

How Was Your Day in Preschool?

Teaching Accurate Recall to Young Children with Autism Using Mobile Technologies and
Visuals Supports

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Abstract

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As the number of children diagnosed with autism increases, the need for sustainable interventions and easy to use technologies is important. Advances in technology have changed the way educators can deliver and support instruction, in general and special education classrooms. This mixed methods study investigated the use of mobile technology-created visual supports as a method for teaching accurate recall to three young children with autism. Results suggest that these technologies may provide a sustainable way of developing and implementing visuals, provide a method of teaching accurate recall to young children with autism, and enhance parent-child conversations about the child's day at school. Implications for teachers, families, and children with autism are discussed, as well as individual child results.

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Dedication

To the two men who dissertated right along with me: my husband, Ted, and Baby M.

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Chapter 1

Introduction

Advances in technology over the last decade have improved the tools, accessibility, and affordability of a variety of devices for individuals, families and more recently, schools. Technologies such as tablets, MP3 players, cell phones, and laptops are commonly used as teaching tools and/or supports in school districts nationwide and internationally. These technological advances have special promise for individuals with autism and other disabilities. While visual supports have long been a popular method for teaching new skills to individuals with ASD (Bellini & Akullian, 2007; Odom & Wolery, 2003), new developments in technology have expanded options for technology-based teaching methods. Studies have examined technologies as a way to target language, emotion recognition, play skills (DiGennaro Reed, Hyman, & Hirst, 2011), social skills (Wainer & Ingersoll, 2011), and motor skills (Chen, 2012) with young children with autism. Additionally, these forms of technology are commonly used in preschool classrooms as instructional tools (Beschoner & Hutchison, 2013) and for documentation and data collection (Seitz, 2008).

While mobile technologies have been used as a tool for parent training (Bigelow, Carta, & Lefever, 2008; Carta, Lefever, & Bigelow, 2013) no studies to date have examined how they can be a tool for teaching the specific skill of accurate recall to young children with autism. Furthermore, no studies to date have explored how sharing photographs with families using mobile technologies can enhance parent-child interactions and support children's ability to retell events from their day, at home.

Visual Supports for Individuals with Autism

Given that cameras are commonly included in most mobile devices, it is possible that these new technologies can be used to create visual supports by simply taking a photo of a specific item or event. The use of visual supports can assist young children with autism and related disabilities by providing them with alternative ways to receive the information necessary to be successful in activities and daily routines (Arthur-Kelly, Green, Mathisen, & Arthur-Kelly, 2009; Hodgdon, 1995; Rao & Gagie, 2004). Children with autism and related disabilities frequently have difficulty processing auditory stimuli and respond to sensory input differently than their peers without disabilities (Tomchek & Dunn, 2007). These children often have difficulty understanding, interpreting, and processing verbal language (Hodgdon, 1995). Temple Grandin, a well known, very successful adult with autism describes how people with autism “think in pictures” (Grandin, 1995) and emphasizes the importance of teachers and families using pictures to support the engagement and learning for young children with this disability.

Visual supports include the pictures, line drawings, schedules, lists, symbols, videos or other types of graphic displays that prompt or remind children to engage in a behavior or prepare them for a certain activity (Odom & Wolery, 2003). Examples include a poster near the sink illustrating the steps of the hand-washing routine, a photo of a child’s caregiver to remind them who is coming to pick them up from school, and the symbols or pictures that make up a schedule in a classroom (Gauvreau & Schwartz, 2013). Adults utilize visual supports in the form of daily planners, calendars, smart phones, maps, to-do lists, etc. throughout the day to remain productive and efficient. For young children with autism, visuals can be an unobtrusive way to support a child focus on the specific message in a direction, reduce anxiety, provide prompting, make abstract concepts more concrete, and help the child express his or her wants and needs (Rao & Gagie, 2004). These can take many forms, including but not limited to schedules, prompts,

communication aides, and play reminders. Furthermore, effective and meaningful visual supports should be a component of all early childhood programs for children with autism and related disabilities (Odom & Wolery, 2003).

Visual Supports are Effective, but Challenging for Families and Teachers. Despite the utility of visuals in early childhood classrooms, there are barriers that decrease their effective implementation and sustainability. In their study exploring consumers' views on visual supports, Donato, Shane, and Hemsely (2014) found that families and special education teachers identified a lack of time, lack of awareness of various forms of visual supports, inconsistency, limited resources, negative attitudes of others towards visuals (e.g. people in the community demonstrating negative reactions to parents using a visual schedule) as barriers to implementation and sustained use. Additionally, practitioners noted that access to resources and materials necessary for creating and storing visuals was another barrier. One educator shared the struggle of developing, organizing, and accessing visuals in her classroom by sharing, "you need to have access to the resources as well, so that [visuals are] made up, they're ready in the room to grab and go with whenever you need them," (Donato, Shane, & Hemsley, 2014, p. 120).

Like other instructional approaches, visual support strategies must be used with fidelity to be successful. Having access to training and coaching on how to use technologies to develop visuals is necessary for their widespread use. Study participants using mobile technologies to create and implement visuals found these required less time, compared to traditional hard copies of visual supports. Parents reported that mobile technologies also provided more options than hardcopies of visuals (e.g. they could use cell phones, tablets, or computers compared with just one copy of a visual schedule), and demonstrated a preference for the use of technologic devices as their children found these highly motivating. Notably, practitioners found visuals using

mobile technologies to be quicker to develop, retrieve, and implement with children, and stated that they resulted in increased use by families. Ultimately, the research of Donato, Shane and Hemsely (2014) suggests that mobile technologies can decrease the barriers related to visual supports and increase ease of use and sustainability, resulting in more access to children with autism and their families.

The Use of Mobile Technologies in School and Homes

Mobile technologies are widely available and accepted in a variety of environments, including schools and homes. While the function of technologies in each setting varies, the prevalent use of tablets, cell phones, MP3 players, etc. is a part of daily life for most Americans at work, school, and home.

Mobile Technology in Schools. The use of laptop computers, tablets, and smart phones in schools has significantly increased in recent years, with several school districts providing these devices to all students free of charge. In 2013, the Los Angeles Unified School District initiated a program providing *all* students, kindergarten through grade 12, with iPads loaded with educational software (Leonard, 2013). After district officials decided to undergo a “digital conversation,” Google Play for Education, a mechanism for teachers to select grade level content and specific applications (apps), and send those to an entire class of tablets, was piloted in New Jersey public schools, also in 2013 (Molnar, 2013). According to the Interactive Educational Systems Design, more than 80% of district technology officials plan to use iPads over the next year or two; 31% reported that they planned to use Google Chromebooks (IESD, 2013).

Mobile Technologies and Individuals with Autism. These new developments have proved especially useful for individuals with autism. Tablets and smartphones have been used for vocational training (Gentry, Lau, Molinelli, Fallen, & Kriner, 2012), video modeling

(Cardon, 2012), to support challenging behavior and academic engagement (Neely, Rispoli, Camargo, Davis, & Boles, 2013), and as task management tools (Gentry et al., 2010), among other things. Apps for these devices have been created specifically for individuals with autism to teach emotion recognition (Gay & Leijdekkers, 2014), support communication (Dundon, McLaughlin, Neyman, & Clark, 2011), track challenging behaviors (Sano, Hernandez, Deprey, Eckhardt, Goodwin, & Picard, 2012), and encourage social skills (Hourcade, Williams, Miller, Huebner, & Liang, 2013).

Mobile Technologies in Early Childhood Classrooms. These devices are used with younger age groups, as well. In early childhood classrooms, technologies are used for data collection and documentation (Seitz, 2008), and as instructional tools (Beschorner & Hutchison, 2013). In their joint position statement of the use of technology, the National Association for the Education of Young Children (NAEYC) and Fred Rogers Center for Early Learning and Children's Media at Saint Vincent College note, "Technology can also help children save, document, revisit, and share their real-life experiences through images, stories, and sounds" and, "The active, appropriate use of technology and media can support and extend traditional materials in valuable ways" (2012, p. 7). Therefore, technologies are not only being utilized by early childhood practitioners, but are recommended as part of high quality early learning environments.

Mobile Technology in the Home. The Pew Research Internet Project reports that over 90% of American adults own a cell phone, with 58% owning a smart phone, and 42% owning a tablet (Duggan, 2013), with the cell phone becoming the "most quickly adopted consumer technology in the history of the world," (Rainie, 2013). In adults ages 25-34 and 35-44 (the age ranges of parents involved in this study), this number 97% and 96%, respectively (Rainie, 2013).

Furthermore, adults use their cell phones for a wide variety of reasons, aside from making calls. Another survey by Pew established that 81% of respondents used their cell phone to send or receive text messages, access the internet (60%), send or receive email (52%), download apps (50%), get directions, recommendations or other location-based information (49%), and listen to music (48%) (Duggan, 2013). Considering the widespread use of cell phones especially with the target consumer population for the current study, it is possible that these mobile technologies could be useful as tools for supporting the development of young children with autism, especially considering the various features, especially cameras, included in these devices.

Embedded Cameras: Useful for More than Just Social Media. Built in cameras are now included in a range of mobile technologies, including smart phones, tablets, and MP3 players. More people report using the camera on their smart phone more often than they make calls (O2, 2012). Given that these devices are used regularly, and that early childhood curriculum (e.g. Creative Curriculum, Reggio Emilia), and best practice (NAEYC & Fred Rogers Center for Early Learning and Children's Media, 2011; Parnell & Bartlett, 2012; Seitz, 2008) are calling for photo and video documentation of student learning, using these built in cameras as a tool for interventions is logical. The National Association for the Education of Young Children (NAEYC) provides guidelines for effective practice using technology tools and digit media, suggesting that teachers, "Capture photos of block buildings or artwork that children have created; videotape dramatic play to replay for children," (NAEYC, 2014). Furthermore, Teaching Strategies GOLD™, a commonly used assessment tool now has an Ipad and Android app, allowing teachers to collect data and document child learning by taking photos, video, audio and notes in the moment (Teaching Strategies LLC, 2015). Given the recommendations and on-

going use of mobile technologies in early childhood classrooms, utilizing these devices to *teach* a specific skill seems compelling.

Problem Statement

Development in the application of computer technology has dramatically changed instructional practices in classrooms. These methods have been especially useful in special education, and for the treatment of individuals with autism. As the number of children diagnosed with autism continues to rise (the Center for Disease Control reports that 1 in 68 children are now diagnosed with this disability [2013]), the need for sustainable, easy to use interventions is increasingly important. The use of technologies such as tablets, camera phones, digital cameras, and handheld video recorders have provided educators with a variety of ways to provide instruction, and offer various ways for individuals with autism to respond and demonstrate their knowledge. However, despite the compelling literature and ubiquitous use of visual supports in early childhood special education classrooms, these have not been studied as a way to teach accurate recall, or as a way to support parent-child interactions at home.

Rationale and Significance

Given that technological devices with cameras have become ubiquitous, understanding if and how these devices can be used to support child learning is important and useful for the field. This study explores how visuals, created using cameras in smartphones and tablets, can be used to aide in the accurate recall and retelling of unique events in young children with autism. In early childhood programs designed to support children with autism, a high level of parent involvement is a central component (Dawson & Osterling, 1996; National Research Council, 2001). Yet, parents still report receiving little information from their child's teacher about their day (Gauvreau & Godinho, 2015). This is problematic, provided the compelling research on

parent-child interactions leading to more sophisticated memory development in children (Larinka & Bauer, 2014).

The purpose of this study is to understand if using photos as visual supports, and texting or emailing them to caregivers, can support children in accurately retelling events from their day when parents ask the age-old question, “What did you do at school today?”

Research Questions

This study attempts to answer the following questions:

- What effect do mobile technology-created visual supports shared on smart phones or tablets have on the ability of young children with autism to recall past events?
- What effect do the use of these photos have on communication when children are asked about their day at school?
- With the use of these visuals, what types of conversational or interactional changes do parents notice in their children?
- How does this intervention, if at all, affect the interactions between parents and children when discussing the child’s day at school?
- What are parents’ impressions of this intervention?
- What are teachers’ impressions of this intervention?

Chapter 2

Literature Review

This chapter provides an overview of what is known about memory development in children with and without disabilities. It begins by discussing the development of accurate recall in young children who are typically developing, from infancy to age five. The implications of

caregivers and their facilitation of memory in young children, an overview of methodology of the memory development literature base, and finally, the impact of autism on memory are also explored. While there are several different types of memory, this study focuses on the acquisition of episodic memory, or the conscious remembering of events and situations relating to the past, present, and future (Tulvig, 2002). The ability to accurately remember a specific event is influenced and shaped by many things, including a child's developmental stage (Richards, 2003; Rovee-Collier & Cuevas, 2009), executive functioning skills (Bennetto et al., 1996; Minshew & Goldstein, 2001), opportunities for family conversations about the event (Fivush, Hayden, & Reese, 2006), and parental style of interaction during these interactions (Haden, Ornstein, Ruden & Cameron, 2009; Larinka & Bauer, 2014).

Memory in both children and adults consists of three interactive phases (See Figure 1).

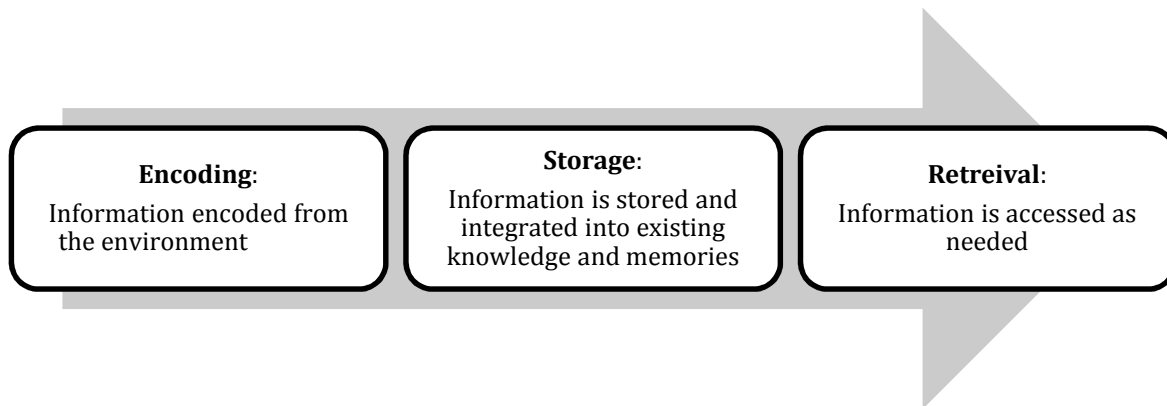


Figure 1. The Interactive Phases of Memory

In the initial stage, information is encoded from the environment. Encoding is the process of converting a certain stimulus (e.g. a sight, taste, smell, fact, experience, etc.) into a construct that the brain can store and retrieve later, and is highly influenced by attention and emotion (Tulvig, 1983). Executive functioning, discussed later in this chapter in relation to autism, plays an integral role in this step. Encoding begins with attention, where a memorable event triggers neurons to fire more rapidly, making the experience more intense and increasing

the likelihood that it will be encoded into a memory. Emotion also influences memory; events that arouse emotions are encoded more easily than events that do not. For this reason, many early autobiographical memories tend to be of emotional events.

In the next step, information is stored by consolidating, organizing, and integrating the new knowledge with existing knowledge, emotions, beliefs, and expectations. During this storage phase, memory strategies, such as using mnemonic devices, or the acts of writing things down, repeating something aloud, etc. can facilitate recall by binding this new information to existing knowledge. The final phase of memory is the retrieval or accessing of stored information – the act of being able to recall something specific at a certain time. This final step is influenced by environmental prompts called retrieval cues (Courage & Cowen, 2008). Retrieval cues are aspects of the environment that initiate or influence the retrieval process and can include images, sounds, smells, or other sensations that prompt a specific memory (Tulvig, 1983). Children are especially dependent upon retrieval cues to recall and share memories (Hudson et al., 1990; Hudson & Fivush, 1991).

It is important to note that these three phases are not fixed entities that consistently unfold in the same order, as one might record and replay a video on a video camera. Rather, memory is a “dynamic and inferential process with reconstructions that depend on a variety of sources of information,” (Courage & Cowen, p. 2). Ultimately, the ability to encode, store, and remember information is influenced by many things, including attention, executive functioning, one’s emotional state, and the surrounding environment.

The Developmental Sequence of Memory

Earlier researchers of memory assumed that since adults were unable to remember events from early childhood, that children simply did not form memories (Bauer & Fivush, 2010), yet

recent research has refuted this assumption. Current literature documents that the frameworks for memory are present at birth, and that even infants can recognize and remember various stimuli, when provided a non-verbal way of responding (Rovee-Collier & Cuevas, 2009). As shown in Figure 2, memory processes become more complex and sophisticated as children grow and develop other skills, such as language and independent mobility (Campos, Anderson, Barbu-Roth, Hubbard, Hertenstein, & Witherington, 2000; Rovee-Collier, 1996).

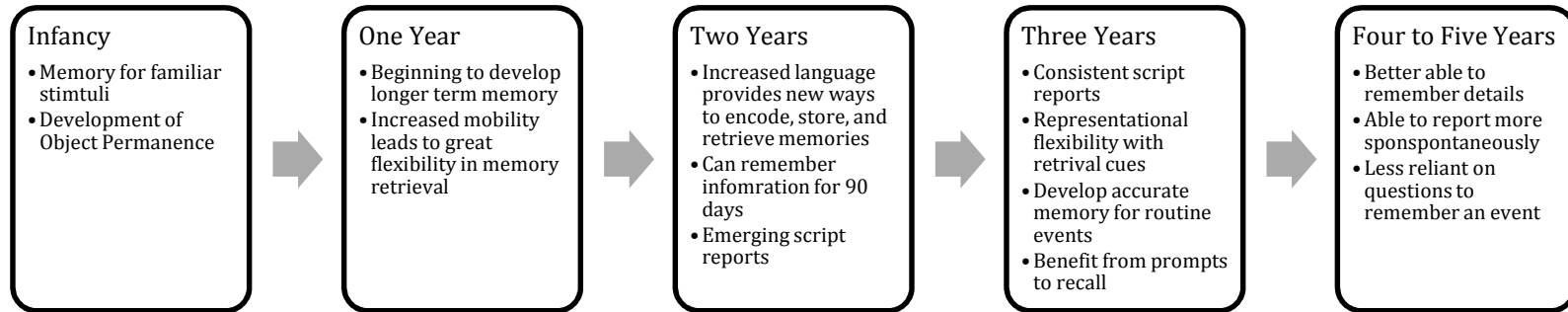


Figure 2. The Developmental Sequence of Memory

Memory in Infants. Infants can form associations between objects, events, and activated memories, and demonstrate the ability to remember a variety of things very early in life. Infants three to four months old demonstrate memory retention for five to ten seconds; this increases to ten minutes at nine to twelve months (Pascalis, de Haan, Nelson, & de Schonen, 1998), but facial recognition may develop differently. Newborns can demonstrate recognition of familiar faces after seeing them for just two minutes, while three month olds can recognize a face they saw 24 hours earlier (Rovee-Collier & Cuevas, 2009).

Despite the fact that infants can remember certain stimuli, most adults are unable to remember things that occurred in infancy, due to the shift between verbal and nonverbal retrieval cues as language develops. As young children gain verbal language and more vocabulary, this language mediates their memories and they are encoded differently (Rovee-Collier, 1999).

Memory in Toddlers. Major changes in memory development occur between infancy and toddlerhood, specifically improvements in retention, representational flexibility, independent locomotion, and language development. Toddlers begin to develop long-term memory – by their second birthday, most children are able to retain information for 90 days (Hayne & Simcock, 2009). While toddlers usually cannot spontaneously share memories, they can accurately answer yes/no questions about things they have done (Ornstein, Haden, & Hedrick, 2004).

The major motor milestones of crawling, cruising, and walking lead to milestones in cognitive development around memory. Once young children can crawl and walk, they begin to recognize old objects in new places, leading to flexibility with retrieval cues and increased opportunities for encoding new information (Rovee-Collier, 1996). In studies examining memory in mobile and non-mobile children, those who could crawl and walk demonstrated

greater flexibility in memory retrieval, compared to their non-locomotive peers (Hayne & Simcock, 2009).

Finally, significant increases in language acquisition provide a new way for toddlers to encode and express their memories (Rovee-Collier, 1999). As children learn new vocabulary, they are better able to encode, recall, and discuss memories.

Memory in Preschool Aged Children. Further cognitive developments, and increasing growth in children's language during the preschool years play a key role in facilitating memory. Younger preschoolers, around the age of three, recall events by consistently reporting them in the same way, suggesting children first form a general set of expectations for a certain event or routine (Hudson, Fivush, & Kuebli, 1992). These *script reports* are temporally organized accounts of familiar events, such as going to the grocery store, attending school, or visiting a restaurant (Nelson, Fivush, Hudson, & Lucariello, 1984; Picard, Cousin, Guillery-Girard, Eustache, & Pilolin, 2012). However, three-year-olds are typically not yet describing a specific instance, but instead more general things that occur within a certain routine. For example, when asked about a trip to the store, a three-year-old might recount, "You buy food and go home," but is less likely to mention a specific event in the routine, such as mentioning the purchases of a treat. However, with additional experience with a specific event or situation, preschoolers are able to recall more details (DeMarie, Norman, & Abshier, 2000; Ornstein, Haden, & Hedrick, 2004). Thus, for younger preschoolers, familiar routines are more easily and accurately recalled than unfamiliar events. Additionally, self-experienced events are also better recalled than events that were simply observed (Baker-Ward, Hess, & Flannagan, 1990). It is easier for a preschooler to remember that they built an incredibly impressive block structure than it is for them to remember a structure built by a peer. Naturally, this ability continues to improve with age,

maturation, and as other skills, such as language, communication, and executive functions continue to develop. Compared to three-year-olds, four and five-year-olds are better able to report more details about events, are less reliant on retrieval cues such as questions or prompting from adults, can spontaneously recall events, and generate more complete reports of a specific episode (Price & Goodman, 1990).

For older preschoolers, novel events begin to become more salient and are easier to recall. Four and five-year-olds are better able to recall information about novel or unique events, such as family vacations or birthday parties, than they are able to recall routine events, such as what they had for a snack that morning (Hamond & Fivush, 1991; Hudson, Fivush, & Kuebli, 1992; Hudson & Mayhew, 2009). At this age, atypical actions stand out in memory and are better recalled than habitual actions, especially when these actions are vivid or disrupt the routine or event in some way (Hudson & Mayhew, 2009). The same is true for adults – it is much easier to recall the morning commute if there had been a terrible accident resulting in heavy traffic, than it is to remember specific details on a less eventful day.

Hudson, Fivush, and Kuebli (1992) suggest that the distinctive features of certain episodes or events are more easily encoded in memory, while the routine aspects of the same memory are less likely to be recalled. Hudson and Krackow (1990) explored this in four and five-year-olds, and found that while children were unable to recall routine information, such as who they were seated next to during mealtime, they could consistently remember deviations from the routine and novel details about their day in day care. Thus, older preschoolers can more easily remember novel or especially interesting events, and are less reliant on retrieval cues than their younger counterparts.

Parent Influence and Parent-Child Interactions in Fostering Remembering

As previously mentioned, memory and recall are dependent upon context and the surrounding environment. Parents and caregivers are a significant environmental factor, and can greatly influence children's ability to accurately recall events. Parent-child conversations about shared events shape the way children learn to reminisce about, describe, and remember past experiences (Fivush, Hayden, & Reese, 2006; Larinka & Bauer, 2014). Especially language rich parent-child conversations during the preschool years are associated with children later developing independent memory skills (Ornstein, Haden, & Hedrick, 2004). In their study exploring preschoolers' memory of family vacation, Hamond and Fivush (1991) found that children whose parents frequently discussed this event were better able to recall details over time. Essentially, the more opportunities children have to discuss their memories, the more complex and sophisticated their memory becomes. This is consistent with literature suggesting a language-rich environment contributes to greater learning and overall better longitudinal outcomes for young children (Hart & Risley, 1995).

The vast majority of research on the impact of parents' communicative style on children's memory focuses on mothers. Differences in mothers' approaches to talking about the past with their children are associated longitudinally with children's memory performance (Haden, Ornstein, Rudek, & Cameron, 2009; Peterson, Jesso, & McCabe, 1999). Maternal elaborateness is a crucial factor in children's ability to report their past experiences in a detailed manner (Hamond & Fivush, 1991; Haden et al., 2009; Ornstein, Haden, & Hendrick, 2004; Peterson, Jesso, & McCabe, 1999). Mothers who engage in more expansion and elaboration strategies within parent-child conversations have children who developed more sophisticated memory skills (Fivush, Haden, & Reese, 2006; Peterson, Jesso, & McCabe, 1999). Specifically, mothers who encouraged longer, more detailed conversations of past events by frequently asking

wh-questions and positively affirming their child's responses, and provided opportunities for children to talk about aspects of these events most interesting to them, had children with more sophisticated memory skills several years later (Ornstein, Haden, & Hendrick, 2004).

Furthermore, maternal social-emotional support is correlated with better child memory. Larkina and Bauer (2014) found that mothers who demonstrated higher affective and behavioral support had children who were more able to participate in conversations about past events.

While not all mothers may naturally demonstrate these abilities, parent training is shown to be effective in increasing these strategies. Peterson, Jesso, and McCabe (1999) found that three-year-olds produced more detailed and longer accounts of recent events after their mothers had received training on asking *wh*-questions, language elaboration strategies, and following their child's lead in a conversation. In short, parental behavior is a major facilitator in children's memory development, and parent training for caregivers who do not naturally use these strategies is effective.

Limitations of Methodologies of Current Literature on Childhood Memory Development

Despite the fact individuals are more likely to recall information about an exciting, novel, or emotional event they have experienced (Hudson & Mayhew, 2009; Nelson & Grunendel, 1979) the majority of research on children's memory has been completed in laboratories, involving researchers asking children to remember information identifying images they had seen previously. These images vary from pictures of landmarks, to animals, to colors (Kirasic, Siegel, & Allen, 1980; Sluzenski et al., 2006). Games or activities are also commonly used to assess memory. Mahey and Moses (2011) used a card sorting game, where children were required to name the objects illustrated on stacks of cards while providing a novel response to specific target cards (such as drawing a picture). Frequently used activities include the day/night task (Gerstadt,

Hong, & Diamond, 1994) where children are asked to say “day” when they see a picture of the night, and say “night” when shown a picture of daytime, the digit span section of the WISC-III (Weschler, 1991), the California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987), and the Wisconsin Card Sorting Test (WCST).

Of the studies that involved exploring children’s memory for an experienced event, all utilized a structured interview, initiated by a researcher, to gather data (DeMarie, Norman, & Abshier, 2000; Hamond & Fivush, 1991; Price & Goodman, 1990). It is interesting to note that the studies exploring shared memories of family vacations did not include the use of vacation photographs, despite the fact that taking photos is a common vacation activity, and that photos are typically displayed in families’ homes or saved in a photo album. Moreover, all studies exploring recall of actual events did not address children’s ability to share these memories with their family members.

While this research has certainly provided the groundwork for future studies addressing memory and young children, there are some methodological limitations. To begin with, most research involves contrived tasks unrelated to personal events a child has actually experienced. Considering that children must rely on accurate memory of personal events to fully participate in school, maintain relationships with peers, and have conversations with their families, this is a limitation. Additionally, the vast majority of these studies utilize only quantitative methodology, omitting any qualitative data from caregivers regarding their child’s memory development. Viewpoints and opinions of caregivers and family are significant, as preschool-age children spend the majority of their time with their family members, yet this data was omitted from many studies.

Lastly, few studies have explored modifications to retrieval cues. Two studies explored the use of photographs as retrieval cues with young children after an event (Aschermann, Dannenberg, & Schulz, 1998; Hudson & Fivush, 1991), but researchers, not caregivers, utilized these photos to prompt memory. Despite the reliance of retrieval cues to access memories in young children (Price & Goodman, 1990), and the compelling evidence of high quality parent-child interactions facilitating memory (Larinka & Bauer, 2012; Peterson, Jesso, & McCabe, 1999) no studies have addressed how to combine these two aspects of memory development.

Memory and Autism

Memory development specifically in individuals with autism has been studied for many years. One perplexing issue is that some children with autism have exceptional rote memory for very specific things, such as the roster of a favorite sports team, while they consistently struggle with recalling autobiographical information, such as whom they played with at recess, or basic instructions for completing a task. Early researchers of memory describe autism as an “amnesic disorder,” discussing that individuals with autism have difficulty with episodic memory and recall of information (Boucher, 1981; Boucher & Lewis, 1989), however, more recent research has refuted these findings. Most current literature supports memory challenges in individuals with autism a result of executive functioning impairments, particularly the cognitive processes required to encode, store, and retrieve memories (Bennetto et al., 1996; Gras-Vincendon et al., 2007; Minshew & Goldstein, 2001). Research documents difficulty with verbal recall of words, sentences, and stories, recognition memory (Bennetto et al., 1996; Minshew & Goldstein, 2001), and cued recall (Boucher & Lewis, 1989). Jones et al. (2011) note that memory involves executive functioning, social and communication skills, and motivation. Individuals with autism may be impacted on all three fronts.

This research uses similar methodology as exploring memory in individuals without autism, typically completing in clinics or labs using contrived recall tasks. Boucher's early research (1981) is one of the few studies to examine memory for real life recent events; he found that children with autism recalled significantly less about activities they had participated in, compared to children without autism. However, as with the research on memory development in children without disabilities, there are limitations in the methodology, considering the clinical setting versus applied setting and overreliance on very specific retrieval cues.

Social Deficits Impacting Memory. The social and communication deficits associated with autism also impact memory (Jones et al., 2011). Millward and colleagues (2000) note that individuals with autism may be “doubly disadvantaged” when it comes to personal recall, as they also have difficulty in communicating their feelings to others, leading to fewer opportunities to revisit events within their emotional context and organize memories in this way. For example, a child without autism would likely share information about having cupcakes at school to celebrate a peer's birthday, leading to a conversation with their caregiver about birthday parties, treats, experiencing feelings of excitement or happiness, etc. This conversation contributes to memory development for the child, and provides them with different ways to encode and organize this new memory (e.g. birthday party, cupcake, feeling excited, etc.). A child with autism may lack the social communication skills and vocabulary required to share this experience with their caregiver, leading to limited opportunities for a conversation around the emotions the child may have experienced during this event. It is also possible that the lack of interest in age appropriate routines and activities may impact encoding and the memory processes. While no studies have addressed this issue, children with autism may be more interested in a specific detail of an activity than the routine itself, leading to limited or idiosyncratic encoding. Given that young

children learn to reminisce about their memories during conversations with their caregivers (Fivush, Hayden, & Reese, 2006; Ornstein, Haden, & Hendrick, 2004), and children with autism may struggle to fully participate in these conversations, they may be missing out on countless opportunities to develop and refine their recall skills.

Several researchers have suggested a deficit in the personal episodic part of autobiographical memory in individuals with autism (Powell & Jordan, 1993; Millward et al., 2000). In these studies, children with autism had more difficulty recalling events they had personally experienced than the events they saw another child experience. This finding contradicts most theories of memory that predict individuals should be better able to recall personal experience, rather than those experienced by someone else (Baker-Ward, Hess, & Flannagan, 1990). This line of research suggests that memory processes are impaired when children are required to process personal information (Millward et al., 2000). O'Shea et al. (2000) note that individuals with autism have poor social motivation, which may lead to poor attention to faces, resulting in poorer recall of events involving other people. These researchers found that children with autism made more errors related to the social context of a story, and recognized fewer faces than children without autism (O'Shea et al., 2000). One implication of this finding is the lack or impairment of theory of mind in children with autism. Perner (1990) notes that children begin to develop episodic memory as they develop theory of mind. It is possible that children with autism who have yet to fully develop theory of mind will also be impaired in their recall and use of episodic memory (Perner, 1990, as cited in Millward et al., 2000).

Executive Functioning and Memory. Executive functioning is an umbrella term for skills including working memory, inhibition, self-monitoring, impulse control, cognitive

flexibility, and the initiation and monitoring of action (Hill, 2006), and is impaired in children with autism (Geurts, Verté, Oosterlaan, Roeyers, & Sergeant, 2004; Yerys, Hepburn, Pennington, & Rogers, 2007). Executive functioning is also commonly discussed in the literature base around memory and recall; specifically, the steps of encoding and retrieval rely on strong executive functions (Picard et al., 2012). While these skills improve as children age (Mahy & Moses, 2011; Picard et al., 2012), these impaired processes in individuals with autism impact memory and recall (Geurts et al., 2004; Yerys, et al., 2007). Several studies have examined these deficits in preschool-aged children, suggesting those with autism performed significantly worse than typically developing children on executive functioning tasks, including those assessing working memory (Mahy & Moses, 2011; Yehrs et al., 2007).

Furthermore, memory performance of individuals with autism becomes increasingly impaired as the complexity of the material increases, providing additional evidence for executive functioning challenges impacting recall (Minshew & Goldstein, 2001). In their study of adolescents and adults with autism, Minshew and Goldstein conclude that encoding may be the reason memory is impaired in this population. They suggest modifications, such as reducing the amount of information presented, simplifying the information, or increasing processing time as a strategy for promoting accurate recall (2001).

Visual Supports and Mobiles Technologies: A Possible Combination for Teaching Recall

For individuals with other disorders or impairments, such as traumatic brain impairments (TBI) or Alzheimer's, visual supports have been used specially to support memory and accurate recall. While the use of visuals is well established with individuals with autism (Odom et al., 2003), there is a lack of research addressing memory with this population. However, these supports are shown to be effective for promoting memory in individuals with TBI (Fish, Wilson,

& Manly, 2010), while using photographs to discuss familiar events and people is a commonly recommended intervention for those living with Alzheimer's, (Alzheimer's Association, 2014). It is possible that visual supports may be one way to support memory and recall in individuals with autism, especially given the recommendations for these aides for individuals with related deficits.

Visual supports are one evidence-based practice widely used to support individuals with autism (Odom et al., 2003). Visuals have been used to effectively teach and support a wide variety of skills, including social, adaptive, cognitive, and motor skills (Gauvreau & Schwartz, 2013; Meadan, Ostrosky, Triplett, Michna, & Fettig, 2011). However, no studies to date have examined how visuals can be used to teach accurate recall.

While the research on visuals is compelling, traditional visual supports can provide challenges and barriers for practitioners and families that interfere with fidelity of implementation and consistent use. In Donato, Shane, and Hemsely's study (2014) exploring consumers' views on visuals, both families of children with autism and special education practitioners identified several barriers. These difficulties including a lack of time, lack of awareness of various forms of visual supports, inconsistency, limited resources, negative attitudes of others towards visuals (such as people in the community demonstrating negative reactions to parents using a visual schedule, social story, etc.) resulted in fewer opportunities for consistent implementation of visuals. Practitioners found that that access to resources and materials necessary for creating, storing, and managing multiple visual supports was another obstacle. Despite the effectiveness of visual supports, they become useless if consumers are not able to access them on a consistent basis.

However, it is possible that mobile technologies may provide alternative ways to develop and implement visuals, leading to increased use by consumers. Donato et al. (2014) found that having access to and training on how to use technologies to develop visuals was associated with the widespread use of these supports. Participants using mobile technologies to create and implement visuals found that these tools required less time than traditional hard copies. Parents found that mobile technologies provided more options than hardcopies of visuals, in that they could easily use various devices, such as a cell phone, tablet, or laptop to access a specific visual instead of searching for a single copy of a specific image or symbol. Overall, families demonstrated a preference for the use of technologic devices and shared that their children also found these highly motivating. Practitioners shared similar views. They also reported that visuals using mobile technologies were quicker to develop, retrieve, and implement with children, and resulted in increased use by families.

Ultimately, the research of Donato, Shane and Hemsely (2014) suggests that mobile technologies can decrease the barriers related to visual supports and increase ease of use and sustainability, resulting in more access for children with autism and their families. It seems that given the prevalence and access to these technologies, that utilizing them to teach young children to accurately recall events from the day is logical. Furthermore, the use of these devices is promoted in early childhood classrooms for other purposes, including instruction, documentation, assessment, and data collection (Beschoner & Hutchison, 2013; NAEYC & The Fred Rogers Center for Early Learning and Children's Media, 2012; Parnell & Bartlett, 2012; Seitz, 2008). In Parnell and Barlett's (2012) article about using mobile technologies as documentation tools in early childhood classrooms, authors note, "technology has influenced our ability to retell learning experiences. We can look at a photo, blog, or website repeatedly to recall

past events or share information with families, children, and colleagues,” (p. 56). While these authors did not intend to explore technology and recall, but rather provide guidelines for early childhood educators interested in incorporating technology into the classroom as a way to assess children, it is interesting to note that this was included. As previously mentioned, mobile technologies are commonly used for assessment in early childhood classrooms with the Teaching Strategies Gold™ iPad and Android application (Teaching Strategies LLC, 2015).

Conclusion

To conclude, there is a lack of published research on modifications of retrieval cues and parent-child interactions and conversations about the child’s memories when child has autism. While many authors have documented the importance of parent-child interactions in facilitating memory and recall (Fivush, Haden, & Reese, 2006; Larinka & Bauer, 2014), no studies to date have focused specifically on children with autism and their caregivers. Additionally, the majority of research that has addressed individuals with autism and memory employs methodologies where children are asked to recall contrived things, such as images they have been shown by a researcher, despite the fact that children are better able to recall novel events they have experienced (Hamond & Fivush, 1991; Hudson, Fivush, & Kuebli, 1992; Husdon & Mayhew, 2009). Furthermore, these studies rely specifically on quantitative methodologies, and involve a researcher reminiscing with the child, not a parent or caregiver.

Moreover, there is compelling evidence on visual supports as an effective strategy for teaching children with autism (Odom et al., 2003). Recent research suggests that mobile technologies may help mediate the barriers of effective implementation of visuals by providing families and practitioners with alternative ways of developing and accessing these supports (Donato, Shane, and Hemsley, 2014). Furthermore, technologies such as tablets and smart

phones are already used for documentation, instruction, and assessment in many early childhood special education classrooms (Beschoner & Hutchison, 2013; Seitz, 2008), with recommendations for increased use (NAEYC & The Fred Rogers Center for Early Learning and Children’s Media, 2012). It seems that employing these devices as tools for developing and implementing visual supports by taking photographs of children engaged in a various novel activities, with the specific goal of using these to teach accurate recall to young children with autism is logical. Given the ease of sharing photos on mobile technologies, sending these photos to parents via email or text may provide a support for parent-child conversations about the child’s day at school, leading to increased opportunities for interactions that may facilitate accurate recall.

Chapter 3

Method

This study used a fixed mixed methods design, drawing on single case, qualitative, and survey methodologies (Cresswell & Clark, 2011) to address the following research questions:

Table 1

Research Question and Corresponding Methodology

Research Question	Research Method
What effect do mobile technology-created visual supports shared on smart phones have on the ability of young children with autism to recall past events?	Single Case
What effect do the use of these photos have on communication when children are asked about their day at school?	Single Case
How does this intervention, if at all, affect the interactions between parents and children when discussing the child’s day at school?	Single Case, Qualitative
With the use of these visuals, what types of conversational or interactional changes do parents notice in their children?	Qualitative

What are parents' impressions of this intervention?	Qualitative
What are teachers' impressions of this intervention?	Survey

This study seeks to explore how a specific type of visual support influences the accurate recall ability of young children with autism. Given these questions, a mixed methods design (Cresswell & Clark, 2011) was used, incorporating methodologies from qualitative, survey, and single case research. Single case design research relies on repeated observations of behavior and performance, and attempts to examine the effects of an intervention over time (Kazdin, 2011). The goal of single case design is to determine if a causal relationship exists between the introduction of an independent variable, manipulated by a researcher, and a change in a dependent variable (Kratochwill et al., 2010). Single case design will reflect any changes in participants' language and accuracy over time, as visuals are introduced and faded. Qualitative research investigates the *how* and *why* of behavior (Merriam, 1998). Parents and caregivers are the main consumers of this intervention, therefore understanding their opinions, beliefs, and experiences with this study and intervention is extremely important. Additionally, these interviews provided information about the social validity of this intervention, an important consideration of any single case design (Wolf, 1978). Finally, since photographs were collected in the children's preschool classrooms and teachers could potentially utilize this intervention, understanding their perspectives is useful and provides information on social validity and sustainability. Surveys were distributed to all teachers and classroom staff, including paraprofessionals and related service practitioners, with the goal of collecting social validity data from additional possible consumers.

Considering these research questions, one data source would be inadequate. While single subject data would demonstrate changes in the overall quality and accuracy of a child's communication, relying solely on this data would neglect the critical perspective and role of families in this intervention. Given that conversations about family members' days at work and school are a common occurrence in many households and that many parents struggle to get information about their child's day (a Google search of 'asking your child about their day at school' yielded 271,000 results, including countless tips and strategies for parents in navigating and facilitating these conversations), understanding how this intervention impacts families is significant. Furthermore, as the intervention occurs at school and is potentially one that could be adopted by teachers, educators' perceptions of the usefulness and sustainability of these visual supports are notable. In order to thoroughly understand the effect of this intervention on families, children with autism, and early childhood special educators, a mixed methods design will provide the most useful methodology.

A Human Subjects review was unnecessary for this study, as all of the participants were part of a large-scale evaluation of a comprehensive treatment model for children with autism and this was added as one component. However, all parents were consented prior to intervention, for their participation in qualitative interviews; see Appendix A for Consent Form.

Participants

Three children with autism, who attend a university-based inclusive early childhood program, participated in this study. Emily, Laura, and Sam were all four-years-old (mean age four years, three months). All attended an inclusive preschool classroom four days a week, and an extended day program for children with autism three days per week, located in a university based lab school in a large urban area in the Pacific Northwest.

Criteria for selection included:

- Children over the age of three. Episodic memory begins to develop around age three (Courage & Cowen, 2008); therefore this intervention is developmentally inappropriate for children younger than three
- Children with a diagnosis of autism. The second criterion is related to the compelling research on visual supports and individuals with autism (Odom, Brown, Frey, Karasu, Smith-Canter, & Strain, 2003). Visual supports are one evidence-based practice shown to be effective for children with autism, therefore this criterion ensured utility of this intervention for potential participants
- Children identified by their teachers as potential candidates for this intervention – those with fairly large, age-appropriate vocabularies, but who were not yet independently, accurately recalling events that occurred earlier in the day. Preschool teachers aided in identifying several potential participants, as these teachers had firsthand knowledge of which families may be interested, able, and willing to participate in this study. After teachers had identified potential participants, families were contacted by a researcher and asked if they were interested in participating. All families initially contacted agreed to participate, and all owned a smart phone and had access to email.

Emily was a four-year, four-month old Caucasian girl. She lived with her parents and younger brother where English and Italian were spoken at home. Emily had been receiving services since infancy, as she experienced seizures and required several surgeries related to a brain tumor. She received a score of 75, placing her in the 77th percentile on the Social Communication Section of the AEPS. Her Clinical Evaluation of Language Fundamentals,

Second Edition (CELF) scores were as follows: a scaled score of 8 and percentile rank of 25 on Sentence Structure, a scaled score of 17 and percentile rank of 99 on Word Structure, a scaled score of 16 and percentile rank of 98 on Expressive Vocabulary, and a scaled score of 8 and percentile rank of 25 on Recalling Sentences. Emily enjoyed princesses, gross motor play, and individual attention from adults. Emily's mother reported that when asked about her day at school, she would share routine information inconsistently. She would usually recount that she "played *Frozen* during recess," and "ate animal crackers at snack," on a regular basis. However, Emily's teacher reported that during recess, Emily was typically unengaged and tended to wander around the playground until she was prompted to initiate with a peer. Teacher report also reflected that while animal crackers were a commonly served afternoon snack in the classroom, there were not available every day.

Laura, a four-year, three-month-old Asian American girl, enjoyed socio-dramatic play, small figurines, and spent her time during free play engaged with other young girls. She received a diagnosis of autism at age three, and had previously attended a community-based preschool. Laura lived with her mother and father; English and Vietnamese were spoken at home. Laura's mother reported that she was not able to share specific details about her day at school, and would consistently engage in echolalia when asked questions that required her to recall an event. For example, in the initial probe at home with her mother, Laura was asked about her day at school and responded by scripting a favorite book. When asked very specific questions, such as, "Did you play with Chloe at recess?" or "Did you eat cheese at snack today?" Laura would respond, but her mother was unsure about the accuracy of these responses. She received a raw score of 67 on the Social Communication section of the AEPS, placing her in the 68th percentile. CELF score were as follows: a scaled score of 16 and percentile rank of 98 on Sentence Structure, a

scaled score of 18 and percentile rank of 99 on Word Structure, a scaled score of 17 and percentile rank of 99 on Expressive Vocabulary, and a scaled score of 14 and percentile rank of 91 on Recalling Sentences.

Sam was a four-year, three month-old Caucasian boy with a diagnosis of autism spectrum disorder, and had been receiving educational services since the age of two. Sam lived with his mother and stepfather, and was interested in snakes, trains, books, and gross motor play. During unstructured times at school, he struggled with appropriate engagement with peers, occasionally engaged in challenging behavior, and required prompting from teachers to maintain successful peer interactions. Results from the Social Communication domain of the AEPS indicate that Sam was in the 87.8th percentile, with a raw score of 86. CELF scores were as follows: scaled score of 17 and a percentile rank of 99 on the Sentence Structure, a scaled score and percentile rank of 98 on Word Structure, a scaled score of 12 and percentile rank of 75 on Expressive Vocabulary, and a scaled score of 16 and percentile rank of 98 on Recalling Sentences. Qualitative data demonstrated that when asked about his day at school, he consistently replied, “I played!” to his mother and stepfather, rarely adding any additional information. Occasionally, he would comment about a specific and highly preferred peer, but never included any details about events or activities.

Setting and Materials

This study took place across two settings:

1. The child’s preschool classroom, where photos were taken and intervention occurred.
2. The child’s home, where caregivers used the photos as a visual support as they asked their children about their day at school.

Preschool Classrooms. All preschool classrooms served sixteen children; six who receive special education services, four who qualify for Head Start, and six who are typically developing. Preschool classrooms meet four days per week for 160 minutes. A lead teacher with a teaching certificate and a Masters' Degree in Special Education, an assistant teacher (a graduate student studying early childhood special education), and a paraprofessional supported all children under a trans-disciplinary model. Related services were provided by a Speech and Language Pathologist (SLP) and Occupational Therapist (OT) or Physical Therapist (PT) within the classroom twice per week. Classroom schedules included a mix of adult and child directed activities, such as a circle time, snack time, free play, recess, and gym. The majority of the day was spent in free play, where teachers provided embedded instruction on child goals. Instructional strategies included discrete trial teaching, naturalistic instruction, and peer-mediated instruction. Classrooms are organized into zones, with a pretend play area, a book area, a sensory table, a block area, and an art or manipulative table. All preschool classrooms used The Creative Curriculum® (Dombro, Colker, & Dodge, 2014) to plan their daily and weekly lessons and classroom materials.

Families' Homes. As part of this study, families were emailed or texted photos of their children at school along with a short description of each photo (e.g. "During gym today, Emily climbed on the climbing wall. She made it all the way to the top without any help from a teacher!"). Parents were asked to use these as a visual support when asking their child about their day at school, but were not given a specific script or any other directions to follow during these conversations. Researchers wanted to ensure the sustainability of this intervention with families, thus refrained from directing these parent-child interactions to a greater extent.

When and where parents choose to have this discussion was their child was up to them. Families reported that these conversations usually occurred immediately after the child arrived home from school, or during dinnertime.

Families were asked to record these conversations with their children so researchers could transcribe and analyze the data. Prior to beginning intervention, families were asked if they preferred to use a handheld audio recorder or their own smart phones. All families preferred to use their own devices to record. These recordings were then either emailed or texted to the researchers.

Materials

Materials included video cameras, smart phones, tablets, and a laptop computer, as well as any classroom materials participants may be using as photos were taken. For school phases, video cameras were used to film responses when participants were asked about their day. Smart phones and tablets were used to take photographs of children, and a laptop computer was used for transcribing child-researcher and parent-child interactions. SALT® (Miller & Inglesias, 2008) software was used to code and analyze transcriptions. Finally, stamps and stickers were used as reinforcement. Given that this intervention is designed to take place during on-going routines and activities in a preschool classroom, and use materials teachers are already using for other purposes, no additional materials were used.

Study Design

Single Case Design. This study employed an ABABCA design at school. Data were collected at home as well, during phases with no photos (A), with three photos sent home (B), and with one photo sent home (C). Table 2 displays study phases and descriptions for both school and home.

Table 2

Study Phases Across Both School and Home Settings.

Phase	Condition	Description
A	Baseline	Treatment as usual, children were asked about their day with no additional support.
B	Intervention at School and Home	Three photos were taken of children in their preschool classrooms, and used as visual supports when asking them to recall previous events.
C	Intervention at School and Home	One photo was taken of children in their preschool classroom, and used as a visual support.

The study began by alternating baseline and intervention phases, to determine if participants could accurately recall events when presented with visual supports. Throughout these phases, probes were completed with caregivers and participants at home (e.g. parents were instructed to ask their child about their day at school as usual without the use of a visual). It was hypothesized that children would not be able to recall events consistently and accurately without the support of a photo.

This design demonstrated if participants were learning to accurately recall unique events, as the visual supports were gradually faded over time. Researchers were confident that participants would be able to accurately recall events when photographs were used, as children were simply describing pictures in these phases, therefore gradually fading these supports by reversing conditions between A, B, and C phases may result in acquisition of accurate recall.

Qualitative Interviews with Families. In addition to single case data, qualitative interviews were completed with caregivers prior to the intervention and upon completion of the study. This data provided information about caregivers' opinions on the usefulness of this intervention for their family, specifically how parents found the use of visuals to impact their

conversations with their children, if at all. In addition to single subject data collected by researchers in the school setting, understanding to what extent parents found this intervention to impact their interactions with their child provided data related to the research questions (See Table 1 for research questions).

In pre-study interviews, caregivers were asked what they currently hear from their children about school, what information they receive about daily events in the classroom, and what they wish they heard more about. Upon completion of the study, interview questions addressed how families used the photos sent to them, if and how their conversations with their children were different when these photos were included, and their overall thoughts about this intervention. See Appendix B and C for Qualitative Interview Protocols.

Survey Data. Finally, preschool teachers were anonymously surveyed to understand their opinions about this study and the sustainability of this intervention in preschool classrooms. Teachers are potential consumers of this intervention, therefore their views were essential to understanding social validity. Paper and pencil surveys were distributed to classroom staff upon completion of the study. See Appendix D for Survey Protocol.

Procedure

Photographs as Visual Supports. Photos of children were taken on smart phones or tablets throughout the preschool day, while they were engaged in a variety of activities and routines. Photos attempted to document activities that were most salient to children, given the literature suggesting that older preschoolers remember novel events more accurately than they remember routine ones (Hamond & Fivush, 1991; Hudson, Fivush, & Kuebli, 1992; Hudson & Mayhew, 2009). Three photos across a variety of child and adult directed activities were collected of each child each day during B phases. In C phases, just one photo was collected, as

researchers were attempting to fade this support and provide opportunities for independent child recall. Examples of photos taken include a photo of a participant on a roller racer in gym class, a photo of the child playing a parachute game with classmates, and a photo of a participant eating a popsicle during a peer's birthday party at school (See Figures 4 and 5 for examples of photos).

Recall Protocol. Regardless of the phase, children were asked by researchers about their day in preschool prior to leaving school. Occasionally, children were asked about their preschool day in their extended day classroom, if they attended this program after preschool. Children were pulled out or pulled aside and shown photos, one at a time, from earlier in the day on a smart phone or tablet, and asked "Tell me about your day in preschool?" or "What happened in preschool today?" See Appendix D for Intervention Protocol in each phase.

Baseline Phases. During A phases, participants were asked about their day or prompted to share additional information a total three times, without any additional supports. Researchers started by asking them to "tell me about your preschool today," then follow with two prompts, such as "what else happened?" or "tell me another thing about school today." All interactions were video recorded and immediately transcribed.

Intervention during B Phases, with Three Photos. In B phases, children were also prompted three times, once for each photograph, to "Tell me something else," or "what else happened in preschool?" During these interactions, researchers followed the child's lead, and used strategies to promote language development and conversation skills such as repeating what the child said, affirming the child's responses, and commenting on the photo (Massey, 2004). For example, if the child shared more information about a specific photo, the researcher would follow their lead within the interaction, adding comments related to what the child was saying. If the child did not share a large amount of information, the researcher would make a comment

about the photograph, then move to the next photo of the day. At the end of each interaction, children were asked if they wanted to share anything else about their day in preschool, then given a small sticker or stamp and escorted back to the classroom or group.

Intervention during C Phases, with One Photo. During C phases, just one photo was used as a visual support. The same protocol was followed; children were asked to share information about their preschool day and shown the photo. After these interactions, researchers would turn off the smart phone or tablet and tell the child, “We don’t have any more pictures today. What else happened at school?” and ask a third time, “Tell me one more thing,” or “What else did you do today?” While a single visual support was used in this phase, participants were still asked to share three pieces of information. All interactions were video recorded and immediately transcribed.

Intervention: Photos Sent to Families. Prior to intervention, parents were asked how they preferred to record their conversations with their children, and given the option to use a handheld audio recorder, a video recorder, or their own smart phones. All families preferred to use their own smart phones. Families were also asked when they preferred to receive photos of their children; two families preferred to have these sent immediately after school, and one family preferred them to be sent around 5:00 PM, prior to dinner time. Families were also asked if they preferred photos to be texted or emailed; two preferred texts, one preferred email. Based upon these preferences, researchers sent photos to families at their desired times via text or email, accompanied by a salutation and a short description of the photograph. Figure 4 and 5 illustrate example photos and the corresponding descriptions sent to families.



Figure 3. Photo and text sent to Emily's mother.

I hope you and Emily are having a nice evening! Today, Emily, Melissa, and Isabel built a ballet studio with Teacher Emma in the block area. They talked about ballet lessons, too! Have a great night!



Figure 4. Photo and text sent to Sam's mother.

Hi there! I hope you and Sam are having a nice afternoon. Today at small group, the class did some bubble painting, where kids blew bubbles into a mixture of bubble juice and paint, then pressed paper on the top to make a bubble print! Sam and Ethan worked together on this – they thought it was pretty hilarious. Have a great evening!

Photos were sent to families after data demonstrated that children were able to accurately recall events with the use of photos at school. Families were not given any specific instructions for these interactions with their children, but simply asked to audio record these conversations as they had been doing previously. These recordings were sent back to the researchers, via text or email, and immediately transcribed and analyzed.

Throughout all phases, researchers remained in close contact with families via text, email, and phone to promote and ensure study retention.

Data Collection

Descriptive Data. Prior to intervention, all participants were assessed using the Clinical Evaluation of Language Fundamentals – Second Edition (CELF-2; Semel, Wiig, & Wayne, 2004) on the following subtests: Sentence Structure, Word Structure, Expressive Vocabulary, and Recalling Sentences. These subtests were selected through consultation with a Speech and Language Pathologist as a way to assess children’s recall, expressive and receptive language present levels. Additionally, the Social Communication section of the Assessment, Education and Planning System (AEPS; Bricker, Pretti-Frontczack, Johnson, & Straka, 2002) was used to understand and document the child’s current level of communication with others.

Single Case Data. To align with the single case design research standards, data was collected for at least three data points within each phase (Kratochwill et al., 2012). After data was stable across at least three data points in any given phase, researchers moved to the next phase.

Dependent Variables: School. Dependent variables were:

- Total words children used to describe their day,
- Number of different words children used to describe their day,
- Accuracy, reported in a percentage,
- Researchers’ total and different words,
- Mean Length Utterance (MLU).

Videos were immediately transcribed and coded using SALT® (Miller & Iglesias, 2008) to determine MLU, the different words, and total words used by participants and researchers.

Accuracy was represented by a percentage on a 0-100% scale. Regardless of the phase, children were asked three times to describe their day or to elaborate on their responses, with each

response receiving a possible total accuracy score of 33.3%, resulting in a total possible 100% for accuracy. Preschool teachers were consulted to establish if child responses were reliable and accurate.

Data was graphed and analyzed on a daily basis (Kazdin, 2011) to determine if the intervention was impacting participants' communication, accuracy, and overall ability to recall events. Upon completion of the study, data from ABAB phases at school and ABC home data was analyzed using percentage of non-overlapping data (PND) (Kratochwill et al., 2010; Scruggs & Mastropieri, 2012). PND is a method for determining effect size in Single Case Designs by demonstrating the strength of intervention between phases (Kratochwill et al., 2010). With PND, the greater the percentage, the greater the impact of the intervention on the target behavior (Gast & Spriggs, 2010). Further phases were not analyzed using PND, as the goal after initial phases was to demonstrate maintenance of dependent variables as the independent variable was faded.

Dependent Variables: Home. Parent-child conversations were analyzed differently, given the unique nature of these interactions. Dependent variables were:

- Total number of parent questions asked,
- Total number of child responses,
- Total number of accurate child responses,
- Percentage of overall accuracy,
- Child response rate.

It was hypothesized that parents would ask more questions during baseline phases, and children would be less responsive. Child response rate was calculated by dividing the total number of child responses by the total number of parent questions, and multiplying by 100. Rate of child accuracy was computed by dividing the child's total number of accurate responses by their total

responses, and multiplying by 100. As with school phases, the child's preschool teachers provided information on the accuracy and reliability of child responses. All home data was graphed and analyzed on a daily basis.

Inter-observer Agreement (IOA). Ten percent of transcriptions were coded for IOA, to ensure consistency and reliability.

Reliability. Given the nature of child accuracy, preschool teachers aided researchers in assessing reliability of whether a child-reported event actually occurred. Preschool teachers were immediately consulted after the child's preschool class and after the data had been transcribed to determine the accuracy of children's responses. For audio recordings sent by families, preschool teams were consulting the following morning to assess reliability of school events reported to parents.

Fidelity of Intervention. Fidelity was assessed by using the Data Collection Protocol (See Appendix D) and reviewing the video of researcher-child interactions.

Qualitative Data. In order to understand how this intervention impacted families at home and to gain understanding of participants' recall and memory capacity before and after the intervention, qualitative interviews were completed with each caregiver pre- and post-study. Given that this intervention requires time and effort from families, understanding of social validity for parents is important; these interviews were also be a way to understand if families find this intervention useful. Researchers were interested in understanding to what extent visuals altered the conversations between parents and children, and what changes parents noticed in their interactions using the photos as a visual support. It was hypothesized that children would share more information with the inclusion of a visual, and that parents would naturally get more information about their child's school day through these photos alone.

Examples of open-ended questions include, “*Tell me a little about what your child currently tells you about his day at school?*” and “*Describe a specific instance when your child was able to share something about what he/she did at school that day?*” See Appendix B for Qualitative Interview protocols. Interviews were scheduled for times most convenient for families, and took place at the early childhood center where children attended preschool and in families’ homes. Interviews took between 15 and 30 minutes.

Qualitative interviews were audio recorded, transcribed, and coded for themes (Merriam, 1998; Miles & Huberman, 1994). Member checks were completed after each interview, where coded data was shared with families to ensure accuracy and validity of this data (Merriam, 1998).

Data analysis took place informally throughout each semi-structured interview, and formally during January and March-April 2015, and utilized the strategies described by Merriam (1998) and Miles and Huberman (2002). Interviews were analyzed separately and divided into three cases. An initial step involved reading through each interview transcript and identifying broad themes. As themes began surfacing, an open-coding scheme was developed and codes entered into a data table.

Preschool Teacher Survey Data. In order to understand potential consumers’ opinions of this intervention, preschool staff, including lead teachers, related service professionals, and paraprofessionals were surveyed upon completion of the study. Researchers were interested in understanding if preschool staff found this intervention useful for children and families, and if they would be interested in implementing it with other children.

To ensure all team members were able to complete the survey, paper and pencil surveys were distributed to preschools teams during a weekly team meeting, and collected at the end of

the school day. Quantitative survey data was analyzed and graphed by question, and open-ended responses were coded for themes.

Chapter 4

Results

Results of this study indicate that mobile technology-created visual supports can be used as an aid to teach accurate recall to young children with autism. When sent to families, these photos can promote more meaningful parent-child conversations, decrease challenging behavior, support accurate recall, and help children share more details from their day at school. Furthermore, results suggest that this intervention has high social validity among parents, preschool teachers, and young children with autism.

Dependent variables studied include child accuracy, total different words used by children, and total different words used by researchers. Child MLU and total words used by both researchers and children are also reported. Finally, data from pre and post qualitative interviews with families, in addition to survey results from preschool staff are included.

Accuracy

Accuracy data, reported as a percentage, was collected to understand if these supports had any impact on children's ability to correctly recall past events. Children were asked three times to share information about their day in preschool totaling a possible 100%, with each question or follow up prompt comprising 33.33%.

All participants demonstrated increased accuracy during intervention phases, as demonstrated by Figures 6-9. When three photographs were used as visual supports, all participants demonstrated 100% accuracy when retelling events from their day in preschool.

When three photographs were faded to just one, one participant continued to accurately retell events from her day with 100% accuracy. Emily was able to share accurate information related to the photo, in addition to other things not included to the photograph, such as events that had occurred earlier in the day or the activities in which other children or teachers were engaged. Percentage of non-overlapping data (PND) was 88% across ABAB phases at school, and 100% at home. When photographs were faded completely, she continued to share accurate information 100% of the time. Follow up probes demonstrated that she maintained this skill to some extent, with data ranging from 66-100%. As photographs were faded from three to one at home, she was still able to accurately recall events from school at levels higher than in baseline, with 100% PND between baseline and B and C phases. See Figure 5.

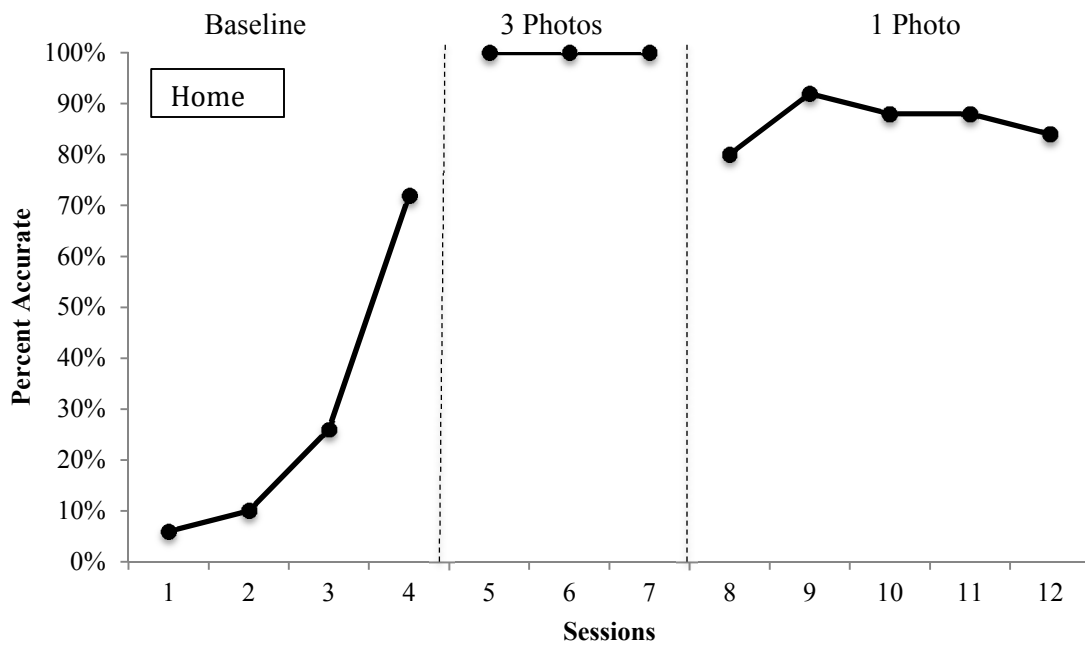
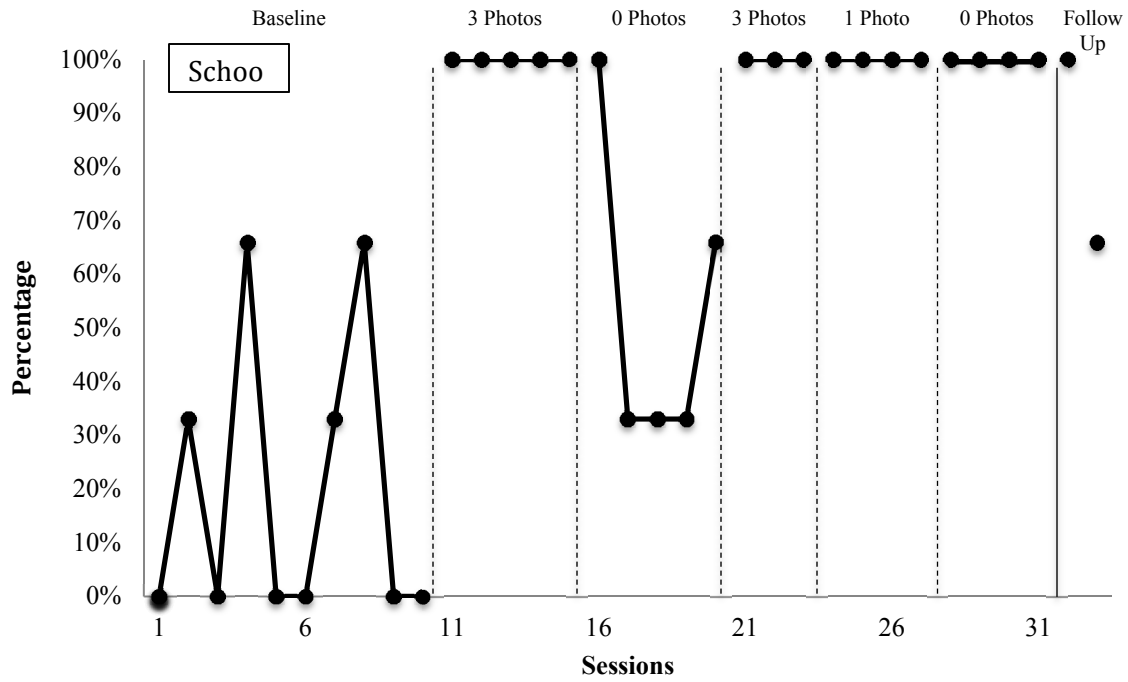


Figure 5. Emily: Accuracy Across School and Home.

However, other participants did not demonstrate accurate recall for other events after visual supports were faded from three to one photo. Both Sam and Laura were able to accurately describe an event related to the single photograph, but struggled to consistently share more factual information regarding additional occurrences at school. When prompted for more information, Sam would routinely report similar things he reported during baseline phases, commenting, “I earned the iPad” and “I played with Eve.” Laura would either express that she wasn’t sure what happened, or revert to scripting a favorite book or TV show.

Yet, data suggest differences between skill acquisition for Sam and Laura. Laura’s data demonstrates that she was better able to recall an additional event with the support of just one photograph (See Figure 6). In the initial baseline phase, she recalled events 0-33% of the time, averaging 6.6% accuracy. With three photos as a visual support, her accuracy was stable at 100%. During the initial ABAB as photos were faded from three to one, she recalled events from preschool with 66-100%, averaging 44% accuracy in this phase. When photos were completely faded, she reported events with 33-66% accuracy, yet demonstrated 100% accuracy when these were reinstated. As photos were faded from three to one again, Laura’s accuracy ranged from 66-100%, averaging 77%. Without any visual supports in the final phase, Laura’s accuracy ranged between 33-100%, with an average of 79.8%. While her responses were not as detailed and descriptive with the support of one versus three photos, she was still able to share other accurate information from her day, such as celebrating a peer’s fifth birthday with lollipops, or getting to pet a dog during recess.

At home, Laura demonstrated a similar pattern as photographs were faded in that environment. She was consistently more accurate with more visual supports, but was still able to report who she played with during certain times of the day, discuss content related to the

classroom curriculum, and share logistical information, such as what she ate for snack or whether or not she used the restroom. In this setting, Laura averaged 30% accuracy in baseline, 97% accuracy with three photos, and 67% accuracy with one photo, with 90% PND. Follow up probes demonstrate that she was recalling events with 66-100% accuracy. See Figure 6.

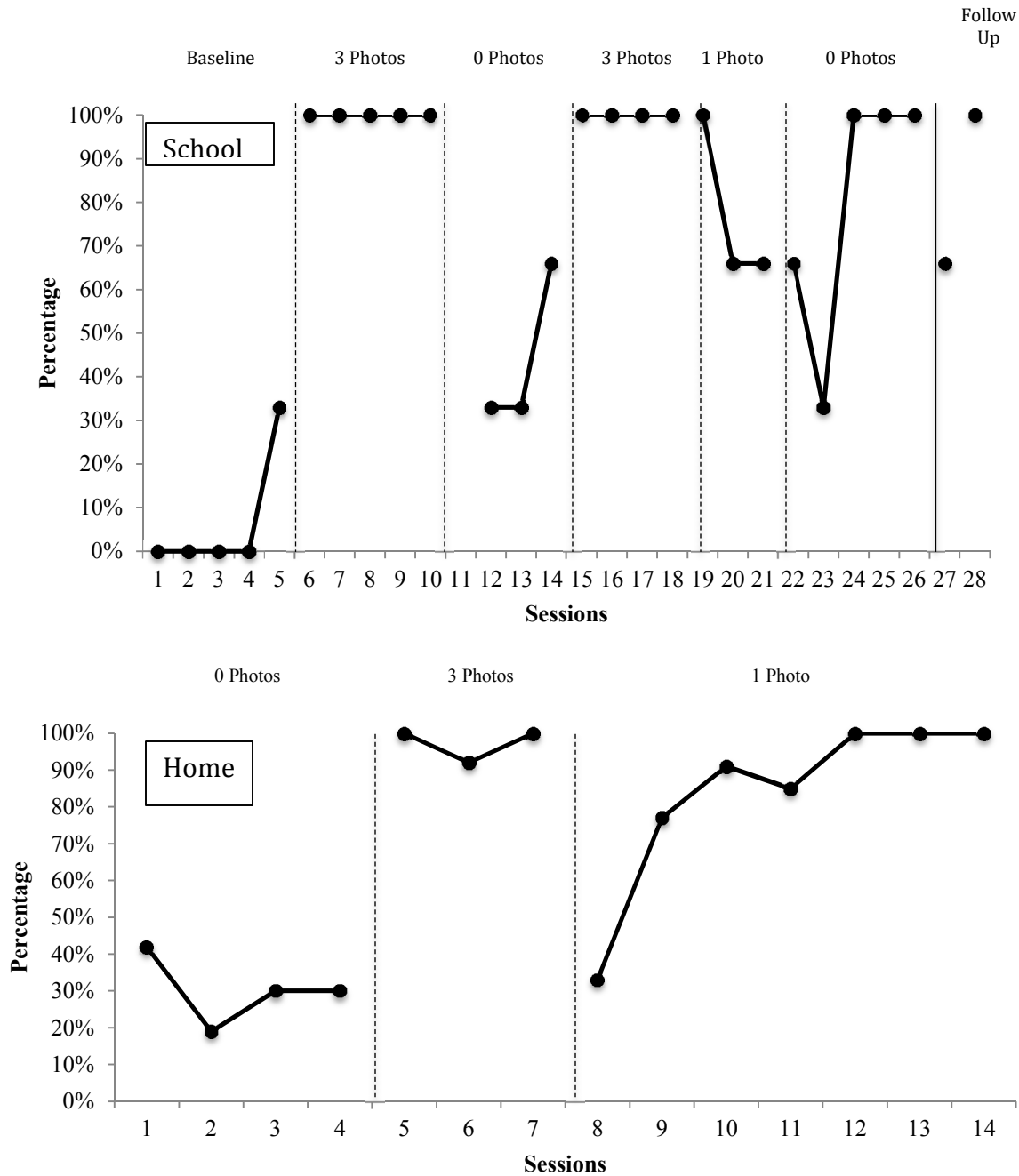


Figure 6. Laura: Accuracy Across School and Home.

Sam’s data demonstrate that he needed additional instruction to learn to accurately recall events without a photo. Based on this data, researchers proceeded with additional intervention and an ABABABCBA design. Prior to intervention, he averaged 7% accuracy but with three visuals, averaged 100% accuracy. When visuals were completely removed the first time, Sam

could recall events with 33-66% accuracy, averaging 40% accuracy. However, in the second reversal phase, his accuracy averaged 0%, and he typically responded with the same script each time he was asked. He would always tell researchers. "I played. I played with Eve [a highly preferred peer]. I earned the iPad." Preschool teachers confirmed that Sam did frequently play with Eve, and have opportunities to earn time on the classroom iPad contingent upon fulfilling a token system, but these events did not consistently occur on a daily basis. His teachers reported that he had, in fact, not earned the iPad several times when he recalled that he had, and that Eve was absent for multiple days when Sam reported playing with her. Hence, there were inconsistencies in Sam's accurate recall, in addition to a lack of information regarding novel events. Given that researchers were interested in teaching children to accurately recall novel events, these responses were coded as inaccurate. However, data indicate that Sam's accuracy increased at the end of intervention. When fading from three photos to one in the final two C phases, Sam averaged 50% and 92% accuracy. During the final baseline phase, he was able to recall greater detail about several novel events in preschool, including a broken sewing machine resulting in his class having to postpone a sewing project until after a school break, details surrounding an imaginative game played during recess with peers. Therefore, while his acquisition phase was much longer than other participants, data demonstrates that he was recalling events with greater accuracy compared to baseline at the end of the study (100% accuracy during the final baseline phase, with 33% and 66% in follow up). At home, he was consistently more accurate and able to share novel information during intervention versus baseline phases, with 100% PND. See Figure 7.

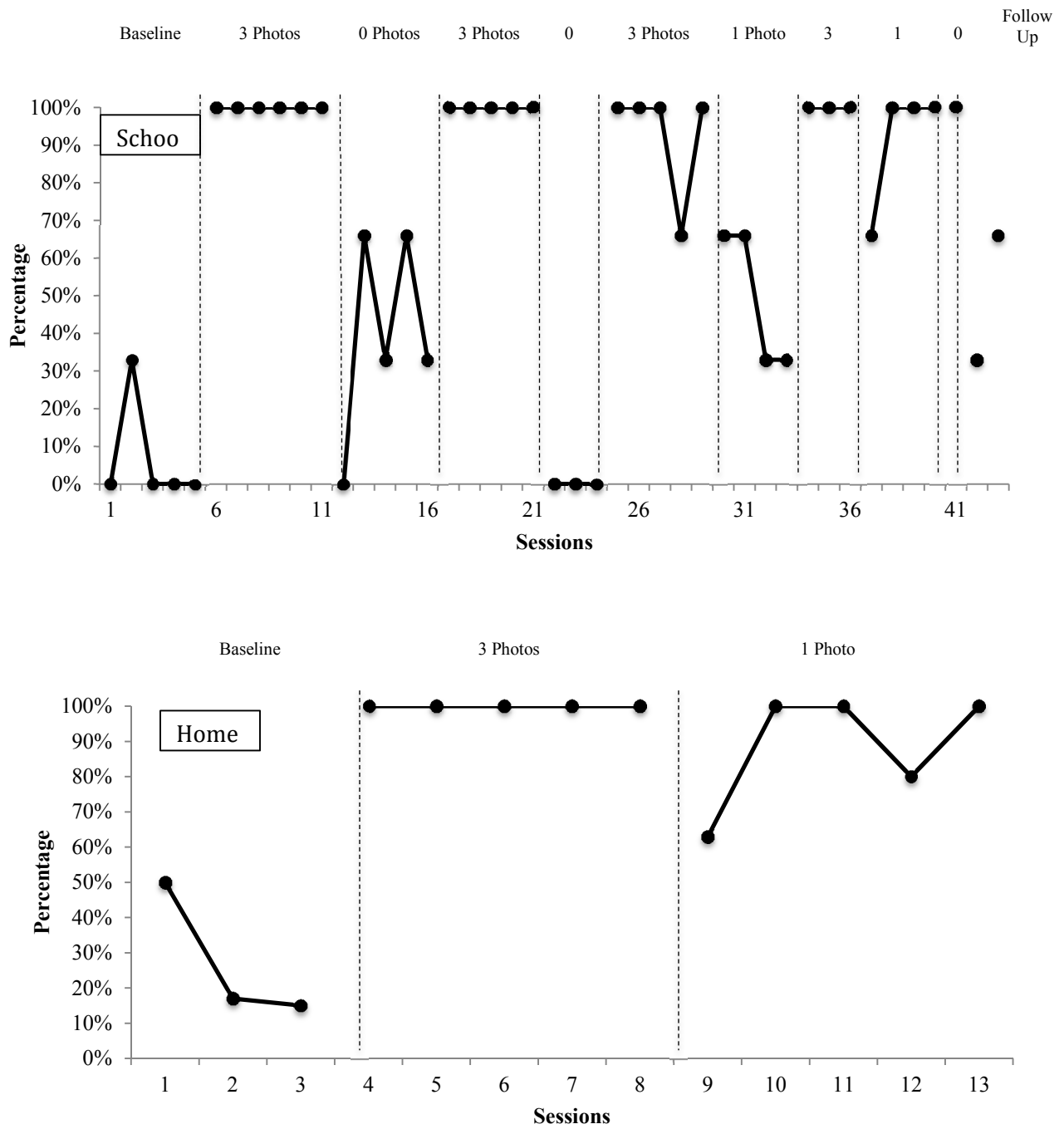


Figure 7. Sam: Accuracy Across School and Home.

Different Words Used by Children

In addition to accuracy, researchers hypothesized that children's overall communication would differ with the support of a visual. Data indicate that all participants used more varied language, as measured by the total number of different words said when recalling their day, during intervention phases (See Figures 8-11). The percentage of non-overlapping data in ABAB phases was 100% for Emily and Laura, and 90% for Sam. It seems that children had more content to discuss when visuals were provided. All three participants often commented on events not included in the photo or added other details to further clarify the photograph, such as explaining exactly how they built a certain structure in the block area, describing the steps to an art project, or recounting the rules and players involved in a specific game played during recess. It is interesting to note a larger increase in the different words used by Emily and Laura during the first intervention phase, as compared to subsequent phases. This may be related to the novelty of this intervention and the opportunity to discuss photographs resulted in this exaggerated increase. As the study progressed, data indicate an overall increasing trend in different words for both Emily and Sam, but less so for Laura.

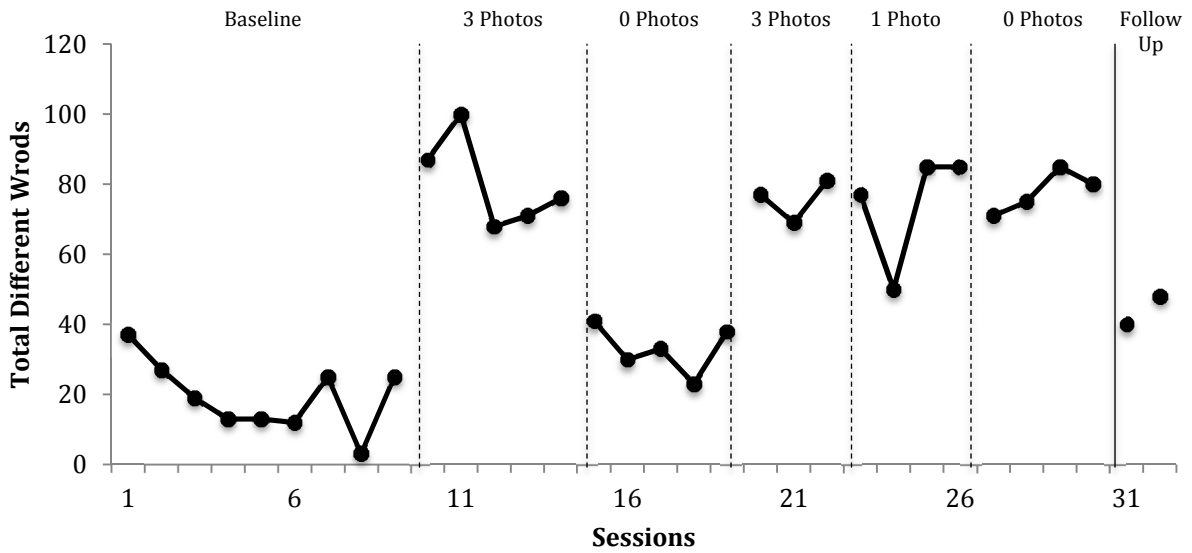


Figure 8. Emily: Different Words.

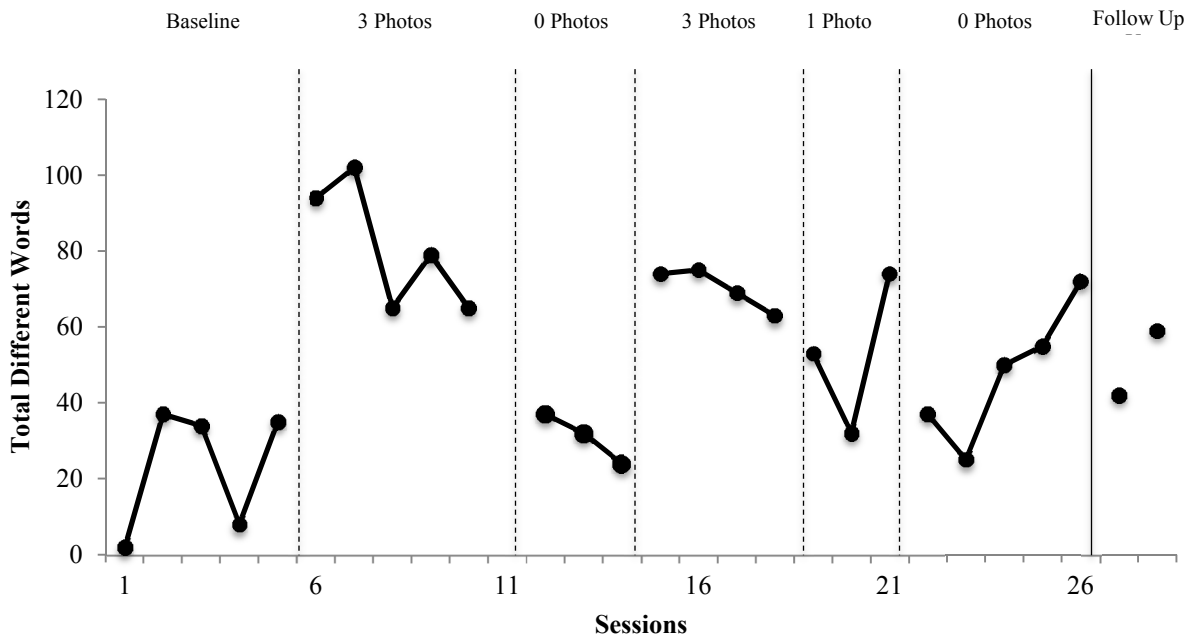


Figure 9. Laura: Different Words.

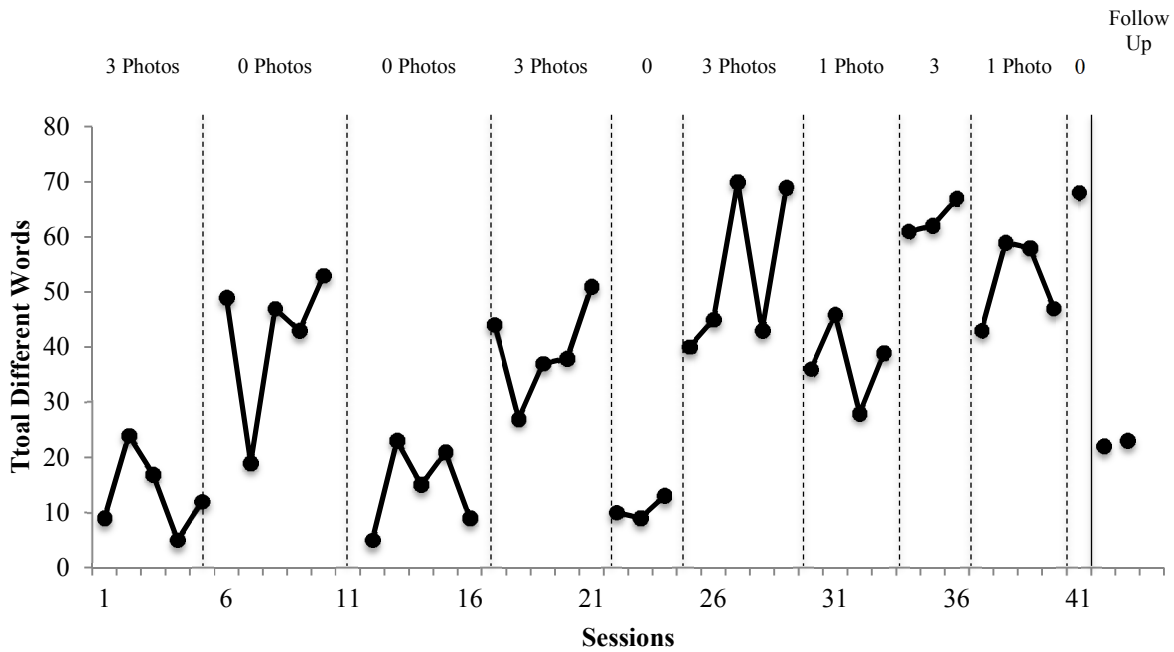


Figure 10. Sam: Different Words.

Researcher Communication and Language

Data also demonstrate changes in the language used by researchers when discussing children's day. During intervention phases, researchers consistently used more total and different words, compared to baseline phases. Percentage of non-overlapping data was 100% for all participants across ABAB phases (see Figures 11-14). Like children, it appears that photographs provided adults with additional conversational topics. Transcript analysis revealed that researchers were better able to make comments on what was occurring in photographs and ask more meaningful follow up questions when visuals were used. Furthermore, child and researcher graphs demonstrated similar trends – an increase in child language was mirrored by an increase in researcher language, suggesting that these visuals resulted in more complex conversations for both conversational partners.

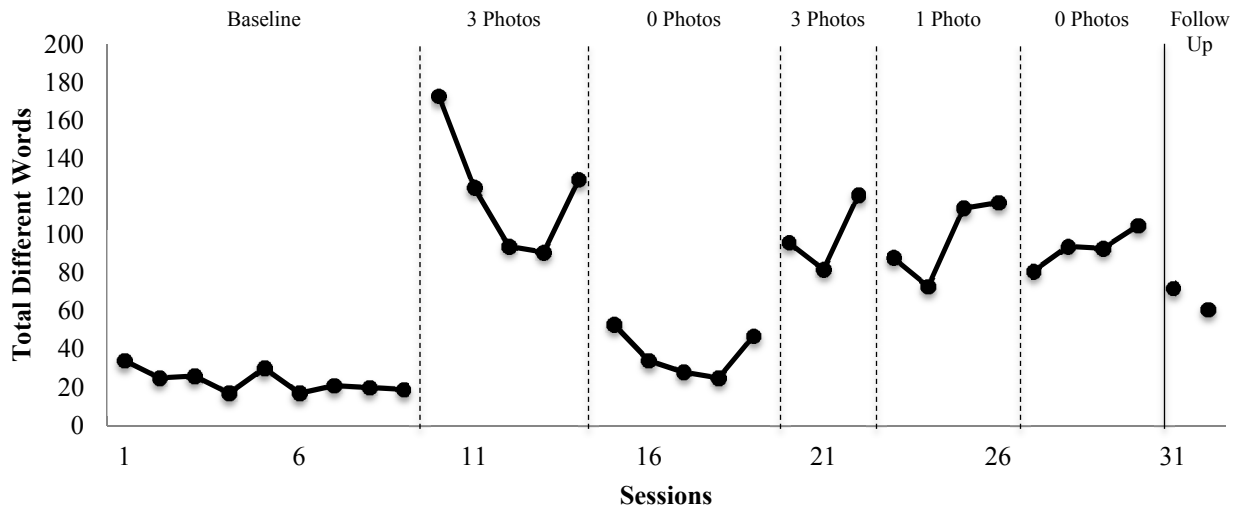


Figure 11. Emily: Examiner Different Words.

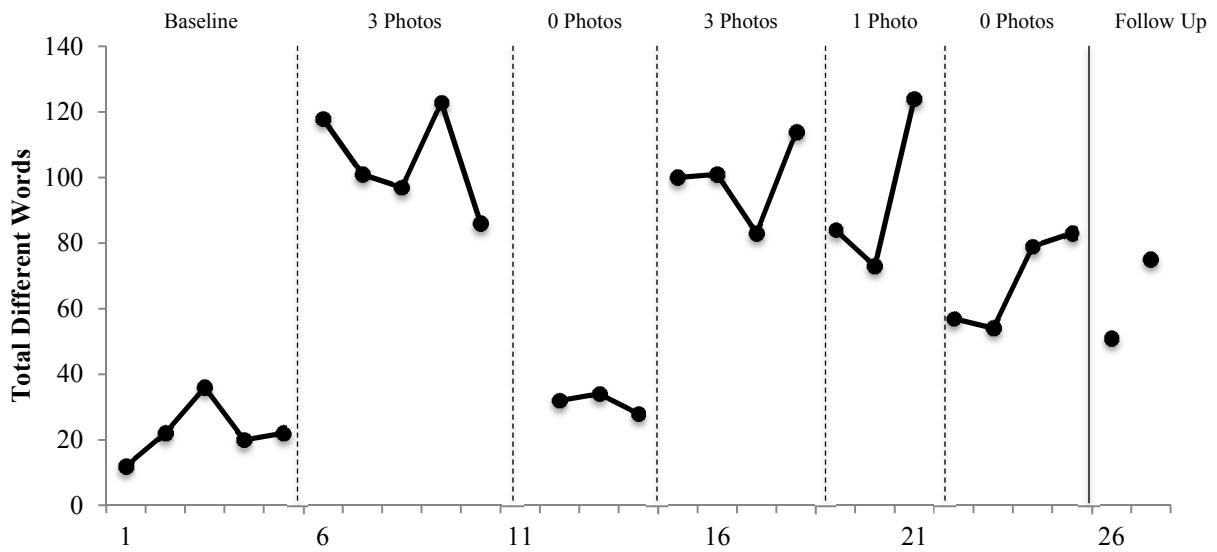


Figure 12. Laura: Examiner Different Words.

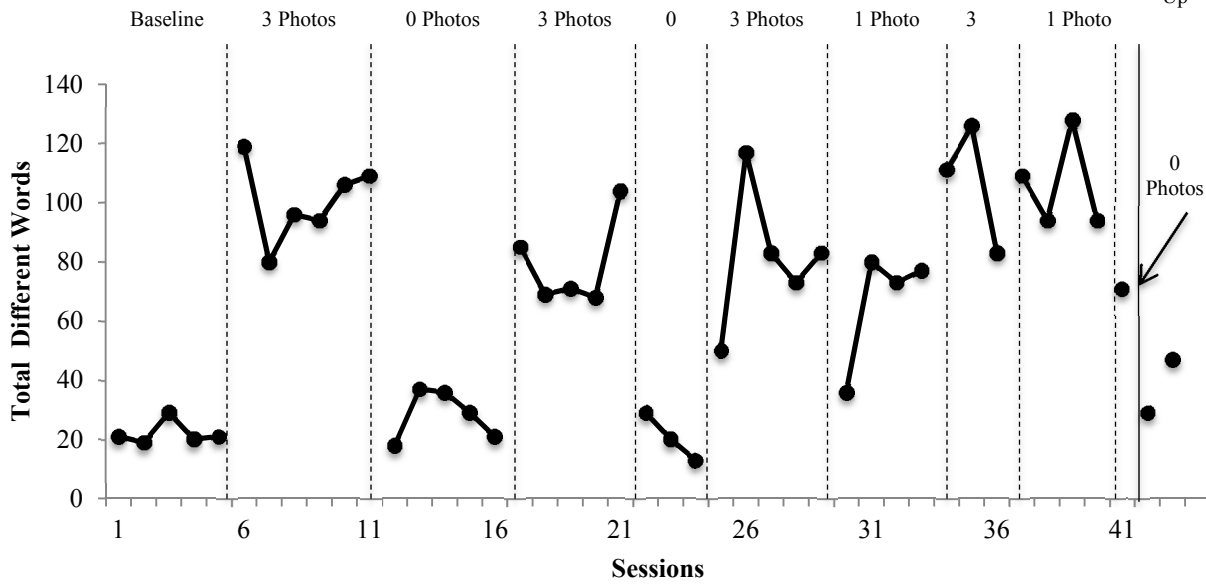


Figure 13. Sam: Examiner Different Words.

Table 3

Percentage of Non-Overlapping Data

	Emily	Laura	Sam
Accuracy			
School	88%	100%	100%
Home	100%	83%	100%
Child Different Words	100%	100%	90%
Researcher Different Words	100%	100%	100%

Other Related Measures

The following dependent variables are reported in Tables 4-5: Mean Length Utterance, Child Total Words and Examiner Total Words. An increase in both child and researcher total words is evident during intervention phases, although this seems less compelling than the variances in different words, considering the longitudinal outcomes associated with children’s wide-ranging vocabularies and language complexity they are exposed to in early childhood (Hart & Risley, 1995).

Given that the study design used with Sam was different than that of the other participants, his data is represented in Table 5.

Mean Length Utterance. The average MLU of all participants did not change to a great extent between baseline and intervention phases.

Child Total Words. Children consistently used more words, on average, during intervention phases. This finding is not surprising; children had more content to discuss when provided with a visual. There are substantial differences in total words for all participants across study phases – Emily averaged 29.11 words prior to intervention, yet in the final baseline phase averaged 150.75. Laura began with 31.6 total words, but ended with 94.4, while Sam averaged 21.4 words and 64.7 at completion. Hence, for all children, this variable did not revert to baseline levels post intervention. Furthermore, for two of the three participants, there was a not a considerable shift between total word averages as visuals were faded from three to one between B and C phases. This discrepancy was most pronounced for Laura at 71 words, while Emily’s data demonstrated an average decrease by three words; for Sam, who had two shifts from B to C, this was 23 and 15 words, respectively.

Researcher Total Words. Researchers also consistently used more words, on average, within interactions with children during intervention phases. Again, when provided with a visual, researchers had longer conversations with children, as measured by the total number of words.

Table 4

Other Related Measures: Emily and Laura.

MLU						
	A	B	A	B	C	A
Emily	6.99	6.72	8.55	8.52	8.15	7.41
Laura	5.65	6.04	9.84	7.52	5.69	6.39
Child Total Words						
	A	B	A	B	C	A
Emily	29.11	188.8	63.6	173	170.5	150.75
Laura	31.6	172.8	60.33	162.25	91.67	94.4
Researcher Total Words						
	A	B	A	B	C	A
Emily	31.33	304	59	194.67	212	189.25
Laura	32.8	216.2	47.67	210.25	184.33	110.75

Table 5

Other Related Measures: Sam.

	A	B	A	B	A	B	C	B	C	A
MLU	4.592	3.86	4.82	5.01	5.9	4.9	5.26	4.33	4.64	9.46
Child Total Words	21.4	64.2	20.6	69.6	18.67	86.6	63.25	104	88.75	126
Researcher Total Words	34.8	211.5	52	162.8	40	168.8	137	206.67	231	111

Changes in Parent-Child Interactions

Data from qualitative interviews with parents and single case data from parent-child audio recordings and transcriptions illustrated differences in parent-child interactions across study phases. Prior to intervention, all families reported the necessity of asking very specific questions in order to get information about what their child did at school. This was confirmed through analysis of transcriptions from parent-child conversations during baseline. Parents often

began the conversation by asking a broad question, like “What did you do at school today?” but without visuals, this was typically answered with either one word, a short sentence, or the child replying, “I don’t know.” Parents then moved to specific yes or no questions, such as “Did you play Polly Pocket?” or “Did you eat anything?” or follow up questions, like “What else did you do?” but child responses and accuracy varied. All parents discussed hearing similar things about their children did at school each day, but doubted the accuracy. As Laura’s mom shared, “I’ll say, “What did you do today?” And she’ll say the same thing and I don’t really know if it happened.”

During intervention, all parents found that their child included greater detail when asked about their day and provided additional information about things not illustrated in the photo. Two families, Laura and Sam’s mothers, reported a decrease in challenging behavior during intervention phases. Emily’s mother shared that the conversations with visual supports were much more enjoyable for both her and her daughter. Analysis of parent-child home transcripts demonstrated a slight decrease in parent questions, and an increase in child responsiveness for all participants. This data suggests that visual supports enabled children to more actively participate in these conversations with their parents. Finally, all parents found the visuals useful in enabling them to further discuss curricular content at home. After receiving a photo and discussing a measuring game Emily played in class, her mother shared that they introduced a similar game at home, measuring a variety of household objectives, just as Emily had at school. See Table 6 for Qualitative Themes.

Children were able to provide greater detail with visual supports. All parents found photographs to increase the level of detail and specificity shared by their children, including events not documented in the photo. Emily’s mom imparted,

Now, she'll come home and say, "I got to move Dubs" or to be the line leader or whatever, you know. "I was the door holder!" or you know, things that you would think would stand out are starting to stand out more I think.

Laura's mother also noticed an increase in detail shared by her daughter:

Like she would be talking about something that wasn't necessarily in the photo but she could recall more. Like that recording I sent you recently where she was talking about Liam's favorite cereal and Liam not being at school. So she, I mean, she kind of talked about a lot in that recording. And a lot of it wasn't...part of the photo.

Finally, Sam's mother had a similar experience:

He would tell us about other people that may or may not have been in the picture. So like sometimes he would say, "Oh I was doing this and so and so was over there" or "I was doing this with so and so and they got up to do this" or...so there was detail about people.

In pre-intervention interviews, all parents expressed concern about their children's social interactions with peers, specifically wanting more information about who their child was playing with at school. Emily's mom shared, "You know, I worry about social stuff, for obvious reasons." It is important to note that in post-intervention interviews, all parents specifically discussed hearing information about other children with the support of photos.

Decreases in Challenging Behavior. Two parents remarked that intervention resulted in a decrease in challenging behavior (the third parent did not report any challenging behavior). Laura's mother emphasized that her daughter often engaged in high rates of echolalia during their attempted conversations about the school day. This was also observed during interactions with researchers at school. However, she could deduce that Laura was commenting on events from school, despite the inappropriate way she was initiating:

And I also feel that I learn bits and pieces about the day from...not necessarily by asking her question or her in a very straight was telling me because she's very echolalic [sic]. She does a lot of scripting so a lot of times, she'll repeat something

that the teacher has said and I can ask follow up questions. Or like last week, Teacher Clive was pretending that Kyle was a pizza, and uh, she was repeating what he was saying. So, you can get information that way. You're hearing things that obviously happened at school and you can sort of follow - "did Teacher Eileen say that? Was it Clive? Was that Teacher Jess?" And then she can say like, "oh yeah, that was Eileen."

Therefore, prior to intervention, Laura was able to share some information about her day with her parent, but in an inappropriate and nonconventional manner. However, upon completion of the study her mother noticed this behavior less, sharing "I don't hear it [echolalia] as much," and that "...when there was a photo she would just all around be a little bit more specific."

Sam's mother commented that he tended to engage in challenging behavior upon arriving home from school prior to intervention, and found the photos to help establish a more structured afternoon routine. She noted,

It works best for us when I have the photo when he came off the bus because then it can be "hey put your shoes and your backpack away. Come sit down and tell me about this picture." So for him that was, rather than come in the house and like run around and "oh I want a snack" or "I forgot that I was doing this before I left for school." It was a nice kind of focal point at the end of the day to be like, "Oh what happened? Here, let's look at this." And so then he would say whatever it was. And then I felt like transitioning to the next activity was more calm rather than trying to corral him. Because he usually just comes in and he's wild.

Thus, for two of the three participants who engaged in challenging behavior prior to intervention, it appears that this intervention resulted in a decrease in inappropriate behaviors and an increase in appropriate conversational skills with caregivers.

Increases in Children's' Responsiveness with Photos. Data from parent-child conversations suggests that during intervention phases, children were more responsive to parents (See Figures 14-16). In baseline phases, all participants demonstrated a greater degree of non-responsiveness, where parent questions were often ignored. Prior to intervention, children's response rates varied between 48-88% for Emily, 46-86% for

Sam, and 17-93% for Laura. However, the data trends varied for each participant. Emily demonstrated an increase in responding during baseline, while Sam's responsiveness decreased. Laura's baseline data was fairly unstable. It is important to note that during this baseline phase at home, all participants were in a B phase at school, where photos were used as visual supports.

During both intervention phases these rates were much higher; Emily responded 84-96% of the time, Laura 81-100%, and Sam 62-100%. Sam's data is particularly interesting, given that he demonstrated consistent responding to a greater extent, even when photos were faded.

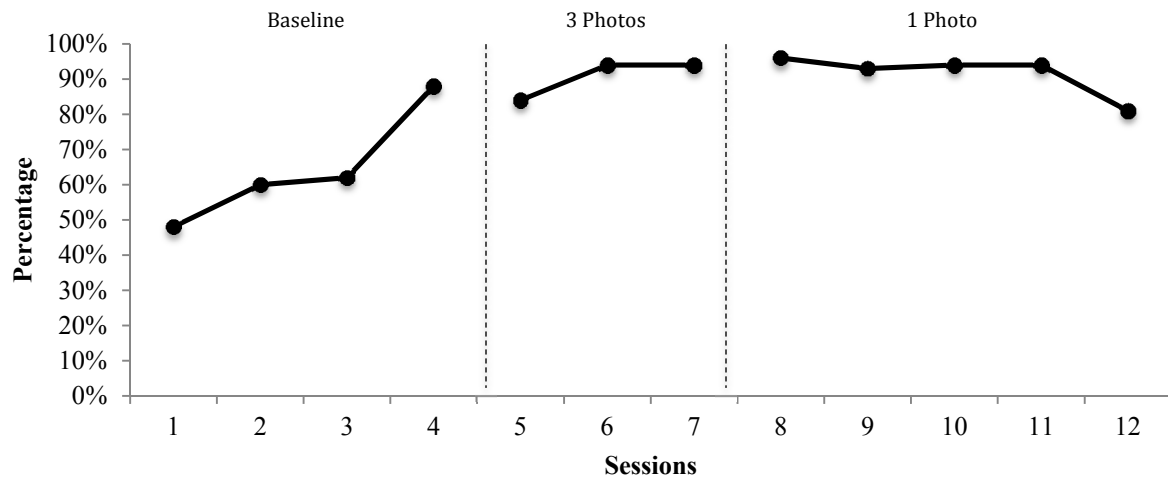


Figure 14: Emily Home Response Rate.

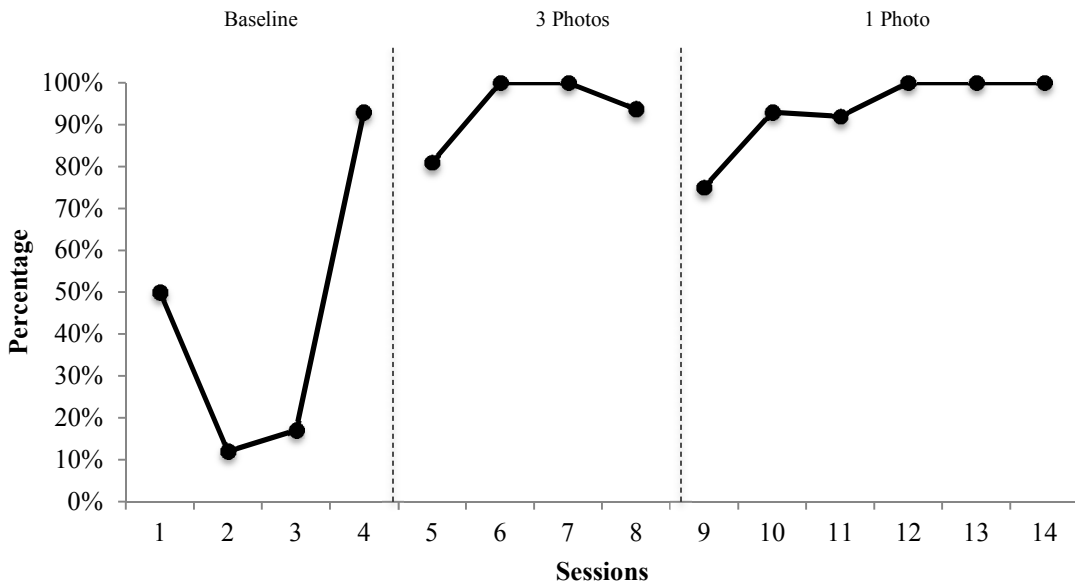


Figure 15. Laura Home Response Rate.

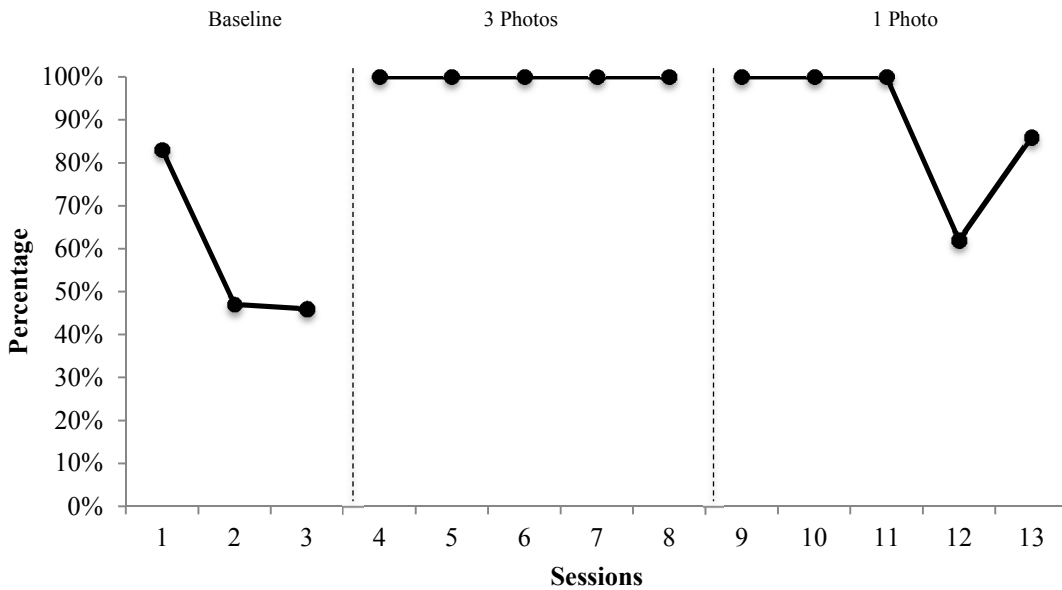


Figure 16. Sam Home Response Rate.

Compared to baseline, parents asked fewer questions, on average, during the first intervention phase when three photos were sent home, which is consistent with qualitative data demonstrating that children were more descriptive during these phases – when children initiated more

information, parents asked fewer questions. When comparing parent questions to child responsiveness, data suggests that without photos, parents asked numerous questions but children did not consistently respond. With three photos, parents asked fewer questions and children's response rates increased. When a single photo was sent home, two parents increased question asking yet their children's response rate remained high, suggesting that parents asked more questions while children provided more answers. For Sam, his mother asked fewer questions when a single photo was used but his response rate still remained higher than in baseline.

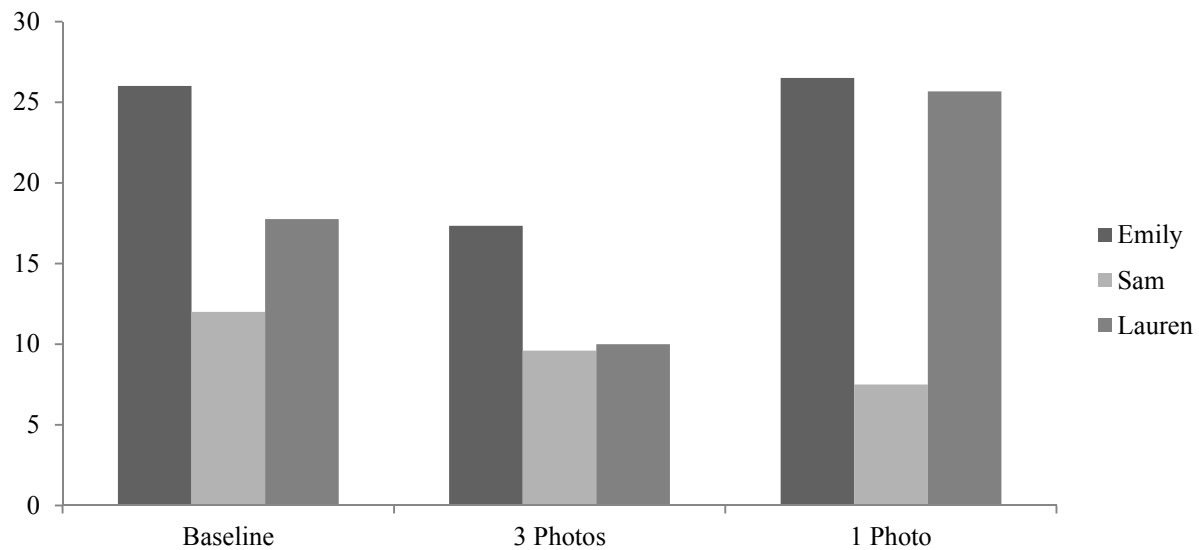


Figure 17. Average Parent Questions Across Study Phases.

Table 6

Qualitative Themes.

	Children	Parents
Pre Intervention	<p>Provided generic responses, parents unsure of accuracy</p> <p>Children often reported the same thing each day, but parents unsure of accuracy</p>	<p>Parents asked very specific questions</p>
Post Intervention	<p>Children provided more detail, including information about peers and events not included in photos.</p> <p>Provided structure for parent-child conversations</p> <p>Increased child initiations</p> <p>Decreased challenging behavior (2/3 participants)</p> <p>Parent report that children enjoyed discussing the photos</p>	<p>Able to address learning topics from school at home</p> <p>Spouse who works able to get information about school to a greater extent</p> <p>Asked less specific questions</p>

Social Validity Among Potential Consumers

Data from qualitative interviews and teacher surveys demonstrates that social validity of this intervention is high. Both parents and teachers found this intervention to be useful and sustainable. Ten surveys were distributed with a 100% completion rate.

Parents. Prior to intervention, all parents reported hearing either generic responses about their child's day at school, such as comments like, "I played" after asking their children fairly specific questions, or hearing repetitive information they were unsure was accurate. No children volunteered information about their day at school, and all parents expressed the necessity of

asking very specific questions in order to gain information about their child's day. Emily's mother shared,

She doesn't tell me about - I'll have to say, "What did you do in small group today?" [and she'll answer] "I don't know, I don't remember," [so I'll ask] "what book did you read at circle?" You know, I don't hear a lot about any of that.

Laura's mother noted,

Um, she doesn't freely [share info about her day at school], I have to ask. And I've also noticed that I have to be a little bit specific about the question that I'm asking...but for the most part, I don't feel like she tells me very much.

Additionally, all parents expressed not hearing a great deal of specific information about their child from teachers. While parents received general information about class activities as a whole through weekly or bi-weekly newsletters, they got less information about their child unless they explicitly asked the classroom team. Emily's mother received a short note with more detailed information about Emily's activities roughly once a month, and found this to be a useful tool for more productive conversations about her daughter's day. Laura and Sam's parents did not receive individualized information unless it was requested. However, all parents expressed wanting more information about what their children were doing at school, with an emphasis on their children's social interactions with peers. Additionally, all parents expressed wanting more logistical information, including details about toileting and mealtimes. When asked what they wished they knew about the school day, Sam's mom noted,

I wish I knew what he was learning, what he was eating, how he was interacting with others students - I mean, that's obviously a deficit point for him...I wish that he would tell me, like, what he ate. What he's learning because I would be able to supplement that at home. And I get the, like, [classroom teacher] will send lesson plans at the beginning of the week. But I don't feel like that's a lot of information about what they're actually doing because it'll be like, 'oh, we're gonna read this book' or, but that's a whole week and then its like you don't actually know what they get to or not.

Despite the emphasis on parent involvement in early childhood special education programs, it appears that the families participating in this study still desired more information about their child's participation at school.

However, in concluding interviews all parents reported that this intervention was useful for their family, expressed interest in continuing the study, and shared that receiving photographs enabled them to get information about their child's day. All parents shared that they enjoyed getting photos of their children at school, that the photos enhanced their conversations, and that their children enjoyed discussing them. Laura's mom noted,

It was nice. I like seeing what she does at school just because I don't get to see it. And it's nice to see her playing with her friends or interacting and, it was also really nice to see the first time I showed her a photo how interested she was.

Sam's mother had similar thoughts: "Well, it's great because I can't always be at school to watch him. So, you know exactly what's going on." Emily's mother shared that attempting to talk to her daughter about school prior to intervention was "like pulling teeth!" but described these conversations post-intervention much more positively:

And now with the photo it's so easy, but even without the photo now I feel like it's like "oh okay" if we only have one photo. Well, specifically with the photos it's so much easier, I don't have to pull teeth, she starts to tell me more detail, it's more fun for her. She smiles and gets excited about telling us. You know and I think it makes it more successful for her too. So she feels proud of herself, you know. And it's fun for us to hear about it, right?

Children. An unintended finding was the high social validity from the perspective of child participants. Two parents mentioned their children specifically asking for photos on the days they were not sent home. When researchers decreased the photos from three to one, parents reported that their children requested more photos, after discussing a single picture. Laura's mother shared, "She kind of had a hard time with that. She asked me where the other photos were." Emily's mother noted,

Yeah, she asks for them now...yesterday when she didn't have preschool, "mommy where's my picture from Teacher Ariane?" And I said "Honey it's Wednesday, you didn't have [preschool]" And so, but she loves it. She loves looking at them.

Children's positive opinions were also evident in transcriptions of parent-child home interactions. During C phases when just one photo was sent to parents, two children articulated that the photos supported their recall. Laura commented, "um, Mom, Mom, you're, the things that you have [pictures emailed from school], help me remember," while Emily asked, "Mamma, can you show me the picture so I don't forget?" after her mother initiated a question without a visual.

Researchers had similar experiences with children during intervention at school. At various points in the study when photos were faded from three to one, or during baseline, all children requested more photos. In concluding baseline phases when photos were not used, all participants requested them and would ask researchers, "Do you have pictures today?" Therefore, it appears that this intervention has high social validity not only among caregivers, but also its intended target population: young children with autism. Additionally, it seems that children recognize the utility of these visuals as a support for their accurate recall.

Preschool Staff. Survey data from preschool teachers suggests that this intervention has high social validity among educators, as well. Of the preschool staff surveyed, 70% responded that this intervention seemed 'very effective' for the children in their classroom, 10% responded that it seemed 'somewhat effective,' 10% responded that it seemed neutrally effective, and 10% responded that it seemed 'fairly ineffective' (see Figure 18).

One respondent shared, "I think this is a great and sustainable idea! I hope to be able to send pictures home to families on a regular basis in my own classroom next year!" while another

wrote, “Children seemed highly motivated to engaged in discussing the pictures! Parents loved receiving pics! [sic]”

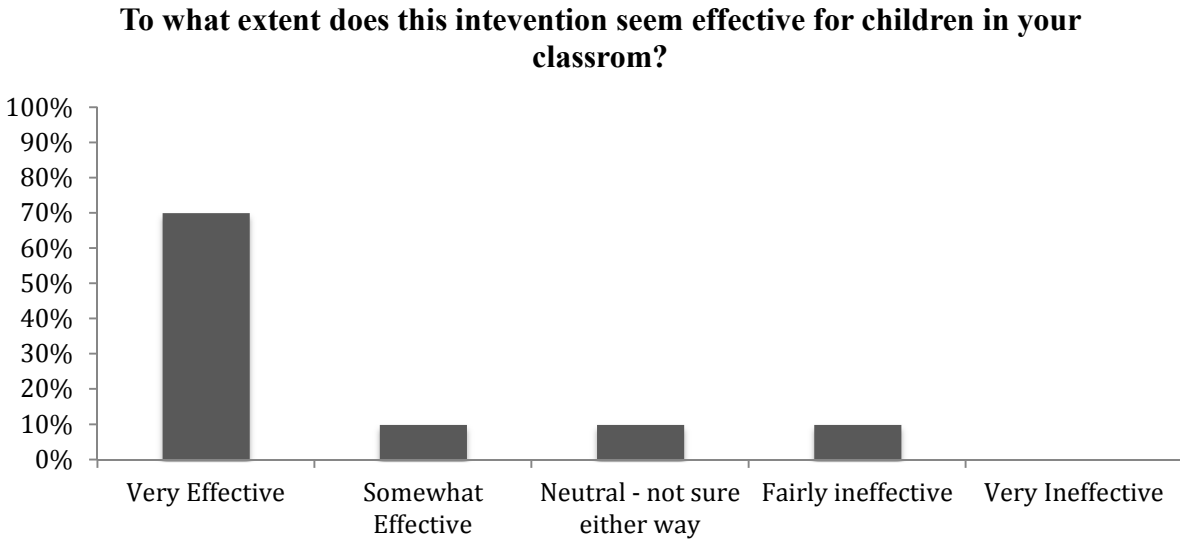


Figure 18. Teachers’ views of intervention effectiveness with children.

All practitioners surveyed reported that they believed this intervention would benefit the families of children in their classroom (See Figure 19).

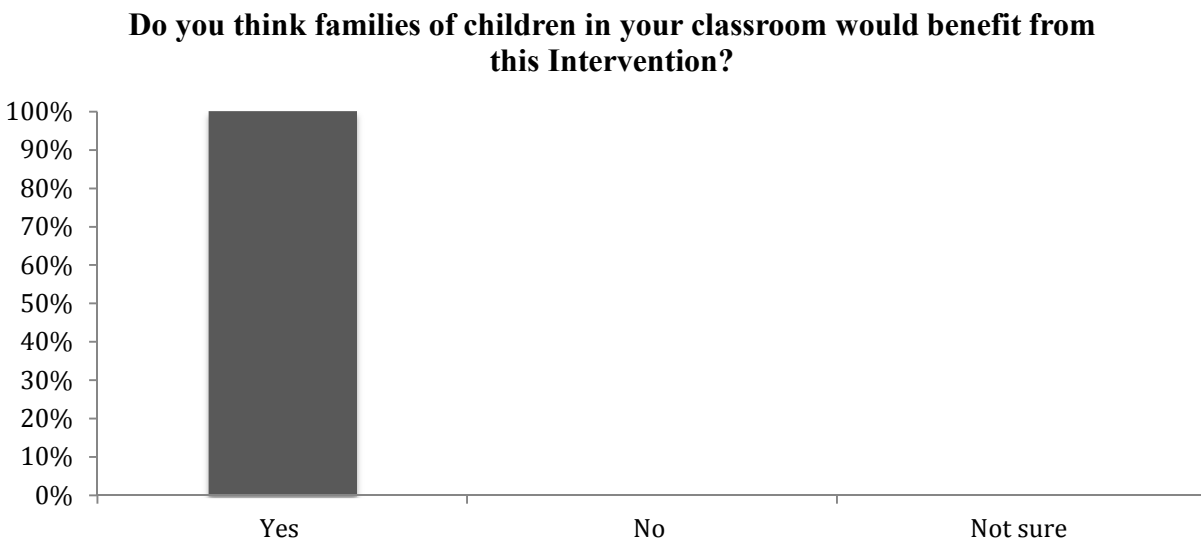


Figure 19. Teachers’ views of intervention effectiveness with families.

Additionally, 90% of those surveyed reported they could use this intervention in their own classroom (See Figure 20).

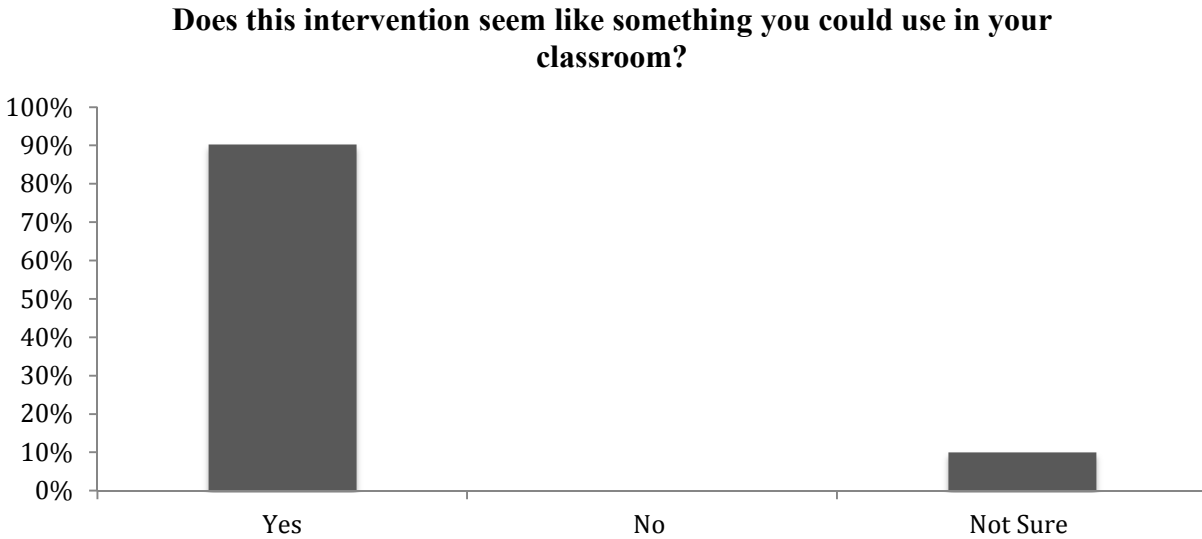


Figure 20. Teachers' views of intervention utility in their classroom.

Lastly, researchers were interested if any preschool staff had been using this intervention with other children not participating in the study, as it was being informally implemented in several classrooms. Forty percent of respondents reported using this with other children. See Figure 21.

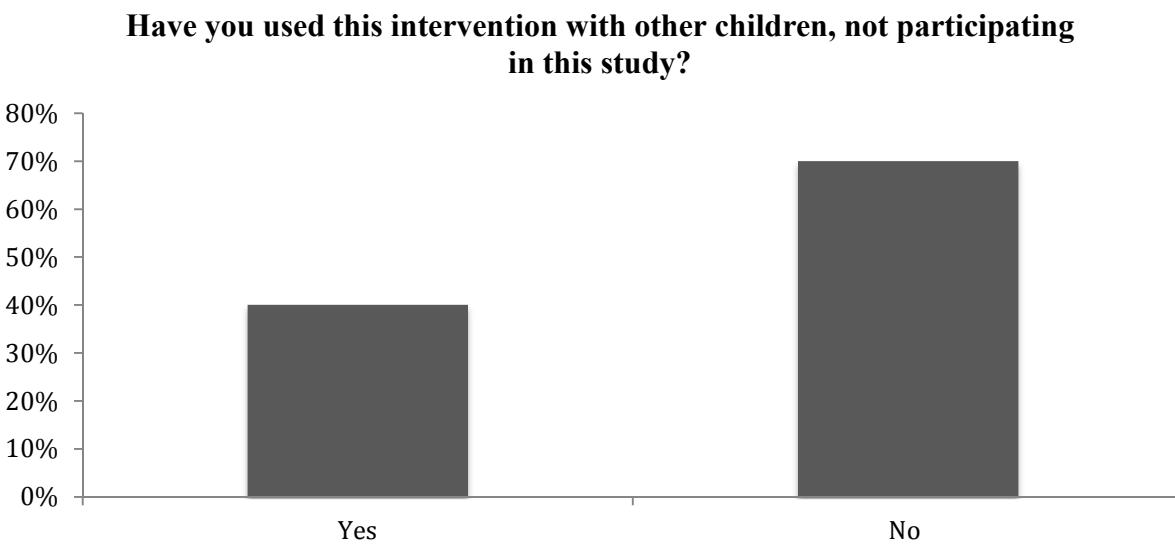


Figure 21. Teacher's use of intervention with other children.

One respondent shared,

I'm doing this intervention with five students. I chose this intervention when all parent reported their child to not respond to the question, "what did you do at school today?" [sic]. Now, all parents report their children to answer when presented with the visual, they provide detail, and three have reported that their child is able to talk about parts of their day without visuals.

Another respondent wrote, "I have sent pictures to parents of their children doing various things in class, and parents have said that it helps them talk about the day with their children." This data is particularly interesting, as it suggests preschool staff immediately implemented this intervention after observing it in their classrooms. Given the issues with research to practice gaps in special education, sustainable interventions that can easily be implemented by teachers are critical. This survey data suggests potential consumers, including preschool teachers and early childhood special education staff, may easily and sustainably implement this intervention.

Inter-observer Agreement, Reliability and Fidelity

Inter-observer agreement was calculated on 10% of all transcriptions, and was 94%. Reliability was assessed by consulting with preschool teachers to determine if child responses were accurate and if children were accurately recalling events that took place during the day at school. Fidelity of intervention was assessed on all instances when a research assistant collected data, and was 100%.

Chapter 5

Discussion

This study suggests that mobile technologies can be used to create visuals to support children in developing accurate recall and sharing information with their families. These visuals, created by taking photos of children at school using smart phones or tablets, can be easily

emailed or texted to parents, and used as a support when discussing the child's day at school. A key finding suggests these visuals promote more meaningful conversation between caregivers and children, including an increase in overall child language and child responsiveness. While this has not been studied in children with autism, it is likely that these conversations contribute to memory development in the same way they facilitate recall in children without autism.

Additionally, social validity data is very high among both parents and teachers, suggesting this intervention could be sustained by early childhood special educators and a useful tool for families.

Implications

Developments in technologies have changed classroom instructional practices, with these methods being especially useful in special education, and for the treatment of individuals with autism. As the rates of children diagnosed with autism continue to rise, the need for sustainable, easy-to-use interventions is increasingly important. Visual supports are one evidence-based practice shown to be effective for children with autism (Odom et al., 2003), yet teachers and families report barriers to consistent implementation (Donato, Shane, & Hemsley, 2014). Moreover, parent involvement is a critical component of any program serving young children with autism (Division for Early Childhood, 2014; Dawson & Osterling, 1996), yet the parents participating in this study reported receiving a lack of specific information about their children from teachers. It is possible this intervention provides a simple, quick way for teachers to share individualized information with families. Finally, there is a lack of published research on effective strategies for teaching children with autism to accurately recall events, and useful supports for parent-child conversations about these events. Considering the compelling literature suggesting that parent-child conversations are the primary way young children learn to reminisce

and recall events (Fivush, Haden, & Reese, 2006; Larinka & Bauer, 2012) a modification for families of children with autism and related disabilities is necessary to ensure this population has access to full participation in these conversations. This intervention may provide an effective way to support these interactions.

Findings Related to the Literature

Numerous studies have demonstrated the importance of high quality parent-child interactions (Maccoby, 1992; Mahoney, Boyce, Fewell, Spiker, & Wheeden, 1998), especially for children who engage in or are at risk for engaging in challenging behavior (Hood & Eyberg, 2003; Webster-Stratton, 1990). For two participants in this study, it appears that this intervention resulted in a decrease in challenging behavior. All parent participants reported an increase in the quality of their conversations with their children when visuals were used.

This study may extend previous research documenting the importance of parental behavior in facilitating memory development in young children (Fivush, Hayden, & Reese, 2006; Larinka & Bauer, 2014, Peterson, Jesso, & McCabe, 1999), by addressing how modifications can promote parent-child conversations in families of children with autism. While most research has addressed collaborative reminiscing, where parents and children discuss shared memories (Fivush, Hayden, & Reese, 2006; Larinka & Bauer, 2014) it is likely that similar parental strategies are effective when discussing independent events, such as a child's day at school. Larinka and Bauer (2014) found mothers' use of affirmations to be especially powerful in supporting recall. Results of the current study suggest that mothers are able to provide a greater degree of support around accurate recall when using a visual with their child, as they have content knowledge of what their child is reporting. Visual supports seemed to provide

parents with factual information about their child's activities, which enabled them to affirm responses, ask relevant questions, and elaborate on what their child was discussing.

Unexpected Findings

High social validity among children was an unexpected finding. Researchers hypothesized that parents would enjoy receiving photos of their child at school, and that these photos would promote more engaging parent-child conversations. However, it was not anticipated that children would request photos when they were not available, or that children would identify photos to be a useful support for their accurate recall. Emily and Laura both explicitly mentioned to their mothers that the photos helped them remember events from school. Another surprise was the rate at which teachers chose to introduce this intervention with other children, after seeing it implemented with study participants in their classrooms. Forty percent of teachers surveyed reported using this intervention with other children, after observing the current student. Researchers predicted that social validity would be relatively high, but it was not expected that several teachers would immediately begin this intervention with other children. This suggests that teachers find it to be sustainable and effective, and is especially promising given the research to practice gap commonly discussed in special education (Dingfelder & Mandell, 2011). While this study was completed at a university based lab school where research is frequently conducted in classrooms, it is exciting to see implementation of a new intervention so soon among classroom teachers.

Limitations

Several limitations exist within this study. While there was a high degree of internal validity, is it possible that there is less external validity. Participants were recruited because researchers anticipated they would be good candidates for this intervention, therefore children

with more significant communication impairments were purposely not recruited. It is possible that this intervention would not be as effective for children more significantly impacted by their disability. Additionally, due to time constraints, follow up data was not collected to the extent that researchers can be confident skills maintained over time for all participants, and data was only able to be collect with Sam for one data point during the final baseline phase.

Another limitation included the small size of the research team. While photos were taken by several individuals, the majority of intervention was completed by the author, because research assistants had limited availability as children were leaving preschool for the day. It is possible that observer-expectancy effects impacted child responses. Inter-observer agreement (IOA) is a challenge with a study of this nature, and an additional limitation. The methodology employed in this study has not been used in other research, therefore there was a lack of established protocol for IOA. Preschool teachers were easily able to provide researchers with feedback on the accuracy of child responses, and while this appears to be the soundest way to establish reliability, it is not the traditional way of establishing this in Single Case Designs.

Another possible critique of this study may be the lack of detailed protocol around conversations with children during intervention phases. However, given the nature of this individualized intervention and the importance of child-focused conversations where adults follow the lead of children (Massey, 2004), researchers were more concerned with employing effective communication strategies and ensuring children had opportunities to expand on their comments, than inhibiting child responses with a strict protocol. In the same vein, parents were not provided with any protocol for conversations about their child's day. While this was intentional, and the goal of this intervention was to support parent-child conversations rather than

dictate what parents should and should not say to their children, this could be seen as an additional methodological limitation.

Implications for Further Research

This study provides groundwork for additional research on modifications for memory development and acquisition of accurate recall in young children with autism. Further research should explore how children can take a more active role in this intervention. Given the widespread availability of mobile technologies, it is likely that children will have access to these devices at increasingly earlier ages. Future studies should address how smart phones or tablets can be used by children with autism to take photos of things they need to remember, such as items from school, homework assignments, etc., or things they would like to discuss with friends or family, and at what age children can learn this skill. In the current study, researchers chose what was photographed, although children would often request that researchers photograph certain activities or events in the classroom. A logical follow up to the current study should examine at what age children with autism can assume a more active role with the creation of their visual supports.

Additionally, future research should address parent coaching and conversations with visuals. While two of the three participants responded relatively quickly to this intervention, one did not. Compared with Emily and Laura, the conversations between Sam and his mother were consistently shorter, with less parent questions and elaborations as compared to other participants. It is possible that parent coaching around asking more questions, elaborating on what her son was saying, addressing other things occurring in the photograph, etc., would have resulted in a shorter acquisition phase for Sam. Additional coaching with parents of children who

are less responsive to this intervention, including specific training on question asking and elaborations, may be useful for some families. Future research should address this topic. Furthermore, longitudinal research might examine the overall memory outcomes of children whose families participated in this intervention, to determine if visuals have any impact on memory complexity longitudinally. While typically developing children who have opportunities to participate in meaningful conversations with parents about shared events demonstrate increased complexity (Larinka & Baurer, 2014), this has not been studied in children with autism. It is possible this intervention provides a support for those conversations, leading to possible long-term outcomes.

Finally, given the high social validity from teachers, future research should address how educators can use mobile technologies to share individualized child information with families. All families participating in this study expressed wanting more information about their child's activities at school. While all parents received weekly or bi-weekly newsletters regarding the classroom events, all expressed a lack of information about activities or occurrences specific to their child. Given the ease of taking a quick photo using a smart phone or tablet, and the recommendation of a high degree of parent involvement in any early childhood program (Division for Early Childhood, 2014) or comprehensive treatment model for young children with autism (Dawson & Osterling, 1996), it is likely that mobile technologies may provide teachers with a simple, sustainable way of communicating and sharing more detailed, child-specific information with families.

Conclusions

There is still a great deal to learn about young children with autism and the development of memory. It is possible that mobile technologies can provide a sustainable way to support

memory development through visual supports, and that these visuals can serve as retrieval cues. The results of this study demonstrate the many factors that contribute to memory and accurate recall, including parental conversation style, child challenging behaviors, and the use of modifications.

Results from this study demonstrate that mobile technologies can be used to create visuals that are easily shared with families to support children in learning to accurately recall events from their day. These visuals seem to provide families with contextual information and knowledge, which promote more back and forth conversation and increase child responsiveness for all participants. Furthermore, these visuals provide adults with a tool for a more productive conversation – when visuals were used, adults and children used more varied language compared with phases when visuals were not used. This is especially promising, considering the compelling research on improved longitudinal outcomes for young children exposed to language rich environments (Hart & Risley, 1995).

Furthermore, this appears to be a sustainable intervention with high social validity among potential consumers, including early childhood special education teachers, parents of young children with autism, and children with autism themselves. While mobile technologies have been used for a range of educational purposes, results of this study suggest these new technologies can also be used to create visuals that support accurate recall and promote more meaningful parent-child interactions. For children with autism, these visuals lead to increased communication, responsiveness, and accuracy, and seemed to be a support children enjoyed using and requested when unavailable. Results of this study suggest that this intervention has utility for numerous stakeholders, including parents, teachers, and children.

Appendix A: Consent Form

**UNIVERSITY OF WASHINGTON
CONSENT FORM****Using Visual Supports and Mobile Technologies to Teach Accurate Recall to Young
Children with Autism**

Researchers: Ariane Gauvreau
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Faculty Advisor: Dr. Ilene Schwartz,
Ilene@uw.edu
(206) 543-4011

Researchers' statement

We are asking you to be in a research study. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not. Please read the form carefully. You may ask questions about the purpose of the research, what we would ask you to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions, you can decide if you want to be in the study or not. This process is called “informed consent.” We will give you a copy of this form for your records.

PURPOSE OF THE STUDY

The purpose of this study is to understand how mobile technology-created visual supports can be used to teach young children with autism to accurately recall events. Photographs will be taken of children during the preschool day, and used as a visual support when asking them to recall events from their day afternoon. These photos will also be sent to families, via text or email, to determine if they are useful in supporting children in retelling events from their school day at home.

STUDY PROCEDURES

If you choose to be in this study, I would like to interview about your experience with this intervention a total of two times – once before the study begins, and again after it is completed.

For example, I will ask you “What was it like receiving photos of your child at school?” and “Did these photos seem to change the conversations you had with your child in any way?” These interviews should take between 15-20 minutes.

Within two weeks of any interview, I will create a written transcript on our conversation that will identify you by pseudonym only. Then I will destroy the original recording, saving only the coded transcription. Only I will have access to the transcript, which will be saved on a password-protected computer. Throughout all interviews, you may choose not to answer any question. If you would like a copy of any interview transcript, I will gladly provide you with one.

All child data will be stored on a password-protected computer, in a locked office. Only the researcher will have access to this data. All data will be destroyed three years after the study.

RISKS, STRESS, OR DISCOMFORT

Some people feel that providing information for research is an invasion of privacy. Some people feel self-conscious when notes are taken during observations, or when interviews are recorded. I have addressed concerns for your privacy below.

BENEFITS OF THE STUDY

You and your child may benefit from participating in this study. One possible benefit would be your child learning to accurately recall events from his or her day at school, and share these with you more independently. Another benefit is that families report enjoying receiving photos of their child at school. One final benefit is that these photos may support the conversations you have with your child about their day at school.

OTHER INFORMATION

You may refuse to participate and you are free to withdraw from this study at any time without penalty or loss of benefits to which you are otherwise entitled. If the results of this study are published or presented, I will not use your name or any other identifying information. I may use this data as a foundation for my doctoral dissertation.

If you have any questions about this research study, please contact Ariane Gauvreau at the telephone number or email on the top of this form.

Printed name of researcher

Signature

Date

Subject's statement

This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions later about the research, I can ask one of the researchers listed above.

PARTICIPANTS STATEMENT

This study has been explained to me. I volunteer to take part in this research. If I have questions later on about the search, I can ask the researcher listed above.

I give my permission for this researcher to audiotape my interview

I do NOT give my permission for this researcher to audiotape my interview

I give my permission for the researcher to re-contact me to clarify information

I do NOT give permission for the researcher to re-contact me to clarify information.

Printed name of subject

Signature of subject

Date

Copies to: Ariane Gauvreau
Subject

Appendix B: Qualitative Interview Protocols

Qualitative Interview Protocol: Before Intervention

1. **Can you tell me a little about what [your child] currently tells you about his day at school? Do you hear about peers? Specific activities? Are there some things he tends to talk about more than others? What sort of things?**
2. **Can you talk about a specific instance when your child was able to share something about what he/she did at school that day?**
3. **When do you usually talk to your child about their day at school?**
4. **What do you usually hear from your child's teacher about his day at school?**
5. **How often do you hear reports from the classroom team? Weekly? Daily?**
6. **When it comes to your child's day at school, what would you like to know more about or what do you wish you heard about regularly? Their friends? Favorite activities? Eating? Conflicts with other kids?**
7. **Does your child seem to be able to remember events that have occurred recently, such as what you did yesterday or what happened earlier in the day? Can he/she recall these would help or prompting?**
8. **Can you talk about a time when he/she was able to remember something when you asked them to, such as "Can you remember what we did yesterday?"**

Appendix C: Survey

Recall Study Survey

Thank you so much for allowing us to complete this study in your classroom! We are so grateful for your support and participation with this intervention, and would love to learn more about your opinions of this study. Please fill out this survey – it should take about five minutes to complete.

Please feel free to contact me at Ariane@uw.edu if I can provide any assistance or answer any questions.

1. To what extent does this intervention (using photographs taken through mobile technologies, like iPads and smart phones, and used to support children in retelling events from their day) seem effective for the children in your classroom? Please check one box.

- Very effective
 - Somewhat effective
 - Neutral – not sure either way
 - Fairly ineffective
 - Very ineffective
 - Other
-
-

2. Does this intervention seem like something you could use in your own classroom? Please check one box.

- Yes
 - No
 - I'm not sure.
 - Other
-
-

3. Do you think the families of children in your classroom would benefit from this intervention?

- Yes
 - No
 - I'm not sure.
 - Other
-
-

4. Have you used this intervention with other children, not participating in this study?

Yes

No

If you answered yes to #4, please share how you decided to start this intervention with other children and how families have responded

5. Please use the space below to share your thoughts on this study and intervention below.

Thank you for your time! We could not have completed this study without you!

Appendix D: Accurate Recall Study Data Collection Protocol

Photographs

Photos should be taken during activities where participants are fully engaged, participating appropriately (no challenging behaviors, self stimulatory behaviors, etc.), and during events that would likely *be interesting and salient to the child*.

Examples of Effective Photos

- A child building a tall tower in the block area
- A child eating a cupcake during a classroom birthday party
- A child playing on the obstacle course during gym
- A child playing a parachute game outside

Non-examples

- A child listening passively at circle
- A child lining up during a routine classroom transition
- A child disengaged, wandering around the room during free choice.

Photos will be taken using a smart phone or tablet, and then send to the researcher doing data collection.

Example Photos**Baseline Data Collection**

During baseline phases, participants will be pulled out of the classroom and brought to a child-sized table (several tables are already available in the hallways, testing rooms can also be used). *Before pulling children, researchers must ask the classroom teacher if this is an appropriate time.*

Children will be asked to “tell me about your day in school?” or “What did you do in preschool today?” If the child responds, researchers should affirm their comment (“Oh, you had snack”). No photos or visuals will be used. Children should be asked a total of three times. Follow up questions should be “What else happened in preschool?” “Can you tell me one more thing?” or “Can you remember something else?” All data collection sessions will be video taped for transcription later. After the session, children should be allowed to pick a sticker or a stamp, and escorted back to their classroom. Researchers should check in with the teaching team to ensure teachers are aware the child has re-entered the group.

Intervention Data Collection

During intervention phases, researchers will follow the same protocol for escorting children out of the classroom. However, during these phases, children will immediately be shown the photos from preschool when asked about their day.

For example, a researcher will escort a child to a small table, ask them about their day in preschool (“What did you do in preschool today?”) and immediately, using a 0-second time delay procedure, show the child one photo. Researchers should follow up with comments on whatever the child says. For example, if the child says, “I was playing basketball!” a researcher might say, “That’s right! You made a basket! You threw the ball in the hoop!” This protocol will be repeated three times, with each photo. If a child does not respond when asked, researchers should make a comment about the photo (e.g. “It looks like you are eating a blue cupcake!” or “I see you driving a big, yellow truck in the block area!”).

Given that the research that emphasizes conversations and question asking being linked with children developing more sophisticated and accurate memory, part of the intervention is having a conversation with children about their day in preschool. Asking children questions (e.g. “Which friend are you playing with?” “What do you have in your hand?”) related the photo is an effective way to support accurate memory and should be incorporated into these interactions.

When sending photos to the researcher doing intervention, please include some anecdotal data about what is occurring in the photo. A comment such as “*Joey was playing with trucks in blocks. He and Jeff built a road and a big bridge, and Joey thought the cars crashing was really funny!*” help the intervention data collector provide prompting, if necessary. These comments are also very useful for families when we send these visuals to them for use at home.

All these interactions should be recorded and transcribed within 48 hours, and saved to the shared DropBox so they can be analyzed.

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