full of facts (Tulving, 1985). Episodic memory creates an autonoetic consciousness (Tulving, 1985). Autonoetic consciousness is self-knowing, giving individuals an awareness of personal identity and a sense of personal time. Episodic memory builds from semantic memory, which stems from procedural memory. Connections between the components are essential to a functioning system (Tulving, 1985, 1993, 2002). Finally, working memory, which contains multiple components for processing, holds pertinent information during execution of complex tasks. Working memory has been conceptualized as the interface between short-term perception processing and long-term

storage and recall of information (Baddeley & Hitch, 1974, Baddeley, 2000). This elaborate system requires synchronous organization to function properly (Schacter & Tulving, 1994; Tulving, 1985).

Formation of episodic memories stems from the ability to store and recall effectively. The recall of previously novel stimuli stimulates the limbic system with varying amounts of activity (Rekkas & Constable, 2005). A stronger neuronal response leads to a more successful recall of a particular stimulus or event (Rutishauser, Schuman, Mamelak, & Adam, 2008). Selective firing occurs in the limbic system with different intensity for new versus familiar stimuli (Rekkas & Constable; Rutishauser, Mamelak, & Schuman, 2006), to facilitate rapid learning of novel stimuli. The rapid neuroplasticity for creating memories based on single-trial learning may be due to the release of neurotransmitters which support the neurological changes needed for creation of long-term memory (Rutishauser et al., 2006).

Substantial evidence indicates that individuals with ASD have memory difficulties (Greenberg & Rubin, 2003; Klein, Chan, & Loftus, 1999; Milwarad, Powell, Messer, & Jordan, 2000; Renner, Klinger, & Klinger, 2000; Williams, Goldstein, & Minshew, 2006b). For the most part, semantic memory and noetic consciousness remain intact for individuals with ASD, particularly for those who are considered high functioning (Salmond, Adlam, Gadian, & Vargh-Khadem, 2008; Salmond et al., 2005; Toichi & Kamino, 2002). However, there appears to be a relatively selective deficit in episodic memory (Ben Shalom, 2003; Klein et al. 1999; Milward et al., 2000; Salmond et al., 2005). Deficits in episodic memory in individuals with ASD lead to poor organization of personal memories and difficulty integrating semantic knowledge (Bennetto,

Pennington, & Rogers, 1996; Klein et al.; Minshew & Goldstein, 1993; Renner et al., 2000; Trillingsgaard, 1999). Furthermore, individuals with ASD appear to lack rapid, functional access to personal memories (Crane & Goddard, 2008; Hare, Mellor, & Azmi, 2007). Specifically, there are deficits in autonoetic consciousness among individuals with ASD (Bowler, Gardiner, & Grice, 2000; Toichi, 2008).

Interestingly, memory of personal episodes requires interaction between many regions throughout the cortex, including the sensory centers, limbic system, and prefrontal regions (see Greenberg & Rubin, 2003 and Ben Shalom, 2003). These complex interconnections between cortical areas have been found to be markedly deficient in individuals with ASD (Ben Shalom; Just, Cherassky, Keller, & Minshew, 2004; Minshew & Goldstein, 1998; Minshew et al., 1997), potentially being responsible for differences in the way this population processes information from encoding to storage to recall. Additionally, underlying deficits in language may further affect memory coding and recall, further supporting the intimate connections between memory, information processing, and language (Baddeley, 2003; Williams et al., 2006a, 2006b).

Information Processing in ASD

Information processing is a complex skill theorized to result from the interaction of multiple cognitive systems. This process relies on quick, accurate recognition, consideration, association, and storage of incoming information. New information needs to be stored with other relevant contextual information for future rapid recall the next time it is needed (Atkinson & Shiffrin, 1968; Baddeley & Hitch, 1974; Montgomery, 2002; Solso, MacLin, & MacLin, 2005). Better associations within the connections result in better retention and subsequent recall (Rutishauser et al. 2008). For the two systems of

encoding and recall to work efficiently, they must be interrelated (Baddeley & Hitch; Gardiner, 2008). In addition, information may be stored in several different, but associated, contextual locations. These may include sorting for time and sequence information, location, meaning, and emotional saliency (Ben Shalom, 2003; Minshew & Goldstein, 1993).

The synchrony between activity at different cortical levels has been shown to indicate integration of processing across neural regions (Kveraga, Ghuman, & Bar, 2007; Rekkas & Constable, 2005; Rutishauser et al., 2008). This results in a unified cognitive reaction involving information from multiple locations within the brain (Ghuman, Bar, Dobbins, & Schnyer, 2008). For example a neural loop between the prefrontal lobe and the hippocampus has been proposed to serve as the mechanism to formulate and retrieve memories (Ghuman et al.; Varela, Lachaux, Rodriguez, & Martinerie, 2001). Efficiency in communication across cortical regions allows the brain to rapidly process new information, relate to current knowledge across vast experiences, and formulate a path of further action (Kuperberg, Dechersbach, Holt, Goff & West, 2007; Rutishauser et al.).

Several experts have suggested that deficits associated with ASD stem from information processing disorders, particularly problems with complex information processing, due to poor interaction and connection between multiple cognitive regions (Just et al., 2004; Williams, Goldstein, & Minshew, 2006 a, 2006b). Minshew, Goldstein, and Siegel (1997) investigated this hypothesis by comparing responses of carefully matched cohorts with and without autism. A clear profile emerged, where individuals with autism performed consistent with or better than their matched counterparts on simple tasks of cognitive profile testing (i.e., attention, simple memory, simple language,

and visual-spatial skills). However, there were significant differences between the groups in all areas of complex processing (i.e. skilled motor, complex memory, complex language, and reasoning), except for visual spatial processing. The complex task of organizing and storing information in a manner that supports future recall is one of the most prominent deficits found in the group with ASD (Minshew et al., 1997). This profile was indicative of a selective impairment in complex processing, evidencing a primary deficit within and across cognitive domains (Minshew et al., 1997).

In a follow-up study described in two reports, Williams et al. (2006a, b) completed similar testing with children with high functioning autism and children who were developing typically. The results of this analysis yielded similar but not identical results to the study with adults. The children with ASD exhibited skills equal to their peers in attention, simple language, simple memory, reasoning, and visual-spatial skills. The tasks which discriminated them from those without ASD were sensory-perceptual, motor, complex language, and complex memory (Williams et al., 2006a). Williams et al. (2008) summarize these findings by explaining that there are areas where individuals with ASD (in their research considered high-functioning with IQs within normal limits) have performance comparable to matched cohorts, but do not exhibit commensurate skills when complex processing tasks are involved. This suggests that the lack of a system for effectively encoding material leads to problems facilitating learning and memory as the information increases in complexity (Williams et al., 2008).

Higher order skills rely on intact interactions between various centers in the brain including the prefrontal regions, limbic system, and visual cortices. There are suspected difficulties with the functioning and interconnections between lower and higher order

systems of the brain as well as between specialty areas such as those for sensory processing, language, memory, and problem solving in individuals with ASD (Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Kanna Keller, Chekassky, Minshew, Just, 2006; Minshew et al., 1997; Williams et al., 2006a, 2006b). Furthermore, the actual volume of the brain across cortical lobes and tissue types is larger in individuals with ASD (Courchesne et al. 2001, Mosconi, 2006). The diverse nature of the structural differences may affect neural circuitry and multiple cognitive mechanisms (Cody, Pelphrey, & Piven, 2002). The result is a breakdown of skills for higher order processing which presents as deficits in understanding stemming from inadequate interconnections within the neurocognitive system, the same systems that have been implicated as possible areas of concern in memory.

Researchers have suggested that memory and information processing systems are dynamic and can be reshaped; however individuals with ASD may not be able to benefit fully from this reshaping due to deficits in neurotransmitters. Long-term potentiation (LTP) is a post synaptic occurrence associated with neural plasticity resulting in strengthened synaptic connections for creating memories (Bruel-Jungerman, Davis, & Laroche, 2007). Memory creation is maintained by neurogenesis, particularly in the hippocampus (Eriksson et al., 1998; Mercaolante et al., 2008). These newly generated neurons have been suggested to be better suited for integration of information from cortical connections to the hippocampus due to their reaction to neurotransmitters such as gamma-aminobotyric acid (GABA; Bruel-Jungerman et al.). Complex processing from the higher level cortical regions to the lower centers such as the limbic system uses the neurotransmitter system of GABA and glutamate. Deficits in GABA have a negative

effect on cerebral organization, due to the impact on neurogenesis and connectivity (Levitt, Eagleson, & Powell, 2004). Deficits in the GABAergic system are suspected in ASD (DeLong, 2008; Hussman, 2001) This could potentially lead to a functional picture of decreased stimulation from the neurotransmitters resulting in deficits in neurogenesis, particularly in the area associated with complex memory and language (the hippocampus), which is connected to other higher level cortical regions, resulting in deficits in complex processing (DeLong; Hussman; Mercaolante et al.).

Interventions which increase neurogenesis are therapeutic and have been demonstrated to be effective in increasing neurogenesis and subsequently memory and complex processing (Akshoomoff, 2001; Bruel-Jungerman et al., 2007). Among these are physical exercise, environmental enrichment, learning opportunities associated with being in new complex situations, and acquiring novel information (Brown, Cooper-Kuhn, Kempermann, van Pragg, Winkler, Gage, & Kuhn, 2003; Bruel-Jungerman, Laroche, & Ranpon, 2005; Snyder, Kee, & Wojtowicz, 2001). The potential for increasing synaptic strength, neurogenesis, and potentially dendritic complexity leads to “behavioral plasticity” or overall changes in adaptive functioning (Dong & Greenough, 2004).

Expressive Communication and ASD

Form, content, and use are components of a successful language system (Bloom & Lahey, 1978). Development of these interconnected expressive skills is correlated with other early developing sills: communicative intent, tool use, play and imitation (Bates, 1979). This interconnected developmental triad creates the foundation for language learning and use. Ultimately, language development is impaired if any of the precursors

of the language system do not function correctly (Bates). However, when working in synchrony, spontaneous verbal communication appears effortless and natural.

Spontaneous language emerges as children initiate and interact with their environments. Spontaneity and the ability to use language to initiate are critical components of effective communication and reciprocal interaction (Prizant et al., 2006). However, there is some debate in professional literature regarding the best way to conceptualize the construct. The classification can be based on relationships to antecedents and there are two possible perspectives for classifying the utterance: a binary or a continuum framework (Carter & Hotchkis, 2002). The binary condition is an all-or-none perspective. Communication which occurs following a prescribed antecedent, such as someone asking a question, is reactionary, and not spontaneous. However in the absence of the antecedent, the utterance is considered to be spontaneous (Carter & Hotchkis, 2002). The binary classification requires that spontaneous communication occur independent of questioning or partner prompting.

Spontaneous speech can also be placed upon a continuum in which the controlling stimuli serve as antecedents (Carter & Hotchkis, 2002; Chiang & Carter, 2008; Charlop, Schreibman, & Thibodeau, 1985). The continuum model acknowledges that each communicative act has some degree of spontaneity, from minimal to most intrusive to the speaker. Carter and Hotchkis' four level model accounts for a wide variety of antecedents and the communicative complexity represented in each. At the top of this continuum are behaviors in response to natural cues, such as making a remark to a friend. The next level accounts for stimulus highlights. Here a communication partner may make comments to help draw attention to particular targets, thus increasing their saliency in the environment

and potentially influencing the possibility of a communicative act. The next level is referred to as generalized communicative cues. In this case, a communicative response is implied, but the exact content is not specified. The final level is most restrictive and the least spontaneous. These are behaviors following specific direct prompts which are designed to elicit a discrete target response. These four levels represent the two components of the binary framework along with more detailed options to better describe multiple influences on spontaneous utterances.

Individuals with ASD exhibit disruptions in the form, content, and use of expressive communication, particularly regarding spontaneous communication. Per definition, deficits in pragmatic language, or language use, are found in all individuals with ASD (APA, 2000). Examples of these pragmatic differences include limited initiation of spontaneous remarks, odd prosody, off topic responses, limited communicative functions, and irrelevant comments (Cantwell et al., 1978; Capps, Kehres, & Sigman, 1998; Hale & Tager-Flusberg, 1995; Tager-Flusberg, 1996; Tager-Flusberg & Anderson, 1991; Wetherby & Prutting, 1984). Deficits in these basic interaction abilities lead to decreased skill in interpersonal interactions, particularly in sustained communication and conversation abilities. Spontaneous communication allows a speaker to control the exchange (Charlop, Schreibman, & Thibodeau, 1985), maintain context-specific interactions (Krantz, & McClannahan, 1993), and achieve control over the environment while learning about the world (Kaczmarek, 1990). If spontaneity is viewed as expression in the absence of a prompt from a communication partner, then it is worth noting that individuals with ASD present with an increased reliance on cues and prompting from others in comparison to those without ASD (Charlop et al.; Odom &

Strain, 1986). Since initiation and spontaneity are critical for independent communication, and they are an area of need for children with ASD, many programs for individuals with ASD recommend teaching spontaneous communication and initiation (Chiang, & Carter, 2008; NRC, 2001; Prizant & Wetherby, 2005).

Increases in functional expressive communication, including spontaneous initiations, provide a more socially acceptable means for the child to express himself as opposed to using challenging behavior, such as self injury, to escape demands or gain access to desired attention or items. Initiation allows for increased overall independence in communication (Carr & Durand, 1985; Charlop et al., 1985, Kaczmarek, 1990). Skills in language use allow the child to express thoughts via conventional communication, such as speech, so that others can understand and respond (Koegel, Bruinsma, & Koegel, 2006; Wetherby et al., 2000). This leads to opportunities for extended interactions, decreased behavior problems, and greater comprehension. The complexity of expressive language and its components, plus the social constructs for use of requisite skills, contribute to the difficulty individuals with ASD experience in mastering this core ability. For these reasons, expressive communication, including spontaneous initiations, has been a target for intervention research in ASD for decades.

Language Interventions for Children with ASD

Spontaneous communication, which is creative, generative, and conventional, is a target for many language interventions involving children with ASD (Prizant et al, 2000). Interventions should prioritize expanding the ability of a child with ASD to use many of the social aspects of communication (e.g., joint attention, sharing information, negotiation), as these skills contribute to functional, relationship-based communication

(Prizant et al.). Select examples of some of these interventions include adult-mediated or peer mediated approaches, video modeling, Picture Exchange Communication System (PECS), and Social Stories™. These interventions target improving functioning via better recognition of information, connections between cortical centers, and emphasis on top-down processing.

The adult-mediated approaches typically utilize behavioral techniques and structured procedures followed by systematic fading of prompts during generalization phases (Charlop et al. 1995). Peer-mediated strategies (Owen-DeSchryver, Carr, Calse, & Blakeley-Smith, 2008) offer an alternative to adult-directed strategies for increasing spontaneous communication and are frequently used in applied settings (Laushey & Heflin, 2000, Owen-DeSchryver et al, 2008). Video modeling is another means of intervention for children with ASD which has demonstrated efficacy for increasing spontaneous communication skills (Bellini & Akullian, 2007; Sansosti & Powell-Smith, 2008). Augmentative systems such as the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) have been used as an alternative to spoken language for children with ASD who do not use functional expressive speech and targets requesting, not labeling. Social Stories™ (Gray, 1994, 2000; Gray & Garand, 1993) are individually constructed stories which explain social situations and expected behavior. They are repeated frequently (based on the individual need of the child) and help to organize recall and memory for the targeted skills.

Researchers are demonstrating that several communication interventions are effective for increasing initiations and other forms of social language for children with ASD. The interventions provide some support for information processing and various

memory skills. However, many of these approaches require extensive preparation (video modeling, Social Stories™) or specialized materials (PECS) or training (time delay/ behavioral strategies). Intervention options which require less time and preparation are needed for helping children with ASD improve their use of expressive social language (Licciardelo, Harchik, & Luiseli, 2008; Zanolli, Daggett, & Adams, 1996). Additionally, an emphasis on academic or other personal goals may capitalize on relevant aspects of functioning, which could enhancing semantic memory. If the activities are engaging and enriching, then LTP may occur, further strengthening the interaction. A targeted approach should take into account specific needs of children with ASD, including their deficits in processing complex information, memory, and communication.

Priming

One strategy, priming, is emerging as an intervention that specifically targets increasing prior knowledge of a target task or situation, leading to improved functioning (Wilde, Koegel, & Koegel, 1992). The fundamental aim of priming is to allow a child to become familiar with novel materials, processes, vocabulary, skills, and goals of upcoming activities before their introduction in the relevant context. This gives the child an opportunity for exposure to basic information before being expected to use it in functional situations (Wilde et al.). The priming described in this model is considered "conceptually driven priming" (Tulving & Schacter, 1990; Vriezen, Moscavitch, & Bellos, 1995). Conceptual priming occurs with conceptual tasks and uses semantic processing. So, conceptual priming facilitates semantic learning, which includes adding to or modifying information in the semantic memory system (Gardiner, 2008; Tulving & Schacter). The information stored in semantic memory is reactivated for recall for a

specific event. Subsequently, it will be stored as an event in episodic memory, while enriching semantic knowledge.

In the field of education, priming, or preteaching as it is also called, has been effective in helping children with and without disabilities make improvements in academic areas. Burns, Dean and Foley (2004) used preteaching of unfamiliar words to improve reading fluency and comprehension for children who were identified as having reading disabilities. Kameenui and Douglas (1986) introduced concepts of subtraction prior to direct instruction to second grade students who were not meeting standards for math.

The effects of priming, per se, are not impaired in individuals with ASD (Bowler, Matthews, & Gardiner, 1997; Gardiner, Bowler, & Grice, 2003; Minshew, Goldstein, Taylor, & Siegel, 1994). Gardiner et al. demonstrated that responses to both perceptual and conceptual priming are intact in individuals with Asperger's syndrome. Indicating semantic and perceptual systems are intact. However, there seems to be a deficit in applying the requisite concepts to formulate complex connections to stimulate recall (Bowler et al.; Minshew et al.). This is consistent with the findings of Minshew et al. (1997) and Williams et al. (2006b) regarding decreased application of skills in adults and children with ASD for tasks as they became increasingly more complex.

Priming addresses specific needs of children with ASD while circumventing some of the concerns raised regarding other intervention programs. Priming requires only a brief time to implement, uses authentic materials, and is relatively easy to accomplish (Licciardello et al., 2008). Priming is well suited for children with ASD as it specifically targets memory and information integration while using underlying systems which are

intact (semantic memory and simple recall from priming; Bowler et al.1997; Minshew et al., 1994). Through priming, novel information becomes more familiar in subsequent presentations. The repetition is beneficial for increasing processing by using recall strategies from long-term memory, rather than having all novel information going into the working memory system. Furthermore, priming is customarily done as a discrete event before an activity which also facilitates memory. Priming specifically targets enhanced predictability for improved functioning, because novel materials are now familiar in the targeted context. It serves as a precursor to upcoming activities, both academic and social.

Wilde et al. (1992) describe the procedure and some outcomes of using priming for children with special needs, particularly those with ASD. This frequently referenced manual describes a basis for the procedure and expectations for using a preparation strategy to help children increase their prior knowledge of upcoming information to better participate in the actual event. According to the suggested protocol, children are introduced to new material the night before it will be presented at school. The children become familiar with the information such as a book or activity, so that the memory of the content can facilitate increased recall and participation in the actual task. Priming is used in a low demand, highly reinforcing environment to facilitate introduction of novel information before it is used in a functional setting (Wilde et al.). Variations of this methodology have been used successfully to target many goals for children with ASD.

Priming has been effective for helping children decrease disruptive behavior and increase academic comprehension (Boettcher et al., 2003; Koegel, Koegel, Frea, & Green-Hopkins, 2003; Schreibman, Whalen, & Stahmer, 2000; Wilde et al.), become

toilet trained (Bainbrige and Myles, 1999), increase sharing (Sawyer, Luiselli, Ricciardi, & Gower 2005) and increase various social skills (Hetzroni &Tannous, 2004; Kamps et al., 1992; Licciardello et al., 2008; Zanolli et al., 1996) In many cases, the intervention was not specifically called “priming,” however the concepts were similar (Luscre & Center, 1996), and frequently priming was used as part of a package intervention (e.g. Boettcher , Koegel, McNerney, & Koegel, 2003; Licciardello et al., 2008). Unfortunately, studies on priming interventions have not always been conducted using research designs capable of demonstrating a functional relation between the intervention and the observed improvements (Boettcher et al., 2003). However, priming research studies, both independently and in a package, provide some evidence of efficacy for this method.

Overall, priming and activities that offer prior exposure or practice of new concepts, have been beneficial in changing behavior for children with ASD. Several of these studies used complex mechanisms such as individually created videos (Schriebman et al. 2000) and computer programs (Hetzroni & Tannous, 2004), while others simply involved previewing class material (Koegel et al., 2003). These interventions documented the use of priming a specific target and measuring the goal, but several mentioned collateral benefits which were not specifically documented, such as increased language use (Hetzroni & Tannous; Schriebman). Therefore, further research involving priming and subsequent changes in language during typical childhood activities may yield interesting information to this line of work. Furthermore, priming has been theorized to be effective as part of a reinforcement system (Koegel et al.). This may be part of the reason that children with ASD respond to the technique. It has low demands, is child driven, and may give a child increased attention to target tasks (Koegel et al.). As such,

the potential for neurological changes due to LTP enhance the benefit of this intervention. Evidence for the mechanisms underlying the benefit of priming stem from use of the memory recall system, such as repeated exposure increases accuracy in recognition testing.

Repeated exposure, or priming, has been demonstrated to result in faster and more accurate responses in recognizing and making judgments regarding items which have been previously viewed (Dobbins, Schnyder, Verfaellie, & Schacter, 2004; Wig, Grafton, Demos, & Kelly, 2005). Research in priming, specifically repetition priming, has given insight into the neurological underpinning of this construct. Priming allows for increased processing of information by way of reduced speed of access to information, which in turn facilitates observable behavioral performance regarding primed targets. This process occurs rapidly and distinctly. Additionally, research in functional imaging has demonstrated that priming effects are observed in the same neocortical regions responsible for the response (Henson, 2003). Furthermore, the mechanism for priming has been demonstrated to cross cortical regions leading to integration of these areas within a task and result in a top-down direction of information flow (e.g., processing originates in the prefrontal cortex, which makes decisions, sending information to the temporal lobe, where memory systems are housed thereby optimizing processing efficacy; Ghuman et al., 2008). Priming results in changes in interaction between these cortical centers.

Children with ASD may have difficulties with many areas of development, three of which are the interrelated skills of information processing, memory, and expressive communication (Boucher et al. 2008; Williams et al., 2006a). Priming can be used as an

intervention to improve functioning in these areas. With priming before an event there is an opportunity to integrate previously primed, now more familiar, information with more advanced or newly acquired skills. Some of these more advanced skills are initiation of interactions, comments, and reciprocal communication, such as conversations. Information regarding neurological constructs of cortical connectivity, neuroplasticity, and single-trial learning for episodic recall all support the functionality of using a priming procedure to increase processing of new material. In addition, use of scaffolds such as priming are a means of support which offer individuals with ASD an opportunity to prepare for novel situations with less perturbation. Additionally, during recall, the priming task can be used as a cue which may facilitate recall of self-experienced events (Hare et al., 2007; Millward et al, 2000). Subsequently, the increased attention and participation may improve ability to formulate new neural associations and use further complex processing. At this time, improvements in initiation such as spontaneous requests, comments, and reciprocal communication following priming have not been investigated within a learning environment, but have been documented only incidentally. Research is needed to explore the potential benefit of priming before activities for increasing spontaneous communication in children with ASD. Therefore, the question addressed in this study is: What effect does priming upcoming activities have on the spontaneous verbal language of children with ASD?

METHODS

Participants

Three participants were recruited from the investigator's speech-language pathology current or past caseload. In order to participate, each child had a diagnosis of

autistic disorder or autism spectrum disorder as determined by the Autism Diagnostic Observation Scale- General (ADOS-G; Lord, Rutter, DiLavore, & Risi, 2000) administered by a diagnostician who is certified in administration and has attended advanced training on research administration of the test. The ADOS-G gives scores in four areas: communication, socialization, play, and behavior. Calculation of the communication, socialization, and combined scores are used to determine where a child falls in relation to target cut-off points. A child who has sufficient points will receive rating of autism spectrum. However, with more points, the classification is autism. Demographic information about the participants, including results of standardized assessments is presented in Table 1, along with their pseudonyms.

Table 1. *Participant demographic information.*

Name	Age (year; months)	Expressive Language Age* (year; months)	ADOS-G Score	Diagnosis
Blake	7;8	4;3[a]	Communication 2[c] Socialization 5[c] Comm. + Soc. 7[c]	Autism Spectrum Disorder
Mitch	4;7	3;4[b]	Communication 10[d] Socialization 14[d] Comm. + Soc. 24[d]	Autistic Disorder
Alan	4;4	3;5[b]	Communication 7[d] Socialization 15[d] Comm. + Soc. 22[d]	Autistic Disorder

[a] age in year; months from the average of the expressive language subtests of the CELF-4
[b] age in year; months from the average of the expressive language subtests of the CELF-P-2
[c] exceeds cutoff for autism spectrum, but not autistic disorder
[d] exceeds cutoff for autism spectrum and autistic disorder

In addition to being diagnosed with an ASD, the children had to exhibit an expressive language age of at least 3.25 (3 years; 3 months) years as measured by the Expressive Communication age equivalent score on the Clinical Evaluation of Language

Fundamentals®-Fourth Edition (CELF®-4; Semel, Wiig, & Secord, 2003) or the Clinical Evaluation of Language Fundamentals®Preschool, Second Edition (CELF®-P; Semel, Wiig, & Secord, 2004). This cutoff corresponds to an age when the mean length of utterance in morphemes is around 3.5, includes enough syntactic differentiation to exhibit clear intent, and represents Brown's (1973) stage IV, ages 40-46 months. The first three children who completed testing and requisite consents participated in the study. All three participants' parents indicated they were concerned about their son's use of spontaneous language, and all three children had current or previous goals to increase spontaneous communication. The first three children enrolled continued in the study until completion.

Blake. Blake is a 7 year, 8 month old boy with a diagnosis of autism spectrum disorder given based on both psychological testing and the ADOS-G, administered by an examiner certified in using this test with additional training for research application. Recently, his elementary school teacher and speech language pathologist completed a Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988). Scores from both adults placed Blake in the range of "Severely Autistic." Blake lives in an English-speaking home with his parents, an older brother, and younger sister. Both of his parents have earned doctoral degrees and are university professors and researchers. Blake's older brother has been diagnosed with autism; his sister does not have any diagnosed disabilities or medical conditions. Blake attends a Montessori program based in a public elementary school where he is supported by an individualized education plan. There are 19 students in his class. Blake has one-to-one paraprofessional support and spends one hour per day receiving services for social skills, handwriting, fine motor, and language in an interrelated classroom. He participates in speech and occupational therapy at school,

as well as individual speech, occupational, and listening therapies from outside organizations. He takes Risperdal. Blake is able to complete age appropriate self-help skills. He is able to remain on task for extended times, a half hour or more, with minimal support. He enjoys cartoons and movies. He exhibits delayed echolalia by repeating lines from these.

Mitch. Mitch is a 4 year, 7 month old boy with a diagnosis of autistic disorder made by a certified ADOS administrator when Mitch was 3 years, 1 month old. He is also diagnosed with hypotonia and a receptive expressive language disorder. Mitch comes from an English-speaking home where he lives with both parents and a younger brother who does not have any disabilities or medical conditions. Both of his parents have bachelor degrees. His father is a communications manager and his mother is a communications consultant. He attends a prekindergarten program at a private center which integrates children with ASD and typical development. There are 18 children in his class, 6 with an ASD. The center provides individual structured lessons and integrated group instruction and play throughout his day. Mitch is adept at basic self help skills such as toileting and beginning dressing. He is inconsistent in his attention to tasks. Mitch is able to use verbal language for requests and answering questions. He has occasional pronoun reversals. He exhibits frequent immediate echolalia; however he also makes occasional comments about his environment. Throughout the intervention, Mitch was also participating in Floortime, speech therapy, and occupational therapy. He previously had physical therapy and Tomatis listening therapy.

Alan. Alan is a 4 year, 4 month old boy with a diagnosis of autistic disorder given by a certified ADOS administrator when he was 1 year, 11 months of age. He has also

been diagnosed with hypotonia and sensory integration disorder. Alan lives in an English-speaking home with both parents and a younger brother, who has asthma but no other disabilities or medical conditions. Alan's father has a master's degree. He is a building products distribution manager. His mother has a bachelor's degree and works in the home. Alan attends a private, structured preschool program at the same center as Mitch which integrates children with typical development and ASD. The two boys are not in the same class. There are 18 children in Alan's classroom, 6 of whom have been diagnosed with ASD. Alan needs frequent prompting to complete basic personal care activities, but is generally independent once he is reminded what to do. Alan enjoys letters and is exhibiting early reading skills. Alan was making some comments about his environment at the beginning of the intervention; they tend to be related to his interests of letters and numbers. Alan has frequent pronoun reversals in his speech and some immediate echolalia. During the study, Alan also had occupational therapy. He was on a gluten-free, soy-free, and yeast-free diet. Alan was taking Diflucan and vitamin supplements. In the past he has had oral motor therapy, speech therapy, and music therapy.

Setting

The intervention was conducted in two small rooms within a building at a pediatric medical center complex. The rooms were sparsely furnished with a child-sized table and chairs, limited decorations on the walls, and basic cabinetry. Items which could potentially cause distraction (e.g., computers, books, games) were covered with a plain white sheet and not acknowledged during the sessions. The same two rooms were used through out the intervention, one for the presessions and the other for the activity

sessions. Both rooms were equipped with a video and audio monitoring system so that parents were able to observe the children from a remote location. The activities for each session were stored in individual bags or containers, where only one bag would be visible during each session.

Materials

Before initiation of the intervention, the investigator created 30 age-appropriate thematic units consisting of games, crafts, books, and toys related to a particular topic. Examples of topics included: bubbles, things that are red, shadows, and clouds. Appendix A contains the complete list of thematic units, activities, relative vocabulary, and materials. There were two or three different activities within each unit. A suggested activity order was predetermined; however if a particular child was interested in one material more than another, the order could be changed. An independent rater with experience in education and speech and language development looked at each unit topic, material list, relevant vocabulary, and target activities and determined face validity for the materials used in the intervention. She also confirmed that the units were generally equal in overall content. Three additional units were created at the end of the study to complete the reversal phase. These were similar to the others and confirmed for face validity. None of the materials were directly related to any of the specific topics of perseveration identified by the parents for the participants. There was a video camera on a shelf in the room for presessions. Presession taping was used to later confirm procedural integrity. During the activity sessions, a video camera used for data collection was on a tripod next to the table and the tape recorder was on the table or moved to a location appropriate for capturing audio during the session. Both video and audio

recording were used to ensure accurate capturing of the children's speech. Two kitchen timers were used to time the presessions and activity sessions.

Procedure

Upon receiving approval from the relevant institutional review boards and written parental permission, the three participants were given individual assessments of their current expressive language skills, participated in a tour of the rooms that would be used in the intervention, and were introduced to the researcher who would be conducting the presessions. One of the boys was familiar with the location and all three knew the investigator. Following assessment, the boys returned weekly to complete two consecutive sessions per week. The intervention lasted between 10 and 12 weeks.

Each session consisted of two parts, a presession and an activity session. A trained researcher conducted the presessions while the investigator led the activity sessions (ACT). During the presession, one of two things happened. In the related presession condition (RP), the researcher showed the child materials that would be used in the ACT. The child was able to interact with materials, hear the vocabulary associated with the activity, see samples of the completed crafts, preview books, and make connections between his general knowledge and the upcoming activity that would occur with the investigator in the next room. The child was made aware that he would be using the presession materials with the investigator soon. The related presessions incorporated the empirically-validated strategy of priming (Wilde et al., 1992) in order to facilitate semantic and episodic memory recall (Tulving & Schacter, 1990). Approximately half of the sessions had related presessions.

During the unrelated presesions (UP), the child was presented with theme-based materials different from those that would be used in the upcoming ACT. He was allowed to interact with them as described above. However, he was told the name of the theme and that these were things that could be used "sometime," rather than these were going to be used in the ACT. The materials in the bag had no association with the upcoming activity in the other room. The UP presessions did not incorporate priming.

Following the 10-minute presession (RP or UP), the child went to the second room for a 20-minute ACT to complete age-appropriate thematic activities such as crafts, games, and books. The investigator leading the ACT was handed a bag of materials as the child entered the room. She was blind to the condition of UP or RP. Each bag of materials contained a new thematic unit with two or three activities. Each activity was completed based on natural interactions and responses between the investigator and the child. Therefore, the amount of time spent on any particular activity within a unit was variable, and all the materials may not have been used in each session. The children were offered opportunities to comment, request, and interact while engaging in the activities. If a particular task was difficult, the child received necessary help. They were free to decline from or ask the investigator to do non-preferred tasks (e.g., putting hands in paint). Taping began at the beginning of the session and stopped with the sound of the timer (set for 20 minutes). At the end of the first session of the week, the child returned to the first room for another presession. At the end of the second session, the child met his parent and left. Each child was given a small surprise gift at the completion of the study and took home any materials or crafts that were created during individual sessions.

Design

This study employed a multi-element design (Kennedy, 2005) with a subsequent withdrawal to UP for three sessions and reinstatement of RP for three sessions for the participants who met a target criterion during the intervention phase. The two elements used in the design were RP and UP. These were randomly ordered by the researcher conducting the presessions for each participant by listing RP and UP on 20 cards and pulling them out one at a time to establish the order for session type for each participant. The 20 session cut off was an arbitrary decision which was deemed to allow sufficient time for the participants to acclimate to the procedures and subsequently exhibit fractionation in their performance. If there were more than three of the same session types in a row, the opposite type was automatically used next. The researcher conducting the presessions also randomly assigned the activities for each participant. Each of the thematic units was listed on a card and placed in a bag. The researcher pulled one card for the RP, as the same materials would be used in both the RP and ACT, and two cards for the UP, to allow for different activities for each portion of the session. The process was repeated three times so that each participant had an individually prescribed order of session sequence and material presentation. The type of presession and presession theme were not shared with the investigator to keep her blind to the relevance or lack thereof of the presession during the multi-element portion. Due to the necessity of coding and planning when to initiate the withdrawal, the investigator was not blind to the condition for the final phases.

Data were graphed and visually inspected to determine treatment efficacy through fraction or absence of fractionation between RP and UP (Sidman, 1960). An a priori

criterion of a 30% increase (Hamilton & Snell, 1993) between the mean of five categories of spontaneous utterances (requests, comments, information seeking, topic initiations, and total spontaneous utterances) between the first three UP and three RP across three consecutive data points was used to determine the start of the phase change to the reversal to confirm the functional relation between priming and language changes.

Along with visual inspection, Cohen's d (Cohen, 1988, 1992) was calculated to determine a relative effect size of the difference between the two conditions, UP and RP, to quantify the treatment effects. Cohen’s d was calculated by subtracting the mean of the percentage of occurrence of the UP condition from the mean of the RP condition and dividing by the pooled standard deviation of the two conditions. The pooled standard deviation was calculated by taking the square root of the square of the standard deviation of UP plus the square of the standard deviation of RP divided by two (Cohen, 1988). Conventional values for effect size are as follows: .20 is small, .50 is medium, and .80 (and higher) is large (Cohen, 1988; Cohen, 1992). The effect size was used to describe the magnitude of change for each participant for each dependent variable reaching criterion.

Dependent Variables

Spontaneous Utterances were operationally defined as child initiated verbalizations without verbal antecedent prompting. Spontaneous Utterances included requests, comments about the environment, information seeking, and new topic introduction (observed if the conversation continued with facilitated response from the adult). These utterances correspond to the binary definition of spontaneous communication (Carter & Hotchkis, 2002; Charlop et al., 1985) and the first two levels of

the continuum for spontaneous communication (Carter & Hotchkis; Chiang & Carter, 2008). Frequency count was used to record the participants' spontaneous utterances. Operational definitions for each of the various types of spontaneous utterances are as follows:

1. Comments: A comment about <u>the immediate environment or activity</u> (e.g., “Mine is broken.” “Look at this” “Oh, man.”) or a response to an utterance (not question) made by the clinician <u>on the same or related topic</u> (e.g., “I like that too!” “I don’t have a car like you.” “Friday is my favorite day.”) Comments included relevant sound effects (e.g., saying "beep, beep" while pushing the toy car).
2. Requests: The child requests a need or want related to the activity (e.g., “I need a clothes pin,” “You do it”). These include protests (e.g., “Stop.”) and requests for information (e.g., "Why is the red bathing suit?" "What are you doing?"). Social Information Seeking: A request for social or personal information from the investigator (“What color is yours going to be?” “Where do you go to eat out?”)
3. Topic Initiation: An initiation of a new topic of conversation that results in a follow-up comment (“I have a new dog.” “My tooth fell out.”). To help determine if an utterance was a topic initiation, utterance coders used a flowchart based on the utterance and subsequent verbalizations (Appendix B).
4. Total Spontaneous Utterances: A total of all four types of spontaneous utterances.

Although the Social Information Seeking and Topic Initiation categories were included in the investigation, their occurrence was anticipated to be minimal. The skills are more socially based than comments about the immediate environment or requests for materials. Additionally, these skills are not frequently used in young children with typical

development as well (Wetherby & Prutting, 1994). These variables were included to allow for more precise coding in the event that they did occur. On the other hand, requesting is frequently a strength for children with ASD. This investigation included requesting as in several other expressive language studies (Charlop et al. 1985; Thiemann & Goldstein, 2001) and to allow recognition of the spontaneity of the requests.

In addition to the utterances coded as spontaneous, there were three other categories for verbalizations:

5. Answer: Child answers a question (such as “What do you want” or “Where is my paper?”) or completes a fill-in (“Ready, set . . . .” “GO!”) This corresponds to the third and fourth levels of spontaneity on the Carter and Hotchkis (2002) continuum. If the investigator asked the child to repeat a phrase (e.g., "Not mud bit, mud pit. Say 'mud pit."), the verbal behavior was coded as an answer. Note: If the child answered a question and then elaborated, the utterance was coded in two parts: the answer and the elaboration. (e.g. “No, I want the purple.” would count as an answer and a spontaneous request.)
6. Irrelevant: Utterance that reflects a restricted interest, echolalia, determined to be off-topic (child initiated topic without continuation of the line of conversation following adult response based on flow chart), or preservative speech (any repetition of word or phrase, repetition of request twice after denial, confirmation, redirect, or reminder from the adult). Examples of not relevant speech include: “Let’s see number 59, the left tackle.” “Do you need glue?” (echolalic) “I want the fish. I want the fish. I want the fish.” Parents were asked about any topics

considered perseverative for their child. These were documented on the transcription coding sheet and used as a reference in coding utterances.

7. Not Counted in the Total: If the utterance was unintelligible or otherwise not possible to assign a code (including singing, jargon, and incomplete utterances), it was not counted in the total. In order to determine unintelligibility, the investigator listened to the utterance at least three times and in both audio and video formats. Utterances which were partially unintelligible or unfinished were not counted, as there was no definitive way of knowing the child's intent.

Coding

Each of the 20 minute sessions was video and audio taped. The participants were aware of the taping. On a few occasions, they approached the video camera, and occasionally they picked up and examined the tape recorder. The recording did not have an impact on the intervention.

The investigator transcribed child and adult utterances for all the sessions by listening to and watching the recordings. If an utterance was unclear, it was replayed at least three times to attempt to determine the content. If the words were still unclear, the utterance was coded as Unintelligible and not counted in the analysis. This occurred if even part of the utterance was problematic, as there was no means of determining exactly what the child had said. The transcriptions of all the child's utterances were later individually coded based upon the operational definitions.

Independent Variable

The independent variable was the 10-minute presession, conducted before the ACT. The presessions placed few demands on the participants, had high potential for

reinforcement, and were intended to be fun. Half of the randomly assigned presessions were RP and the other half were UP. The related presessions followed the conventions of priming described by Wilde et al (1992). In addition to the presession characteristics described above, in the preseession, the researcher introduced the materials and theme and related them to the participants' general knowledge and interests. This was done to activate anoetic and autonoetic consciousness (Tulving, 1985). At the beginning of the presession, participants were told if they would be using the same materials in the activity with the investigator in the upcoming ACT or if they were simply looking at new toys. The participants were reminded throughout the session of whether or not they would be using the materials with the investigator. Kennedy (2005) indicated that a participant may know which condition is in place as he is engaging in a study, and priming is not intended to be a surprise to the child.

Independent Variable Fidelity

The investigator created an initial draft of an independent variable fidelity checklist to maintain integrity with the design throughout the study. Before using this draft, it was sent to three experts in the area of priming who had published research on the topic to provide comments. One of the three responded and offered important suggestions. After incorporating the suggestions and modifying the form, a treatment fidelity checklist was created to be used throughout the study (Appendix C).

In preparation for the study, the investigator conducted training sessions with the researcher responsible for implementing the presessions. Training included reading the manual on priming (Wilde et al., 1992), discussion regarding memory and affect, and

reviewing the treatment fidelity form. Following training, the researcher exhibited the requisite skills to criteria for two practice sessions involving a nonparticipating child.

Twenty percent of the presessions (both RP and UP) were video taped and reviewed for treatment fidelity. This was to assure that a) the sessions were following the conventions of priming and b) that the researcher had indicated whether the materials were relevant to the activity session or not. To calculate the fidelity, each priming session was divided into 2-minute segments. An observer watched the tape of the session for 1.5 minutes and used 30 seconds to record if the targeted aspects of priming were included, not included, or not applicable. In order for a session to be considered valid the following three conditions needed to be met: a) the researcher indicated the condition, b) 100% of the intervals met the criterion of “nonjudgmental” and (c) at least 60% of intervals included the other key aspects of priming determined by Wilde et al. (1992) and the expert feedback. Treatment fidelity was obtained on 100% of the sampled sessions.

Reliability

Data reliability was assessed for each participant for both transcription and coding. For transcription, the investigator's major advisor reviewed the audio and video tapes along with the transcriptions generated by the investigator. The advisor randomly selected at least 20% of the audio and video tapes for each participant to check transcription accuracy. To complete the task, the advisor read the transcription while listening to the recordings. Deviations from the recording were marked on the transcripts. Minor differences which would not affect the coding were not included in the error total (e.g., addition of an article or a disagreement in a particular noun). Transcription accuracy was calculated by dividing the number of agreements by the total number of

agreements, disagreements, and omissions, multiplied by 100. The mean transcription accuracy was 97% for Blake (range 95% to 100%), 97% for Mitch (range 95% to 100%), and 96% for Alan (range 94% to 100%).

To document reliability of coding, an utterance by utterance analysis was conducted. The advisor randomly selected at least 20% of the transcripts for each child and independently coded the data. Inter-observer agreement was determined by dividing the number of agreements (i.e., utterance with exact match) by the total number of agreements and disagreements, multiplied by 100. The mean data reliability was 87% for Blake (range 85% to 91%), 86% for Mitch (range 81% to 90%) and 86% for Alan (range 84% - 90%). A Kappa coefficient (Cohen, 1960) was used to test rater independence in coding. Results for Blake yielded a mean Kappa of 0.84 (range 0.76-0.90). The mean for Mitch was 0.83 (range 0.79-0.91). For Alan, the mean was 0.81 (range 0.69-0.90). The overall Kappa across all utterances coded for reliability was 0.83.

RESULTS

Three children with ASD participated in 10 minute presessions with the researcher before engaging in 20 minute thematic activities with the investigator. Using a multi-element treatment design, approximately half of the presessions were related to the theme (RP) while the other half were not (UP). When the presessions were related to the theme, priming was in effect. All of the verbal utterances for each child were transcribed and analyzed to investigate differences in spontaneous language between RP and UP sessions. Results of measurements of spontaneous comments, spontaneous requests, requests for social information, topic initiations, and total spontaneous comments are presented in Figures 1 through 9. Visual inspection of the data and measurement of effect

size were used to determine differences between the two conditions. When the target criterion of a 30% increase in the number of spontaneous utterances in RP, based on the mean of the first three UP, was met, the participant had brief withdrawal and reinstatement phases to demonstrate replication of the treatment effect. Table 2 presents a summary of the total number of utterances and total spontaneous utterances with means and standard deviations for each of the participants.

Table 2. *Total utterances and total spontaneous utterances with means and standard deviations for each participant for unrelated and related presessions.*

	Total Utterances				Total Spontaneous Utterances			
Name	UP		RP		UP		RP	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Blake	65.5	15.7	70.5	16.7	32.7	8.2	48.5	13.7
Mitch	82.1	14.8	86.4	18.6	43.1	9.9	55.7	16.7
Alan	72.9	25	77	23	44.5	16.1	46.3	16.2

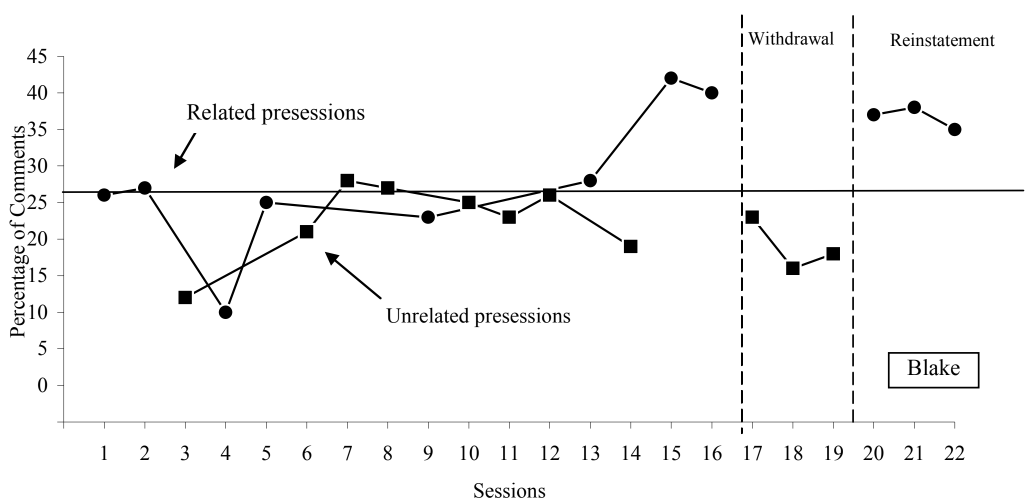
Two of the targeted spontaneous utterance categories, Topic Initiation and Request for Information were not represented with any frequency during the investigation, and therefore will not be discussed within the summary of each participant. None of the participants requested personal information or opinions from the investigator during the sessions. There were three instances of a topic initiation: Blake in sessions 17 and 18 and Alan in session 8. These instances were insufficient to warrant analysis, but are included in each child's total utterances.

Blake

Blake achieved the target of a 30% increase in spontaneous comments occurring during the RP condition (Fig. 1). The mean of his first three UP session comments was

20.33%. A 30% increase yielded a target of 26.43% (26%) for the intervention. After achieving criterion, there was a withdrawal series of three UP sessions and a corresponding reduction in the percentage of spontaneous comments. This was followed by a reinstatement of the RP and a subsequent increase in the percentage of spontaneous comments, providing a replication of the effect. When comparing the mean percentage of spontaneous comments from both UP and RP, Cohen's d is .95, indicating a large effect for the priming condition.

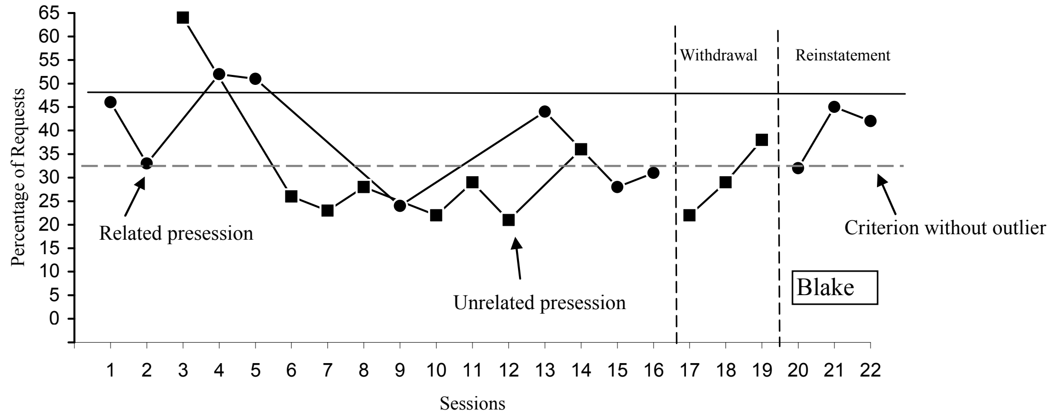
Figure 1. Percentage of utterances with Spontaneous Comments in Related and Unrelated Presessions for Blake.



Blake's use of spontaneous requests did not meet the target criterion during the RP condition. His average percentage of requests in the first three UP was 37.6%. The target, with a 30% increase, was 48.97% (49%). The percentage of requests in Blake's first UP session was 64. He had many requests for materials and attention during the art activity. This resulted in more than double the number of requests as in the next two UP sessions as well as the rest of the others in this condition. If the average is recalculated

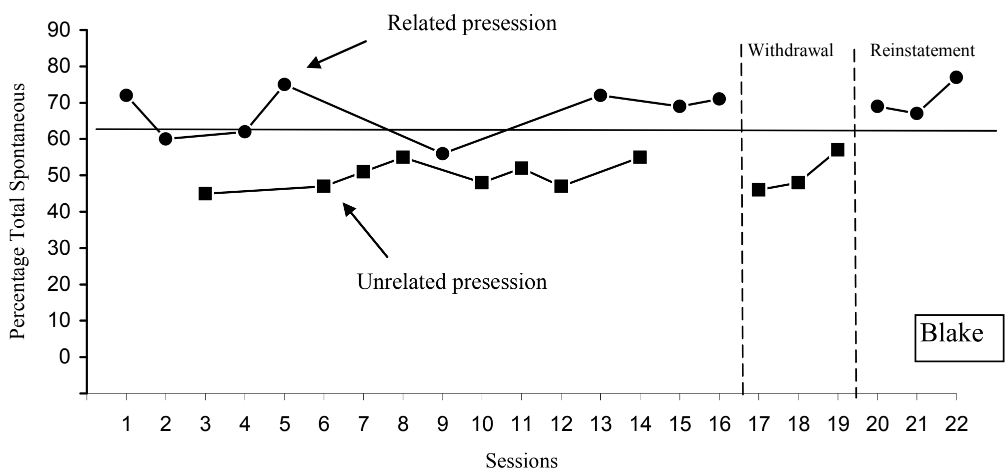
without this outlying score, it would drop to 25.67%, and the target increase would be 33.37% (33%). This does not change the outcome of the analysis, but better reflects the situation (Fig. 2).

Figure 2. Percentage of utterances with Spontaneous Requests in Related and Unrelated Presessions for Blake.



Finally, the mean percentage of Total Spontaneous Utterances for Blake's first three UP sessions was 47.67%. A 30% increase from this number led to a target criterion of 61.97% (62%). Blake met the target for spontaneous utterances for three consecutive sessions (Fig. 3). Withdrawal of RP via three consecutive sessions with UP resulted in a drop in overall percentage of spontaneous utterances; while the reinstatement of the intervention, RP, served as a replication of the effect. Cohen's d is 2.99 for percent of Total Spontaneous Utterances indicating a large effect for RP.

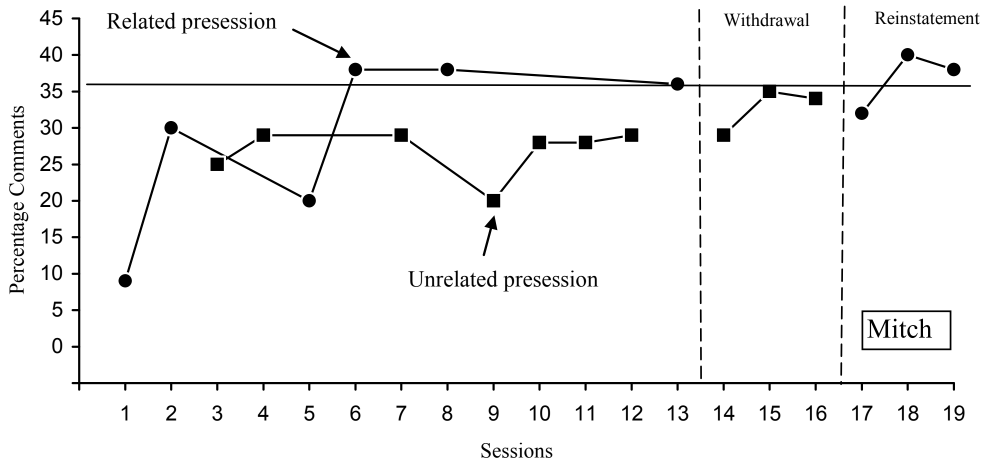
Figure 3. Total percentage of Spontaneous Utterances in Related and Unrelated Presessions for Blake.



Mitch

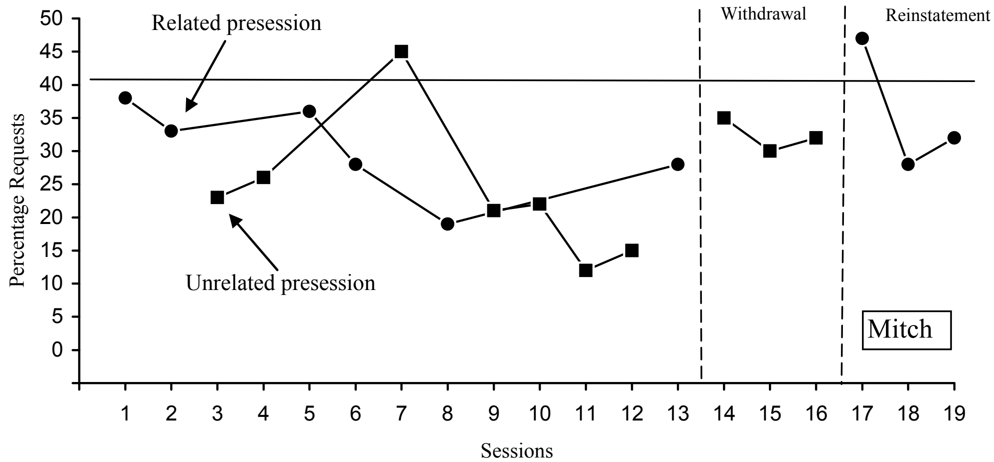
Mitch met the criterion for increasing the percentage of Spontaneous Comments during RP sessions. His mean of the first three unrelated sessions was 27.67% and the target criterion was 36%. Additionally, Mitch demonstrated a drop in percentage of comments during the withdrawal and an increase to the target for 2 of the 3 sessions with the reintroduction of RP (Fig. 4). Cohen's d was .32, a small treatment effect. This may have been lower than expected, due to an outlier data point on the first session, an RP with very few comments, and not indicative of his percentage in any other session.

Figure 4. Percentage of utterances with Spontaneous Comments in Related and Unrelated Presessions for Mitch.



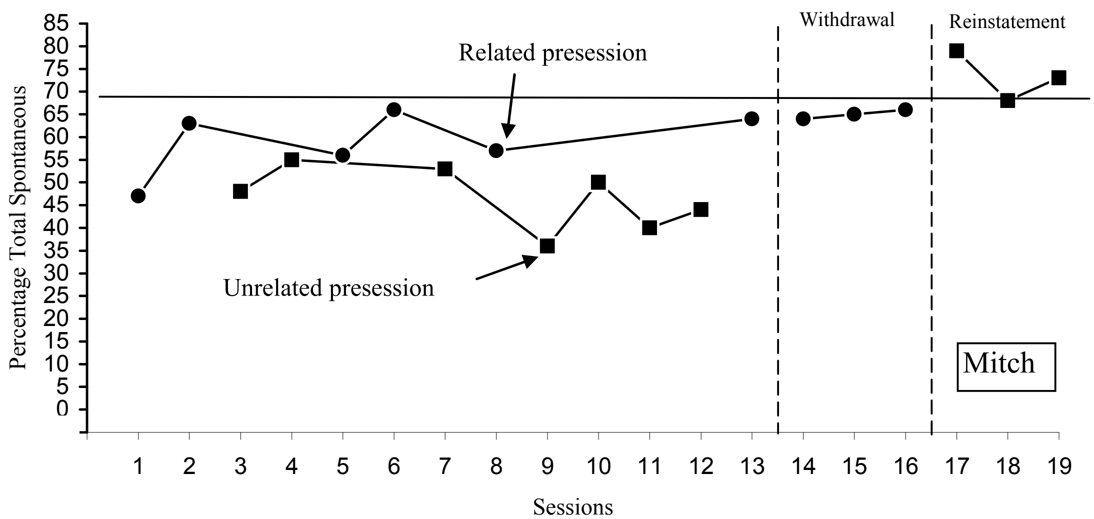
Similar to Blake, Mitch did not meet the criterion of a 30% increase in Spontaneous Requests. The average percentage of requests for the first three NPR sessions was 31.33% setting the criterion to 40.73% (41%). There was no distinguishable pattern in his overall spontaneous requesting between the two conditions (Fig. 5). He had one noticeable outlying score on session 7. This UR session, balls, had many types of balls and color sticker choices for him to request. This may have been the reason that there were more requests in this session.

Figure 5. Percentage of utterances with Spontaneous Requests in Related and Unrelated Presessions for Mitch.



Mitch's mean percentage of Total Spontaneous Utterances in the first 3 UP sessions was 52%. A 30% increase yielded a target criterion of 67.6% (68%). Mitch did not reach criterion for the 30% increase of Total Spontaneous Utterances during the multi-element portion of the intervention. However, of interest, during the withdrawal, and subsequent reintroduction of the RP, Mitch's percentage of spontaneous utterances exhibited a drop and then increase to criterion respectively (Fig. 6). Furthermore, the effect size for intervention with RP versus UP for Total Spontaneous Utterances was 1.00, a large effect.

Figure 6. Total percentage of Spontaneous Utterances in Related and Unrelated Presessions for Mitch.



Alan

Alan's mean percentage of Spontaneous Comments for the first three UPs was 52.3% (52%). The target criterion for a 30% increase was 67.99% (68%). Alan did not reach this criterion during any of the sessions. Furthermore, his results were mixed and indistinguishable between the conditions. For Total Spontaneous Requests, Alan's target was 18.63% (19%) based on an initial mean of 14.3% from the first three NPR sessions. Although he met the target in three sessions, they were not consecutive. Again, his results were generally mixed and not discernible. Alan achieved a mean of 67% for Total Spontaneous Utterances in his first UP sessions. An increase of 30% results in a target criterion of 87.1% (87%). Alan did not reach criterion for this skill either. Therefore, he did not participate in the withdrawal and reintroduction phases.

Figure 7. Percentage of utterances with Spontaneous Comments in Related and Unrelated Presessions for Alan.

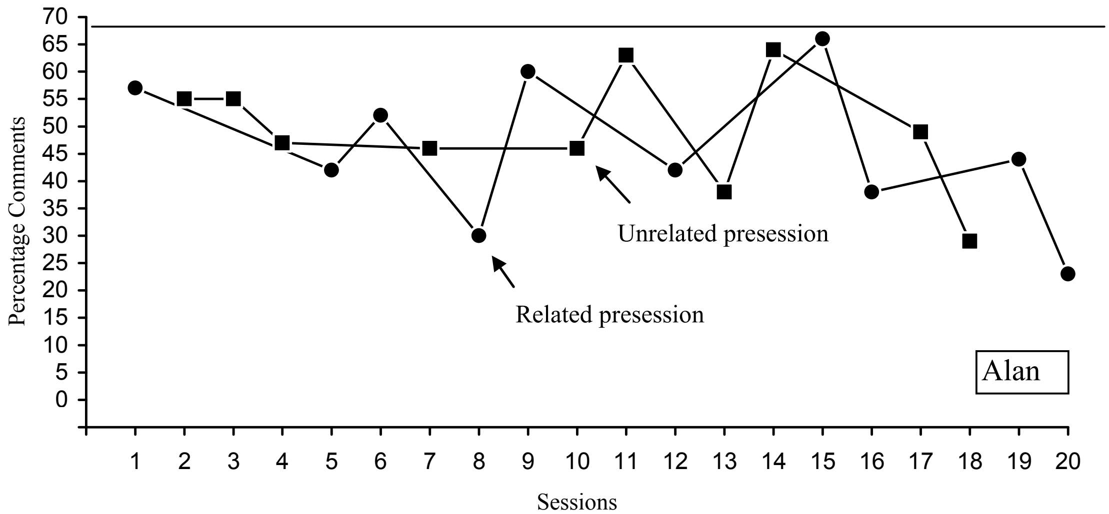


Figure 8. Percentage of utterances with Spontaneous Requests in Related and Unrelated Presessions for Alan.

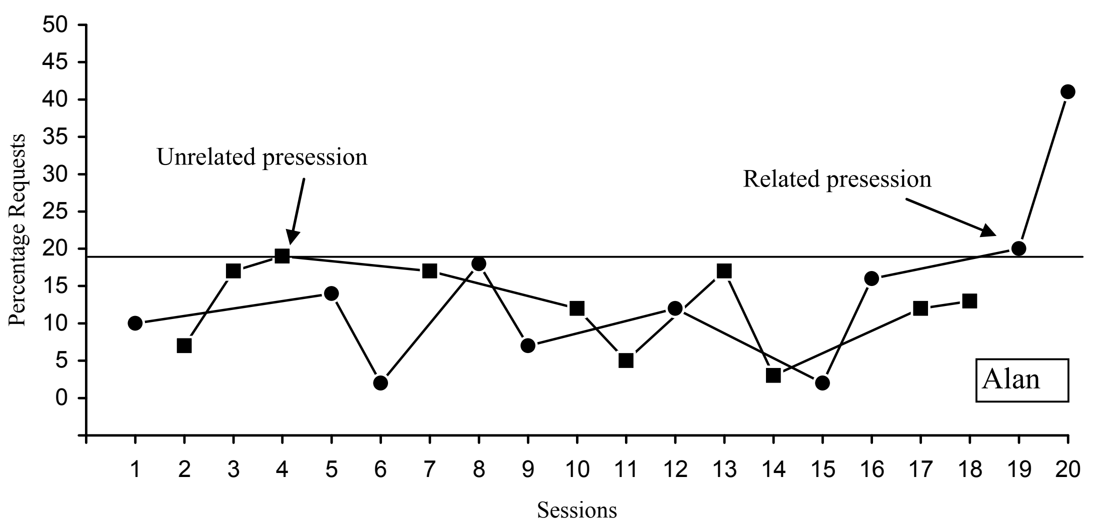
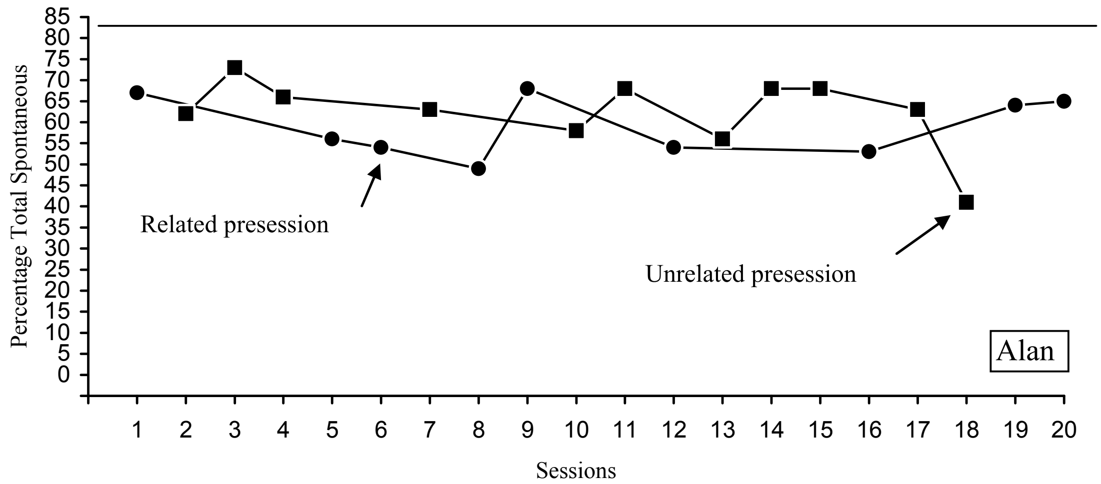


Figure 9. Total percentage of Spontaneous Utterances in Related and Unrelated Presessions for Alan.



Social Validity

In order to determine if there was a perceptible distinction in the quality of utterances between the two conditions, parents were asked to complete a social validity procedure. For four of the sessions (two RP and two UP), parents were asked to refrain from observing the presessions but watch the ACT. Thus, similar to the investigator, they were blinded to the condition. Following the ACT, parents were asked to complete a brief questionnaire regarding their perception of the child's language and interaction during the ACT (Appendix D). Mitch's parent was unable to complete all four observations due to failures in the video equipment. Overall the parents rated the interactions and language use similarly in both conditions; they did not report any observable differences between RP or UP sessions. The parents felt that the children were using some or many spontaneous utterances, had good to excellent attention, participated in the activities, and exhibited quality interactions with the researcher across all sessions with equal frequency. The lack of differentiation between the sessions may be that the questions did not target

the intervention accurately or inconsistency in understanding the definitions for spontaneous utterances.

DISCUSSION

This study was designed to measure changes in spontaneous verbal language for three children with ASD using a priming technique. The children participated in a pre-activity session with a trained researcher which was either related (RP) or unrelated (UP) to an upcoming activity (ACT) session. During the presessions, the participants were able to investigate, touch, ask questions about, and see demonstrations of thematic based activities. Following the presessions, the children went to another room where an investigator, who did not know the type of presession provided, led an age-appropriate thematic based ACT. If the presession was relevant, the same materials were used in the ACT as the presession. If the presession was not relevant, the ACT introduced novel materials. Frequency counts were used to document the five dependent spontaneous verbal language variables: comments, requests, topic initiation, social information seeking, and total spontaneous utterances. Frequencies were converted to percentages of the total number of utterances, which also included answering and irrelevant utterances, for each dependent variable for each session. Treatment efficacy was determined by an increase of 30% in the RP from the average of the first three UP for thee consecutive sessions. Once a participant had achieved the criterion, he subsequently completed brief reversal and reinstatement phases.

The priming intervention yielded mixed results. Two of the three participants met the criterion of a 30% increase in a spontaneous communication skill for at least one of the dependent variables. The other, Alan, did not meet criterion for any of the dependent

variables. None of the participants exhibited any notable use of topic initiation or social information seeking, which was anticipated. Results will be discussed in reference to each dependent variable.

Comments

Both Blake and Mitch met the criterion of a 30% increase in comments for three consecutive sessions with priming. Additionally, their percentage of comments declined during a three session withdrawal and increased to target with the reinstatement of priming. Commenting on the environment to another is a means of maintaining an interaction and sharing a communicative reference (joint attention). The increases in commenting for Blake and Mitch may indicate increased awareness of the environment, interest in the activity, and intentionality to share their thoughts. When considered in the framing of the priming sessions, the children had advance practice with the materials, allowing them to potentially access information from semantic memory and apply to the second event (ACT). During the presessions, the researcher framed the theme and activities to the children's general knowledge by asking them questions about their prior experience with an item or idea, reminding them of similar things in the environment, and relating the aspects of the theme. This explicit organization of the environment may help to create neural connections, which strengthen with the repetition of materials in the actual activity. Blake and Mitch, working with more familiar ideas, were able to increase their use of spontaneous communication. Although two of the children exhibited an increase in commenting, one did not. Alan's profile is different from the others. He exhibited many comments initially and few requests.

Requests

None of the children met the criterion for increasing their percentage of spontaneous requests during ACT with RP. Blake's mean for spontaneous requests during his first three UP sessions was 38%, a thirty percent increase yields a goal of 49% requests. However, his first session's result was substantially higher than all other sessions, and is obviously an outlier. This may have been due to the novelty of the procedure or his history of working on requests with these types of materials. When the mean for the second through fourth UP sessions was calculated and increased by 30%, the result was 34%, which is more in line with the results (see Fig. 2). Many of his RP sessions exceeded the lower criterion, but not in sequence.

Since it is known that children with ASD are generally skilled at making requests, particularly for environmental ends (Wetherby & Prutting, 1984), spontaneous requests may not need to be addressed in an intervention. However, in other studies of spontaneous language, requests were included within the total (as below), but not considered as an individual skill (Scattone, 2008; Thiemann & Goldstein, 2001). Blake and Mitch tended to have similar percentages of requests and comments, while Alan exhibited a tendency to have a smaller percentage of requests than the other two. This may not be due to a skill deficit, but rather an attention deficit. During the sessions, Alan was frequently distracted and needed encouragement to attend to the materials. Therefore, he was not as engaged in completing the activity and did not necessarily need to make requests. Mitch had many more repetitive requests than the total indicates. These were not counted as spontaneous, but rather echolalic. Mitch's perseverance with requesting demonstrated his understanding of the power of this skill. As a final comment,

all three children have attended special education programs which place particular emphasis on verbal requesting. Their relative skill within both conditions may be an artifact of their educational programs. In sum, the intervention had little effect on spontaneous requesting.

Total Spontaneous Utterances

For Total Spontaneous Utterances, Blake was the only child to meet criterion of a 30% increase in three consecutive RP and demonstrate a functional relation through reversal and reinstatement of the intervention. Mitch achieved three sessions at or above criterion during the reinstating of RP following a drop during withdrawal. Although he did not meet the target for percent increase in the initial condition, his Total Spontaneous Utterances yielded a large effect size. Some may still consider this a beneficial improvement and be satisfied with a smaller percentage of change. The increase in overall use of spontaneous language for Blake and Mitch allowed them to share in the communication interaction with the investigator and continue conversational exchanges.

Topic Initiation and Social Information Seeking

Children with typical development acquire the use of protodeclarative (requesting) and protoimpariative (commenting) skills simultaneously beginning during prelinguistic ages (Bates, 1979; Bates, Camaioni, & Volterra, 1975). However, children with autism are skilled at using requesting, or environmental control behaviors, but have deficits in social language, such as commenting, requesting information, and starting conversations (APA, 2000; Tager-Flusberg, 1996; Wetherby & Prutting, 1984). Therefore, it is not surprising that the two more advanced social communication skills were not observed, or not used frequently, during this intervention. Additionally, they are

not used frequently by young children with typical language development (Wetherby & Prutting). Nonetheless there may be two additional reasons for the paucity of Topic Initiation and Social Information Seeking observed in this investigation. First, the activities were new and captured the children's attention. Therefore, they may not have had a need or opportunity to stray from the topic of the ACT session. The second explanation is that the spontaneous language skills of social information seeking and topic initiation may need to be explicitly primed, as in Zanolli et al. (1996) or the result of a more social-based intervention program (e.g. Whalen, Schreibman, & Ingersoll, 2006). These behaviors, once established, may then be better suited for an intervention which models the skills, but does not express them specifically. Children who are older may respond better to interventions to target social seeking initiations. It was not anticipated that the children in this investigation would make substantial gains in these two areas. They were included, however, to help account for various types of spontaneous communication.

The results of this intervention are complicated as one participant, Alan, failed to meet the targeted criterion for any of the dependent variables; in fact he had no discernible differentiation between the two conditions. Further research and analysis of his responses may help to determine which factors influenced Alan's limited performance. While viewing the video tapes of the sessions, it is easy to see several behavioral factors that may have affected his performance.

First, Alan would wander, seemingly aimlessly, away from the adult during the pre sessions and activity sessions. Secondly, during the time of the intervention, he was habitually chewing on his clothing throughout the day. At these times he tended to be less

engaged than what was typical for him regardless of the setting. Additionally, during the study Alan's circumscribed interests were with numbers, counting, letters, and spelling. If he began to count, he continued counting for several minutes. He made frequent comments about his counting (e.g., “There are 7 aphids.”) but the comments about his counting, per se, did not necessarily apply to the topic. During times of spelling, Alan would ask, “How do you spell duck?” This question was generally a modification of an echolalic utterance with a substitution for the word to be spelled. He did not necessarily address the question to anyone and stated the answer for himself, “D-U-C-K.” These types of utterances were scored as Irrelevant. Even his utterances which qualify as spontaneous comments, such as the following from the Flying unit: “It’s spinning” and “Fly to the ceiling,” were not necessarily directed to the communication partner and may have not had social intent, but be more a simple label. This aspect of his communication cannot be confirmed due to the necessity for evaluation of gaze and inflection which are not available from the current video and audio tapes. Alan may benefit from the priming intervention once he has passed these stages of internally driven repetitive utterances and exhibits more prolonged attention. However, children with ASD are a heterogeneous group and require various different strategies tailored to their individual needs (NRC, 2001; Quill, 1998). It may be that priming is simply not an effective method for Alan.

Priming of activities and related vocabulary provided the participants with an explanation of what was going to happen in the environment, not direct instruction in a social skill. This is a similar concept to Social Stories™ which are designed to help the child understand expectations, conventions, and behavioral options, via descriptions rather than using directive techniques. Priming is also similar to video modeling, as it

demonstrates what the child will be encountering. Although, in video modeling, the child does not physically interact with the materials. Both of these antecedent events begin to activate a child's potential for memory and processing. Additionally, priming is relatively simple to implement, inexpensive due to the use of authentic materials, and can be used in many situations. Priming offers many potential befits to children with ASD.

Limitations

This intervention has several limitations which should be considered and improved with replication. First, the participants constituted a convenience sample, as the investigator was working with children whom she already knew. It is possible that these children shared some characteristics or experiences that might not have been true of volunteers responding to general recruiting strategies.

Second, due to the necessity to plan the initiation of the withdrawal and reinstatement phases, the investigator was aware of these changes. This could have potentially influenced the interactions with the participants and their subsequent responses. The potential for confounding could have been avoided had the assisting researcher or a third person been responsible for coding and calculating the data. In the current situation, the adult utterances from the sessions where the investigator knew and did not know the phase could be analyzed to determine if they were qualitatively different. Simple visual inspection of the participant results from both conditions look similar in the multi element and withdrawal/ reinstatement phases, with the exception of Mitch's Total Spontaneous Utterances yielding the highest results during the final three primed sessions.

The format used to calculate inter-observer agreement led to potential problems with misinterpreting an utterance due to lack of context, since the advisor was coding transcripts and not watching the video taped sessions. For example, in one utterance while making a craft, Mitch said, “And the tape.” This was initially coded as a comment, Mitch noticing the tape. However, when listening to the recording, it is clear that he has rising intonation and the intent is requesting the tape so he can put it on his project. This problem could be solved by having the second rater listen to the tape, rather than simply code the utterances based on the transcription.

One of the goals of sessions was for the children to be comfortable and guide the flow of the session based on their interests. Unfortunately, at times the interests were perseverative or extended echolalia. The priming intervention was not sufficient to decrease these disruptive behaviors, and they frequently required other structured techniques to decrease or waiting for the episode to finish before moving back to the target materials.

This intervention used only one priming session immediately before the event, similar to Licciarell et al. (2008). It is unknown if two priming sessions, or a session with a longer time-span between the priming and the activity, would improve performance. As memory consolidation has been demonstrated to occur during sleep (Gais & Born, 2004; Stickgold, 2005), access to the primed information over night may also improve the results. This study followed the design of other priming interventions which consisted of priming immediately before the event (e.g. Licciardello et al., 2008; Sawyer et al., 2005; Zanolli et al., 1996). As memory consolidation involves processing, and children with

ASD exhibit processing deficits, it is unclear if there would be a difference with sleep and at what point the event would become novel again.

Blake, who responded the most consistently to the intervention, was three and a half years older than the other participants. His performance may have been affected by increased numbers of life experiences simply due to age. The actual affect of age is not clear, as Mitch had similar, but not as dramatic results.

Finally, the results of the priming may have been obscured because of the change of adults between the presessions and the ACT sessions. Children with ASD typically have difficulty generalizing across settings, people, and materials (McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992). In this study, the materials were held constant but the setting and people changed. This was done to eliminate any potential bias in the interactions during the ACT sessions as the investigator was blind to the nature of the presession. The results may have been different if the same person primed and then conducted the activity. Additionally, if one person provided priming and then conducted the activity, specific features could be highlighted, explained, and emphasized more consistently. The effects of using the same or different people for priming and implementing the activity should be explored in future research.

Future Studies

Priming has a potential to be a beneficial component to a treatment plan for increasing spontaneous language for children with ASD, however, there are still several aspects that warrant further investigation. First, a replication of this study, with more participants and the suggestions from above, will help to clarify the results found here. Since priming was effective for only two of three participants, more research is needed to

identify individuals' characteristics, such as age, language ability, or interests, which may influence outcomes. Investigating priming in situations with natural opportunities for spontaneous language will extend the results of this investigation. Specifically, priming before a play date with a peer by practicing the games to be played or priming a holiday family dinner by introducing the menu, looking at pictures of the guests, and practice with passing. Within the educational setting, a child can have priming before a field trip by seeing pictures of the place, maybe having some of the materials available ahead of time for inspection, and relating the trip to the academic goal it is supporting. It is difficult to implement procedural fidelity during interventions in authentic situations, so careful planning would be essential. A final target would be to investigate the difference, and potential benefit, of multiple priming sessions, to further enhance the recognition and processing of target information or utilizing priming the day before the event to allow for processing during sleep.

CONCLUSION

Interventions for communication in children with ASD should prioritize expanding their ability to use many of the social aspects of communication (e.g., joint attention, sharing information, negotiation, initiation), as these skills contribute to functional, relationship-based communication (Prizant et al., 2000). Using spontaneous comments to share thoughts, requests to manipulate the environment, and reciprocal, social engagement to maintain an interaction are examples of these social communication skills. Priming is one means of promoting such spontaneous communication. In this study there was a functional relation between using priming and subsequent increases in spontaneous comments during thematic based ACT for two of the three participants.

Additionally, when the priming support was removed, the number of comments dropped. The comments increased again when priming was reinstated. One child met the criterion for increasing total percentage of spontaneous utterances during the two condition phase. Another approached the target, decreased with removal of priming, and met criterion during the intervention phase. Priming during the presessions did not affect spontaneous requesting. This may be due to the participants' relative skill in this area as an artifact of their educational programs, or simply because this is a behavior they have already acquired. Additionally, priming did not have an impact, as expected, on social information seeking and topic initiation.

Autism is conceptualized as a deficit in processing across multiple cognitive skills; one single intervention could not be expected to address all the complex needs in social language or any functional area. However, adding a procedure such as priming, may address many characteristics and needs of individuals with ASD. Priming utilizes the relative strength in semantic memory and helps to prepare episodic memory, which is consistent with needs of children with ASD. Priming also can facilitate processing of complex information, as the priming session can link processing centers to stored memories. These interactions promote LTP, creating and strengthening new memories. Finally, priming can lead to changes in expressive language. When the child has experience with the materials, there is a familiarity with repetition for new vocabulary, an increase in recognition of activities, and a better understanding of expectations. These give the child with ASD a foundation for making more comments and using more language than when all processing must occur with an initial presentation of an event. Priming was ineffective for the child who had less attention to the materials during

priming and had more restrictive interests. The results of this study provide initial data to suggest that priming may facilitate enhanced performance in academic, social, and language abilities to increase independent functioning for individuals with ASD.

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APPENDIXES

APPENDIX A

Theme Activity List with materials

Apples

Toy(s)
Roll squishy apples, scoop with ladle into basket, dump out
Presession: see apples, squeeze, hold ladle, what do we usually do with it
Vocabulary: Squeeze, smoosh, ladle, squishy

Art
2. Apple print painted on to apple tree-
Precut trunk and leaves, mount on background
Slice apple, dip in red paint
Presession: Show art, look at paint (shake) and apples (feel), show how to cut in half
Vocabulary: half

Book
How to Make Apple Pie and See the World™
Presession: point out apple pie on cover, flip pages, use voice to show interest, point to and label key ingredients, map points
Vocabulary: cinnamon, travel

NOTES
Not with monkey
PREP: get apples from refrigerator

Bouncing

Toy(s)
Moon shoes
Demonstrate
Strap on, try walk, jump, walk backward
Presession: Look, feel, put on but don't walk or jump too far, why it's called a "moon" shoe
Vocabulary: *Moon*

Game
Beach ball dribble
Keep track of how many time w/o miss, Try to beat record
About 3-5 minutes
Presession: Try to bounce ball, play with beach ball in air
Vocabulary: *dribble*

Art
Make bouncy balls
Follow directions
Will have to take home and wait for them to dry
Presession: Look at kit, find pieces, review steps, feel model ball
Vocabulary: *bouncy, harden*

NOTES
Don't do with feet
PREP- get water

Bubbles

Toy(s)
Amazing Bubble Blower™
Follow instructions carefully, slowly
Demonstrate use, Plan for fun, Tell best part when done
Presession: Look at machine, squeeze, touch w/o turning on, see how to make a "Million bubbles"
Vocabulary: *million, amazing*

Art
Bubble picture
Dish soap in bowl (a lot), Food color in bowl
Add water, Blow with straw
When a lot of bubbles are coming over the edge, catch with white paper, Make several on one page
Presession: Look at picture, show materials and label, have to make them overflow to "catch" on the paper, model and practice blowing with straws (throw out when done)
Vocabulary: *straw, food coloring, overflow, edge*

Book
King Bidgood's in the Bath™
Silly pictures, ideas, faces
Presession: Review pictures, point out some funny ones
Vocabulary: bath (and how it's used here)

NOTES
Don't use with Wash
PREP: get water

Carrots

Game
Rabbit hop to get lunch
Pretend to be rabbits
Hop on the brown dots (garden) to get to the carrots
Eat 5 carrots and be full
Presession: Look at parts, bounce/hop to get things in the room, try on the headband, hold carrots, the goal is to get the carrots
Vocabulary: *headband, gather*

Art
Put carrots in a garden – able to pull out

Presession: Look at sample, pull out, see the surprise bunny, show how ears look like top of carrots

Book
Just Enough Carrots™
Presession: Look at title, pictures, see animals, discuss what they eat, concept of "enough"
Vocabulary: *Enough*

NOTES
Don't do with bounce
PREP: get carrots from the refrigerator

Clouds

Game
Storm the Desert
Hang up desert picture, coyote
Put clouds in the sky, start light, then dark
Use squirt bottle to make rain
Presession: Show desert picture and Coyote, remember desert is dry, touch cotton, difference in clouds in the sky regular and before a storm
Vocabulary: *desert, coyote, squirt*

Art
Jet message
Stretch long cotton after a plane picture to write a message
Glue cotton on to blue paper, Glue plane at the end
Presession: notice plane's cloud made the word, look at long cotton, what would they write in the sky?
Vocabulary: *cloud, skywrite, message, long*

PREP: need water

Eggs

Toy(s)
Dancing Eggs™
Follow directions with dice to try to do what it says w/o dropping eggs
Presession: look at dice and practice with one egg for each thing on each die (just once)
Vocabulary: *cluck, knee, grab*

Art
Egg shell picture
Crush and color egg shells in a zip lock bag
Glue on to outline of fried egg, use plastic gloves, glue in the paint
Presession: look at fried egg picture (PCS) and the art with egg, touch the art, touch one (smaller) egg shell and break it
Vocabulary: egg shell, sticky, fried egg

PREP- look at dice before session

Feet

Toy(s)
Big feet
    Look at big feet, Tape on
    Walk forward, backward, jump, skip
Presession, look at, touch, but don't put on, big feet
Vocabulary: *huge, backward, attach*

Game
Super Kicker
    Feel different weights of many balls
    Kick each ball, Mark the furthest kick with the green arrow
    Do again
Presession: feel and bounce (just don't kick) each ball, look at differences, show arrow to mark a spot
Vocabulary: *weigh, hard, farthest, arrow*

Art
Decorate big feet with markers and stickers
Presession: notice decorated foot, look through stickers to see what looks good

NOTES
Not with bounce, not with clouds if possible
PREP- Blow up beach ball and balloon ball

Fish

Game Pin the shark in the ocean
    Tape up ocean, Think of bad things to happen to a fish
    Put some problems in the ocean, and a few safe places
    Close eyes, spin, put fish on ocean
Presession: get target fish, set aside
Look at each item in the stack and say/decide if it's a danger (or help) to the green fish- can tell why. Ship wreck, coral are good. Sharks, divers, jellyfish are bad . . . SO the child will know the answers when he comes to the session
Vocabulary: *coral, shipwreck*

Art
Aquarium
    Look at plexi-glass™, peel off protective plastic
    Discuss fish on the window clings
    Put fish on plexi-glass™
    Wrap with blue plastic wrap to be "water"
Presession: look at craft and see how the fish are in an aquarium, peel off some plastic wrap and look at it in the box, see if there are fish on the window clings that the child likes.
Vocabulary: *plexiglass, remove, plastic wrap*

Flowers

Game
Magic trick
    Demonstrate appearing flower
    Explain how it works Practice doing the trick
    (Take to parent at end of both sessions)
Presession: Demonstrate the magic (just once)
Vocabulary: magic wand, appear

Art
Making a flower in a pot
    Gather and show materials (pot, molding clay, glitter, glue . .)
    Put down protection (newspaper)
    Stem in circle, Put clay in bottom of pot
    Paint glue on to ball, Pour glitter on ball (over the dish)
    Put in pot, Put "dirt" around flower
Presession: look at all materials and review steps to craft listed above. Touch anything (Styrofoam™ball, etc)
Vocabulary: clay, Styrofoam™

NOTES
Not with golf if possible

Flying

Toy(s)
Hover copter
    Look at copter, Demo and use with control, several times to try to get to target spots

Presession: show copter, remote, use hands to demonstrate "hover"
Vocabulary: *Hover, remote control*

Game
Flying animals
    Try to land on target

Presession: demonstrate one, child tries if he asks
Vocabulary: *sling shot*

Book
Merle the High Flying Squirrel™
Tell basics of story
    Read beginning
    Flip pages to see where he goes
    Read the end

Presession: look at title, various pictures, beginning end
Vocabulary: *Squirrel*

NOTES – not with rocket
PREP: If copter is going to be used, charge during Presession

Golf

Toy(s)
Golf set
- Look at clubs, balls
- Try holding
- Hit ball to large target
- Try from farther away

Presession: Show all parts one at a time, hold club and swing w/o ball, general golf discussion (watched golf, know anybody with golf clubs, heard of Tiger Woods)
Vocabulary: club, golf, hole, swing

Art
Make a golf club
- Use dowel rod
- Put into Styrofoam™block
- Use electrical tape to connect
- Decorate with tape on top
- Practice with nerf™ balls

Presession: Will be making a golf club to take home, show completed club, point out parts, colorful tape, feel nerf™ ball
Vocabulary: dowel rod, Styrofoam, electrical tape

NOTES
Not with flowers if possible

Hands

Toy(s)
Robot hand grabber
- Try to be a robot – stiff movements, funny speech
- Look at robot hand
- Use it to grab some big and little things, put them in a bowl
- Try it with other hand

Presession: Look at robot hand, squeeze it w/o grabbing anything
Vocabulary: robot, grab

Game
Operation Brain Surgery™
- Have to use your hands to find pieces on the picture
- Feel some pieces, decide what is distinctive
- Try game cooperatively

Presession: Look at pieces, feel them (outside of head), look inside person's head, use HANDS for surgery
Vocabulary: operation, surgery

Book
Wash Your Hands, Little Princess™
- Looking at pictures
- Discussion of germs and hand washing
- Look for ways to make hands less gross

Favorite ways to have dirty hands
Presession: Tell concept of book (girl gets very dirty and germy hands, needs to keep them clean to stay healthy), laugh at a few pictures, comment on some of the germs
Vocabulary: germs, wash, filthy

Ice Cream

Toy(s)
Ice cream popper
Guess what it might do
Use toy to POP
Reset and do again
Pack in bag to take home
Presession: Look at popper in package, guess what it might do
Vocabulary: popper

Art
Ice cream Moon Sand™
Look at moon sand pieces
Feel moon sand
Make some ice cream shapes
Take an order for something else
Clean up
Presession: Open moon sand to touch, mold if child wants to, look at pieces in kit, label
Vocabulary: moon sand, cherry, mold

Book
Make your own ice cream sundae sticker book
Look at different choices
Comment on what like and don't like
Put stickers on
Pretend to eat
Presession: Look at book, peel off one sticker and put on, let child try if interested
Vocabulary: sundae vs. Sunday, banana split

Knock Down

Toy(s)
Balancing men
Try to stack a few
Add one more to balance
Look at patterns and try 2 patterns
Presession: Look at discovery men, take out 3 and try to stack, look at patterns to see what might be hard or easy
Vocabulary: balance, pattern

Game
Domino path
Make a path with dominos
Knock down
Make as long as possible the second time
Presession: show dominos, make a path of 4 or 4
Vocabulary: dominos

Art
Make bowling pins
 Water, food color in 6 bottles
 Roll ball to knock down
Presession: Show models, knock down with hands, look at empty bottle, food coloring
Vocabulary: bowling, food coloring

NOTES- not with bubbles
PREP- Get water

Ladybug

Game
Ladybug Game™
 Review rules
 Play game
Presession: Look at game- pieces, board, basic rules, goal of game
Vocabulary: turn, move,

Book
Are You a Ladybug™
 Reading book with looking at pictures
 Comments
 Try some of the lady bug moves/ skills
Presession: Flip through book, comment on pictures, have child find a few things
Vocabulary: most of the book!

Lights

Toy(s)
Light snake
 Take light tube out, Run around the room
 Compare with snake, Turn off lights (door cracked)
 Pull snake- with shaking- as fast as possible to you
Presession: touch lights

Game
Glow in dark
 Put out stars, turn out lights ahead, to see they don't glow too much,
 Put stars spread out on sheet, set some on top of each other
 Turn out lights at end of session to see glowing
Presession: look at stars and color b/f lights
Vocabulary: *Glow in the dark*

Art
Light catcher
 Tear some tissue paper into small pieces
 Peel back off of contact paper, Put tissue on and put top circle on
 Use yarn to make hanger, Hold in front of light
Presession: look at sample, touch and tear some tissue, look at colors the child likes/ may pick
Vocabulary: contact paper, tissue paper,

Luau

Toy(s)
Hungry Henry™
Look at game
Review rules
Play few times
Presession: look at pieces w/o putting in the pelican, review rules
Vocabulary: pelican

Game
Party memory
Put items on tray, label, touch
Cover tray and remember
Bring back items as child remembers
Give hints
Presession: look at all items,
Vocabulary: label items in which the child shows interest

Art
Dress in hat, leis
Discussion of wearing flowers at Hawaiian party
Presession: look at leis
Vocabulary: Lei

Magnets

Toy(s)
Horseshoe magnet
Try on "horseshoe"
Pick up different items
Some won't work
Predict some
Presession: Look at magnet, talk about what it does, try on some things in room (not from bag)
Vocabulary: magnetic, horseshoe

Game
Magnet gears
Put on small mirror
Make shapes then make it go
Reshape and do again
Presession: look at few gears interacting w/o putting all on magnetic surface
Vocabulary: gear

Art
Magnetix™
Make shapes, play, long, round, etc
Presession: look at 3 or 4 pieces of Magnetix™ to see what they do

PREP- Get small mirror from my office, near the sink

Magnifying/Get Bigger

Toy(s)
Expand a balloon
Really long balloons that will get bigger and bigger
Blow several times with pump, measure with arms, fly through room
Presession: show unblown balloon, stretch big

Game
Magnifying glass
Look at common items
Look with magnifying glass, look at smaller part to make even bigger
Presession: Showing, labeling magnifying glass, look at each other or something in room
Vocabulary: magnifying glass, enlarge

Art
Expand a picture
Make picture with various materials
Discussion of worm and snake, finish picture
Presession: demo picture, look at snake
Vocabulary: expand, rattle snake

NOTES
Not with wind

Monkey

Toy(s)
Jumping monkeys
Wind up, watch them jump
Try jumping over string
Presession: Show monkey, show winding, maybe jump once
Vocabulary: wind

Game
Monkey Memory™
Monkey's behave silly
Review game- see below, practice game, play together
Presession: review rules: look at cards, monkey comes in and snatches something, look at cards, "What did he snatch?"
Vocabulary: Memory, remember, snatch

Art
Monkey snack
Glue monkey pictures on to tree
Get bananas to glue on- discussion of what they were eating, which one, etc.
Presession: Look at different monkeys, bananas, talk about eating snack

NOTES
Not with luau , apples

Monster

Game

Go Away Monster™

Review rules, what goes in the bedroom- look at shape of monster pieces

Choose to play together or separately

Presession: show rules, pieces, feel the pieces

Art

Make a monster

Look at the monster book, choose monster pieces

Follow book to glue on

Presession: look at parts, feel felt

Vocabulary: Felt

Book

Go Away Green Monster™

Read book looking at each addition, subtraction

Presession: Look at cover, title, "do you like monsters?", few pictures

Mule

Game

1. Buckaroo™

Look at pieces, describe a few

Look at mule, resembles a donkey, horse

Read rules, try game a few times

Presession: rules of game, holding pieces, put a few on w/o setting mule

Vocabulary: Mule (like a donkey, horse)

Book

Jake Johnson™

Remind that mules are stubborn

Look at pictures, tell story

Presession: Look at Jake sitting, discuss stubborn

Vocabulary: stubborn

Red

Game

Dress up

Look at and put on red clothes

Take picture

Check pictures, pick one to print

Put camera out of room

Presession: Look at clothes to determine what is similar, try on something if child wants to, look at camera, digital means that you can see the picture on the back

Vocabulary: digital

Art

Make photo frame

Use red materials to make a red frame

Cut picture, put in frame
Presession: Look at sample, pieces to make frame
Vocabulary: frame

PREP- be sure my computer is on, be ready to use the USB connected to the computer already to attach to the camera and print the picture. 4x6 size. Put string to camera, turn on, get print wizard, follow instructions.

Rocket

Toy(s)
Stomp rockets
Listen to instructions to set up (have to use nut, bolt)
Why these are like rockets
Use several stompers, different pressure
Presession: look at toy, assembly for base- bolt, nut - purpose
Vocabulary: stomp, bolt

Game
Space shuttle rocket toss
Look at space shuttle
Throw into target "moon" (box)
Do from longer distances or higher up
Presession: look at rocket, don't throw, see how box is part of the game
Vocabulary: space shuttle, target

Book
Roaring Rocket™
See pictures, remember last game
Focus on lunar differences
Presession: flip through book quickly, not too much attention b/c short book
Vocabulary: Lunar

Shadows

Toy(s)
Shadow Magic™
Hang the background (on floor)
Use small lantern flashlight or open door for background light,
Use patterns and body or other items to make shadows
Presession: Look at each piece of the game without lights off, practice flashing, look at background

Art
Trace a <u>picture of basic shape</u> on <u>black paper</u>
Cut out, decorate
<u>Glue</u> both on color <u>background</u> with the shadow behind or on the "ground"
Presession: Look at the sample, see how it's a shadow, look for shadows in the room

NOTES
Don't use with lights

Spider

Toy(s)
Spider smash paddle
Talk about broken one for adult, looks like a spider web
Try to keep it going
Presession: Look at paddles, like spider webs, ball is spider
Try it briefly back and forth
Vocabulary: Spider web

Game
Inflatable spider ring toss
Try it in different places
Presession: look at toy, try one time
Vocabulary: *toss*

Art
Spider web
Cut plate
String long web with yarn
Weave spider into the web
Presession: look at craft, follow yarn,
Vocabulary: *notch, long*

NOTES- not with Toss
PREP- be sure that the spider ring toss is all blown well

Sun

Toy(s)
Solar system window stickers
Put on long mirror, use big sun to shine
Presession: look at all of the planets, discuss "solar system", relative size
Vocabulary: solar system, cling

Art
Really big sun
Cut rays
Paint everything orange (put glue in paint)
Sprinkle with gold glitter
Staple rays to circle sun
Presession: look at size of project, real sun is huge, review steps to craft
Vocabulary: *ray, glitter, staple*

NOTES
Not with lights, spider, or fish
PREP- get long mirror from my office

Toss-Throw

Toy(s)
Throw long serpentine streamers

Stand on chair to throw some
Stretch them out
Throw all
Presession: Look at streamers in pack, compare to the ones on the art, if it's a non-related pre-session- then throw several, related pre session, just throw one each
Vocabulary: Streamers

Game
Toss big dice action game
Toss the big dice onto a target circle (across the room, near a wall)
If it lands on the circle then do that many jumps
If it lands outside of the circle run to it and try to get to the dice first to roll again
Presession: Look at big die (talk about die vs. dice), roll, feel carpet
Vocabulary Die, toss

Art
Make a face with crazy hair from the streamers
Use serpentines for hair
BIG wiggle eyes
Markers for the rest
Presession: Look at sample, shake hair and eyes
Vocabulary: wiggle eyes

NOTES
Not with spider unless necessary

<u>Wash</u>

Game
Car Wash
Make "mud" with brown paint and a splash of water
Put on play mat road "puddle"
Drive cars on road, into mud
Go to car wash
Wash cars with soapy water, tub, wash cloth, drying towel
Presession: What happens with dirty cars (get washed), look at supplies, guess what will happen, don't open the road
Vocabulary: car wash, mud

Book
Mrs. McNosh Hangs up her Wash™
Add more ideas of silly things to hang
Clothespins and few clothes to hang up
Presession: Flip through book to look at pictures, clip clothes pin on to rope,
Stretch rope to demonstrate that it is a bungee cord
Vocabulary: Clothes pin, bungee cord, wash (2 meanings)

NOTES
Not with bubbles
PREP- get water

Wind

Toy(s)
Balloon car racer
Bigger balloon goes farther, decorate
Race/ roll on, Wind from balloon
Presession: demonstrate balloon racer, wind is coming out

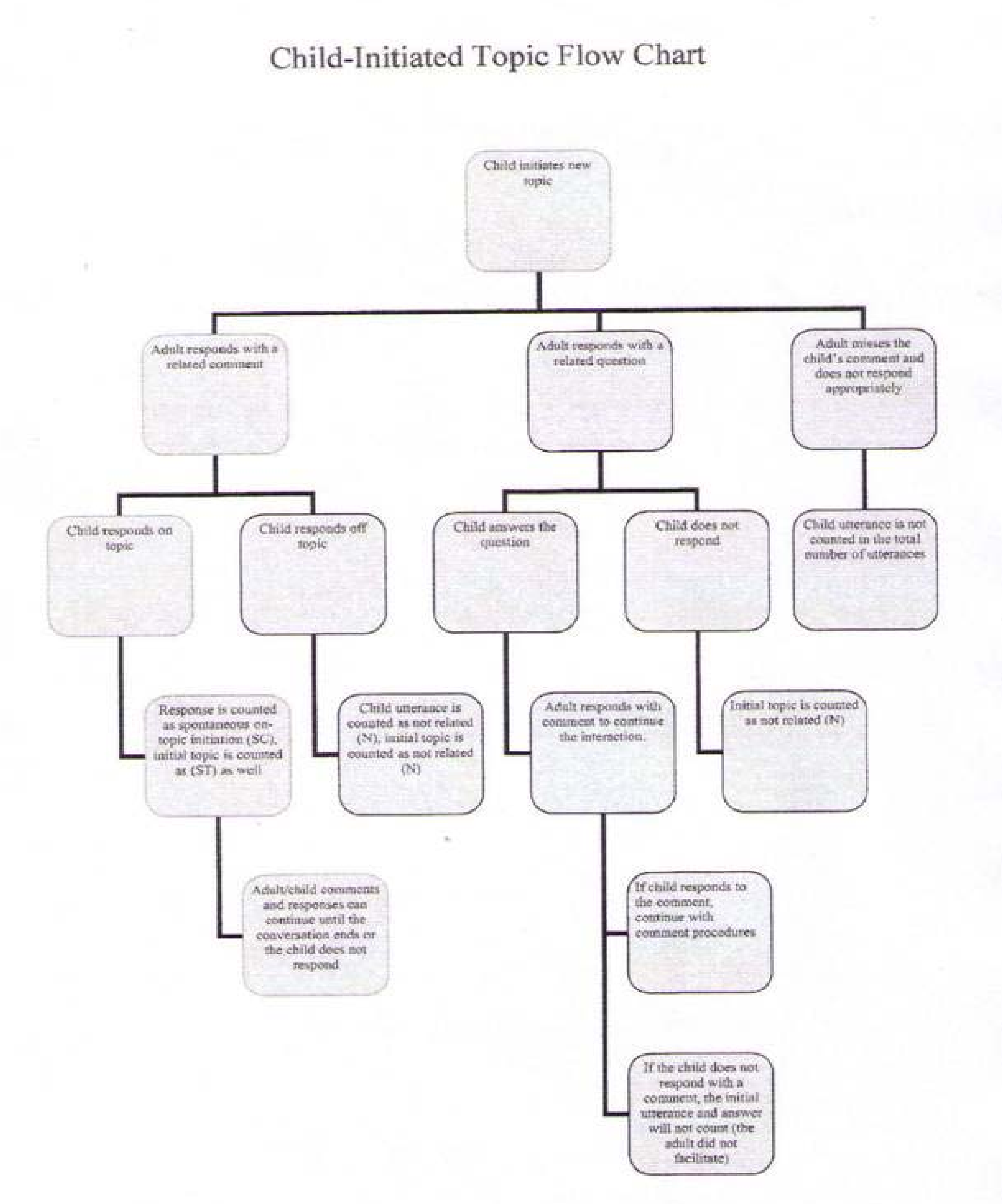
Art
Decorate fan with streamers, long and short
Tape on to fan
Blow fast and slow
Presession: demonstrate how to tape on without taping- cut streamer and put up, turn on fan without streamers
Vocabulary: streamer, fan

Book
The Magic Fan™
Look at Japan fan b/f starting book, feel wind from fan, read, look at pictures
Presession: open accordion fan, look how it matches the book, review pictures in book

NOTES
Not with Throw/ Toss

APPENDIX B

Child-Initiated Topic Flow Chart



APPENDIX C

Pre-session Treatment Fidelity

Child Name ________________________ Date____________________

A. Differentiating comment (can be repeated) _____yes _____ no
Primer must indicate session type.

If differentiating comment is not used, the session is invalid. Do not proceed.

B. During the 10 minute priming session, observe the child for five 1.5 minute segments. At the end of the segment, use 30 seconds to record if the following key aspects of priming were included (I), or not included (NI) by the primer, or if the target was not applicable (NA).

Interval	A	B	C	D	E
1. Showed materials Adult brings out materials and presents to the child with an opportunity to touch, handle, or refuse	___	___	___	___	___
2. Demonstrated materials Models how to do/use materials (turn book pages, open glue, set up game).	___	____	____	____	___
3. Engaged in positive interaction The adult should have a positive affect, smile, cheerful voice; redirections encouraged, not forced.	___	____	____	___	___
4. Offered the child choices Adult gives the child options such as touch or not touch, what does he want to see first, does he want to try?	____	____	____	____	____
5. Reviewed vocabulary Target words are repeated, the child is offered an opportunity to imitate the new words.	____	____	____	____	____

TARGET VOCABULARY and MATERIALS

Presessions should contain an abundance (>60%) of I, include, to be considered valid.
Total Percentage _________

	A	B	C	D	E
C. Non-judgmental	___	___	___	___	___

Non-judgmental: is the child allowed to express his opinion, not forced to interact with materials, allowed time to relax or withdraw if needed?

* Non-judgmental segments should be 100% occurrence per presession.

APPENDIX D

(The parent was given this form four times)

Social Validity
Directions: You will not observe your child for this presession but watch the activity session. After the session, please rate the child's behavior and interactions during that segment using the scale provided. In addition, consider your daily interactions and knowledge of what is typical for your child when answering the questions.

Is your child using spontaneous on-topic utterances* with the examiner?
Many b. Some c. Few/none

Is your child attending to the materials for the activity?
Entirely b. Somewhat c. Not at all

Is your child using the materials for the activity?
Yes b. Somewhat c. Not really/no

Is your child using the relative vocabulary for this activity?
Yes b. Somewhat c. Not really/no

What rank would you give to the overall quality of the interaction between the clinician and child?
Very good b. Fair c. Strained/bad

* For this activity, spontaneous on-topic utterances are when a child verbalizes without a prompting or asking him a question. Examples of spontaneous utterances may include requests ("I need glue." "Stop."), comments ("Mine is broken." "Look at this"), or social or information seeking questions ("What color is yours going to be?" "Do you like it?").