

## Claremont Colleges Scholarship @ Claremont

---

CMC Senior Theses

CMC Student Scholarship

---

2017

# The Effects of a Text Message Intervention on Conversational Speech between Dyads of Children with Autism Spectrum Disorder

Julia Blanco

*Claremont McKenna College*

---

### Recommended Citation

Blanco, Julia, "The Effects of a Text Message Intervention on Conversational Speech between Dyads of Children with Autism Spectrum Disorder" (2017). *CMC Senior Theses*. 1574.  
[http://scholarship.claremont.edu/cmc\\_theses/1574](http://scholarship.claremont.edu/cmc_theses/1574)

This Open Access Senior Thesis is brought to you by Scholarship@Claremont. It has been accepted for inclusion in this collection by an authorized administrator. For more information, please contact [scholarship@cuc.claremont.edu](mailto:scholarship@cuc.claremont.edu).

Running head: TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Claremont McKenna College

The Effects of a Text Message Intervention on Conversational Speech  
between Dyads of Children with Autism Spectrum Disorder

submitted to  
Professor Marjorie Charlop

by  
Julia Allison Blanco

for  
Senior Thesis in Psychology  
2016-2017  
April 24, 2017

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

### Abstract

Children diagnosed with autism spectrum disorder (ASD) per DSM-5 criteria are characteristically limited in their ability to interact socially due to conversational speech delays. Typically, children with ASD experience a more constrained number of appropriate initiations and responses in conversations with peers. Previous research has shown the benefits of using scripted language to increase verbalizations in these children. However, limited research has been conducted on the use of technology to increase social interactions between children with ASD. This study will be based on hypotheses and results from the dissertation, “Teaching Conversational Speech to Children with Autism Using a Text Message Intervention” by Denise Grosberg. Grosberg evaluated the performance of a text message intervention (TMI) procedure using scripted language to teach conversational speech with typically developing peers. The present study used a multiple baseline design across dyads to again assess the efficacy of a text message intervention between dyads of children with ASD, including younger and lower-functioning participants. Results demonstrated an increase in appropriate conversational speech through the TMI and an increase in unscripted language following the intervention. Seven of the participants generalized the behavior across peers and settings as well as after a two-week follow-up period. Data are discussed in terms of the percentage of appropriate phrases used, as a function of appropriate phrases, inappropriate phrases, and the number of times a participant did not respond.

*Keywords:* text message intervention, autism spectrum disorder, appropriate communication

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

## Acknowledgements

The last three years at the Claremont Autism Center have been one of the most enjoyable experiences during my time at Claremont McKenna College, bringing me extraordinary memories, laughter, and learning experiences. I have had the pleasure of spending every Tuesday and Thursday with Dr. Marjorie Charlop, incredible graduate students, and the most inspiring children and parents.

I wish to express my sincere thanks to Dr. Marjorie Charlop for her guidance and encouragement over the years and throughout this process. Thank you for giving me confidence researching, writing, and interviewing for jobs. This has been one crazy year, and I cannot thank you enough for giving me the self-assurance I needed.

I am grateful to the Claremont Graduate University students for always being incredible role models. Thank you all so much for supporting me as a researcher, as a student, and as a friend. Vicki Spector, who read every draft of my thesis, you are a rock star of a human being.

I could not have done this research without the help of all the students who spend time at the Claremont Autism Center. I am so grateful I was able to execute my study with the assistance, advice, and motivation of some of my best friends.

The children and families at the Claremont Autism Center have taught me so much during my time at CMC. I am amazed and inspired by their love. I cannot express in words how much my time with them has meant to me.

Lastly, I want to thank my parents, who are the best cheerleaders, editors, and friends a daughter could ever ask for. I could not be happier to have attended your alma mater; it has offered me extraordinary and unique opportunities that I never would have imagined four years ago. Thank you for always encouraging me to pave my own way through CMC and encouraging me to pursue my passions.

## Table of Contents

<b>Chapter</b>	<b>Page</b>
Abstract.....	i
Acknowledgements.....	ii
Introduction.....	1
Method.....	10
Results.....	26
Discussion.....	50
References.....	60
Appendix A. Pre-teaching Reading Assessment .....	66
Appendix B. MLU Scoring Guide .....	67
Appendix C. Coding Definitions .....	68
Appendix D. Data Collection.....	69

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

### The Effects of a Text Message Intervention on Conversational Speech between Dyads of Children with Autism Spectrum Disorder

#### **Introduction**

Autism spectrum disorder (ASD) is a developmental disorder with pronounced deficits in social skills, language, communication, and cognitive abilities (American Psychiatric Association [APA], 2013). While there is no single behavior that defines ASD, it is often associated with conversational speech delay and difficulties with communication (Volkmar, Klin, & Cohen, 2005). In fact, half of the population of children with ASD do not develop communicative language at all, and often may grunt, point, or use other unique mannerisms to communicate (Grosberg & Charlop, *in press*). Even though research has demonstrated the ability for many children to acquire speech and improve spoken language with appropriate therapy, many of these children will not engage in conversation without verbal cues or prompting (Charlop, Schreibman, & Thibodeau, 1985). While children with ASD may respond to questions or prompts from adults, they demonstrate deficits in spontaneously initiating or responding to bids for joint attention without immediate positive reinforcement (Krantz & McClannahan, 1998; Charman, 2003). The Diagnostic and Statistical Manual of Mental Disorders (5<sup>th</sup> ed.; DSM-5; APA, 2013) indicates that some children with ASD may have difficulty participating in normal back-and-forth conversations while others will not reciprocate interests, emotions, or affect. For children with more extensive conversational abilities, language is often marked with unusual impairments such as echolalia, pronoun reversal, idiosyncratic language, stereotyped speech, and other additional problems with social language (McPartland & Volkmar, 2012; APA, 2013). Furthermore, individuals with ASD who do exhibit expressive language will

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

have deficits in flexibility in conversation. When engaged in preferred topics of conversation, they may be unwilling to change topics if it is not of specific interest. Others may additionally struggle to use speech for reasons other than rejecting or accepting requests or proposals from conversational partners attempting to engage the child (Ganz, Boles, Goodwyn, & Flores, 2013).

These deficits in communication can lead to fewer opportunities to participate socially. This paucity of interaction can exacerbate the risk of problem behaviors, social withdrawal, and aloofness that can be associated with ASD (Lang, Regeher, Rispoli, Pimentel & Camargo, 2010; Charlop-Christy & Kelso, 2003); therefore, children with ASD may frequently be marginalized in social groups and fail to maintain peer relationships. Additionally, these deficits can significantly interfere with academics and the provision of educational programs (Volkmar, Klin, & Cohen, 2005). Even high-functioning children with ASD may have difficulty understanding social norms, recognizing what the listener may be wanting or thinking, and predicting the pattern of conversation (Grosberg & Charlop, *in press*). These observations highlight the necessity for interventions to encourage social communication and conversational skills (Macpherson, Charlop, & Miltenberger, 2014).

The goals of such interventions include increasing the frequency of spontaneous conversation, variation in language, and appropriate social communication (Groskreutz, Peters, Groskreutz, & Higbee, 2015). A successful approach for teaching these behavioral skills has been the use of conversational scripts, which provide a strategic model for appropriate language which are flexible and can be adapted to specific social situations (Krantz & McClannahan, 1993; Grosberg & Charlop, *in press*). When using a script,

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

children read or listen to the script and recite the generated language aloud in contextually appropriate situations to a conversational partner (Ledbetter-Cho, Lang, Davenport, Moore, & Lee, 2015).

Scripts can be efficaciously adapted to fit a child's preferred learning style, and have been successfully introduced in the form of written scripts/cue cards (Charlop-Christy & Kelso, 2003), audio recordings (Garcia-Albea, Reeve, Brothers, & Reeve, 2014), and video-modeling (Charlop & Milstein, 1989). It has been shown that children who have experienced severe difficulty with oral prompts are considerably better able to respond to pictorial or written stimuli that are presented to the child (MacDuff, Krantz, & McClannahan, 1993). These studies have demonstrated that scripts can increase the number of sheer verbalizations and generalize language to new stimuli and conversational partners, as well as across different settings. Further, researchers have proven scripts to be beneficial in developing appropriate initiations and responses in conversation with adults (e.g., Krantz & McClannahan, 1993; Sarokoff, Taylor, & Poulson, 2001; Wichnick, Vener, Pyrtek, & Poulson, 2010).

Integrating scripts into an intervention may be valuable because they introduce new, relevant language and reduce the need for intrusive prompts. For example, Charlop-Christy and Kelso (2003) increased the conversational language of three boys with ASD using a written script/cue card program after all participants failed to acquire new conversational speech using traditional prompting and reinforcement during baseline. The conversational scripts were composed of seven lines including a statement and a question relating to more abstract topics typical of verbal conversations between peers. The use of cue cards extended research on written script programs because it was used for longer



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

duration conversations, unlike the original study by Krantz and McClannahan (1993). Additionally, unlike video or audio recordings, visual cue cards can be easily and quickly modified to suit the individual preferences of the child.

In order to avoid prompt dependency when using scripts, the implementation of a script-fading procedure, a process of systematically removing the last word of a script, has further augmented script-utilizing research (e.g., Reagon & Higbee, 2009; Wichnick et al., 2010; Pollard, Betz, & Higbee, 2012). A script-fading procedure reduces the need for an adult to provide continuous prompting; thereby maximizing the external validity of the study. In other words, by reducing the involvement of adults and confederates in social exchanges, conversations have the potential to form more authentically (Krantz & McClannahan, 1993). There is considerable research on the beneficial use of scripts and script-fading for older children (ages 9-12), which demonstrates a reliable increase in novel verbalizations; however, many of these studies focus on initiations rather than responses and involve conversation with adults only. Wicknick et al., (2010) developed a study that focused on responding to initiations from other children using pre-recorded scripts for children ages 5-7. The participants followed a written activity schedule that took them to a “share toys with friends” station with 10 Ziploc bags filled with toys, the name of a peer to share the toy with, and a voice-over-recording device. The voice-over-recording device would emit a pre-recorded script that would model an appropriate response directed to a prompted initiation from the peer. The scripts were then systematically faded by removing one word at a time from the recording. This study demonstrated that children could respond to initiations when prompted with the pre-recorded scripts. Further, researchers also saw an increase in unscripted, novel responses when the pre-recorded prompts were faded.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

However, this study did not assess generalization, encourage the behavior in a more subtle, natural environment, nor was there a clear demonstration that the behavior was maintained after prompts were faded.

More recent studies have shifted the focus to include scripts and script-fading procedures in more externally valid settings. In one study, Reagon and Higbee (2009) trained mothers of children with ASD to improve vocal initiations at home and in play sessions. Further, Sarokoff, Taylor, and Poulson (2001) embedded contextually appropriate phrases in scripts and on food packaging to increase the number of unscripted initiations to peers. During the intervention phase, scripts with embedded text were presented to participants who engaged with the stimuli when the script indicated to do so. For example, the script may say, “Let’s eat our snacks,” followed by a consumption of the provided snack items. A script fading procedure was implemented for the scripts with a 25% removal rate. For generalization, new snacks, different from the original stimuli, were given to participants with embedded text that they could read without a script. The intervention effectively increased conversational statements about the stimuli even when the script was removed.

In spite of this research, only a few studies have investigated whether the behavior is generalizable to untrained stimuli *and* in an environment in which children and adolescents are likely to spend more time. Brown, McClannahan, and Poulson (2008) created a “mock store” classroom using a script-fading procedure in order to enhance conversation skills during community shopping trips. Three participants were trained and prompted to read scripts attached to specific stimuli that may be found in three mock-store settings: a convenience store, a sporting goods store, and a video store. The scripts were

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

strategically placed on different items during each session, the number of items with scripts was reduced, and the scripts were faded progressively through each session until removed. Prior to the mock-store intervention and after responses to the stimuli were stable in the mock-store intervention, community sessions were conducted with a conversation partner instructed to answer with a conversationally appropriate response in each scenario. Prior to the intervention, none of the three boys verbally interacted with their conversation partner while in the natural environment. Results showed that after introducing the integrated script-fading on the stimuli, all three boys demonstrated an increase in the number of unscripted interactions. Post-intervention, the participants also demonstrated an increase in conversational interactions during the community sessions. Such research demonstrates that scripts can be well-adapted for use outside of a clinical setting and successfully modified for use with both adults and children.

Improving access to technology continues to augment the utility of scripts, which can now be adjusted for use on an electronic device, serving as a more convenient and socially acceptable option outside of a clinical setting (Ramdoss, Machalicek, Rispoli, Land, & O'Reilly, 2012; Raulston, Lang, Tostanoski, Lee, & Machalicek, 2013). Shane and Albert (2008) analyzed survey data from 89 families of children with ASD and found that the favorite leisure activity for children with ASD was time spent engaging with media at the exclusion of other play activities. Results additionally indicated that the observed children were able to “tune out” distracting environmental factors while focused on the media and that nearly half the children were more focused on written language than on a television program. In addition, Clark, Austin, and Craike (2015) found evidence that 52% of children under the age of 8 years old had access to a smartphone or iPad/tablet with an

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

average use of 43 minutes per day. For this reason, a number of studies have implemented technology-based interventions to investigate how technological applications can be adapted for socially acceptable learning while still appealing to the interest of the children with ASD.

Video modeling has been introduced as a popular style of intervention, taking advantage of the amount of fascination and attention with which children with ASD tend to watch television and movies. Using video modeling via a portable electronic device has taught vocational and daily living skills to students with ASD (Bereznak, Ayres, Mechling, & Alexander, 2012). This demonstrates the adaptable ability of video modeling to be used for training behaviors in a natural environment. Portable modeling methods are an innovative way of teaching core behaviors in potentially chaotic settings. Macpherson, Charlop, and Miltenberger (2014) used an iPad to increase compliment behaviors of five children with ASD during athletic group play. While playing kickball, participants were shown a 30-second video that modeled compliment behaviors for the children to imitate during the game. Sessions continued until each child had at least five opportunities to demonstrate the compliment behavior. The data concluded that video modeling increased verbal compliments of the children with ASD, that the participants often gave more than one compliment per opportunity, and that the majority of the children demonstrated response variation when complimenting their peer. By modeling the behavior rather than prompting the child, the children demonstrated an increase of compliment behaviors within only a few sessions.

In a meta-analysis assessing technology-based preferences and existing interventions for children with ASD, Grynszpan, Weiss, Perez-Diaz, and Gal (2014)

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

concluded that more effort should be focused on expanding technology-based applications so that they are easily accessible to both parents and educators. Portable electronic devices, like iPads or other tablet devices, are useful because they can be easily adapted for different ability levels. A recent study focusing on nonverbal children with ASD implemented the use of a speech-generating iPad application, *SonoFlex*, in order to increase the number of times a child initiated requests, responded to questions, and made social comments through the iPad (Xin & Leonard, 2015). This research demonstrated the application as a viable technological aid for nonverbal students to increase expressive communication, enabling them to interact with peers in numerous settings. A number of additional applications have been developed for children with ASD that target other skills, though few with significant real-world impact. For example, one application, *FindMe*, was used in a randomized-controlled experiment that allowed children the opportunity to rehearse social communication skills through a gaming format (Fletcher-Watson, Petrou, Scott-Barrett, Dicks, Graham, & O'Hare, 2015). However, without working with a therapist or parent outside of the application, no significant differences were found between the control and experimental groups, even though it was originally hypothesized that the application's focus on joint attention and social cues would "trigger a cascade skill development." This study cautions reliance on using technological applications to generalize learned behaviors to real-world communication.

Visual scripts that have been successfully implemented on a mobile device have additionally improved the research on technology. As the first study to implement a tablet computer as a medium for visual scripts, Ganz et al. (2013), demonstrated an increased use of verbs or nouns with an *iCommunicate* application on iPads. The participants watched a

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

short video clip and were prompted to respond with what was happening using the iPad application. Not only did the participants demonstrate an increased usage of verbs and nouns, but they also required less prompting from adults. Though this research demonstrates relevant findings, it was limited to specific words within the response, not back-and-forth conversational language. Additionally, this study did not find conclusive results for spontaneous speech or initiations and was notably monotonous for participants as accounted by a child involved in the research. To date, there has been only one study that focuses on engaging children with ASD in fluid conversational language using portable technology, and there have been no studies that implement this kind of intervention between two children with ASD.

Grosberg and Charlop (*in press*) in *Teaching Conversational Speech to Children with Autism Spectrum Disorder Using Text-Message Prompting* implemented a text message intervention using smartphones to increase the number of social initiations and responses in children with ASD. A multiple baseline design across six children assessed the efficacy of a text message intervention to teach conversational speech with typically developing peers. The participants were trained in their homes on how to retrieve and read messages on an iPhone. They were then texted contextually and socially appropriate phrases by a therapist when in conversation with an adult conversational partner. The training continued until the participant could say eight phrases within a period of two consecutive sessions involving the text message prompting. Participants were then placed in conversation with a peer or sibling and conversational speech was assessed, without a smartphone present or any text message prompting. If necessary, a script-fading procedure was implemented with the adult conversational partner. Results indicated that all

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

participants met criteria for conversational speech and that this behavior generalized across peers and settings.

The present study will replicate and extend the findings from Grosberg's and Charlop's study (*in press*). The current study was designed to evaluate: (1) the efficacy of implementing a text message intervention to teach conversational speech; (2) the conversational speech during play with another child with ASD; (3) evidence of generalization of conversational speech across untrained settings with other peers with ASD; and (4) evidence of generalization of conversational speech across typically developing peers.

### **Method**

#### **Participants**

The participants in this study were eight children between the ages of five and 12 who attended an afterschool social skills program. All the children were diagnosed with ASD by a licensed professional and an unaffiliated independent agency according to the *DSM 5 (APA, 2013)*. In order to participate in the study, generalized verbal imitation and verbal exchanges of three or more words in length were required (for purposes of engaging in a conversation). Additionally, children were required to read and understand simple sentences as presented on a smartphone. Specifically, children needed to be able to read, understand, and articulate phrases of at least three words in length. A child was not eligible for this study if he or she presented any symptoms that would interfere with his or her ability to effectively participate in the study (e.g., engaged in self-injurious behavior or exhibited an excessive amount of self-stimulatory behavior).

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Table 1

## Characteristics of Each Child/Dyad

Child	Ethnicity	Age Year/ Month	Expressive Vocabulary Test Age-Equivalent	Peabody Picture Vocabulary Test Age-Equivalent	Mean Length Utterance (MLU)	Peer
<b>Alton</b>	Pakistani American	12-8	9-5	8-0	6	Jane
<b>Jane</b>	Hispanic African	11-4	12-5	9-10	7	Alton
<b>Martin</b>	American/ Hispanic	5-9	6-0	5-7	5	Daisy
<b>Daisy</b>	Hispanic	7-0	6-11	5-7	4	Martin
<b>Adrian</b>	Korean American	11-0	8-5	7-11	5	Allen**
<b>Bradley</b>	Caucasian	8-2	9-4	8-5	5	Maven
<b>Maven</b>	Caucasian	10-10	15-11	12-7	6	Bradley
<b>Brixton</b>	Korean American	10-5	6-3	6-5	3	Michael**

\*\*Indicates that the peer was typically developing

Alton was a 12-year-old boy with an expressive language equivalent of 9 years, 5 months and a receptive language equivalent of 8 years as measured by the Expressive Vocabulary Test, Second Edition (EVT-2) and the Peabody Picture Vocabulary Test IV (PPVT-4), respectively. He was able to read all ten of the lines of the administered reading test. Alton could initiate conversation when prompted, but often chose not to unless the conversation was of particular interest to him. When responding to abstract questions, Alton would often get flustered and say he did not know or did not remember if put under pressure. Additionally, if the topic was not of interest, he would typically trail off and respond “yeah mhm” or mumble to himself. In the social skills program that he attended



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

for two hours per week, Alton would willingly participate in all activities, but did not often engage with the other children unless specifically prompted.

Jane was an 11-year-old girl with an expressive language equivalent of 12 years, 5 months as measured by the EVT-2 and a receptive language equivalent of 9 years, 10 months as measured by the PPVT-4. She was eligible for the study because she was able to read every line of the administered reading pre-test. Jane easily and frequently initiated conversation but demonstrated a strong preference for wanting to stay on topics that were of particular interest to her, and was inflexible when it came to switching conversational topics. For example, she loved technology, especially YouTube. She loved to talk about her favorite YouTube stars but would become frustrated when conversational partners were not familiar with the same interests. She could additionally respond well in complete sentences but would be tangential with her responses.

Daisy was a 7-year-old girl with an expressive language equivalent of 6 years, 11 months and a receptive language equivalent of 5 years, 7 months as measured by the EVT-2 and PPVT-4. She was able to read up through line 5 (out of ten lines) on her reading pre-test and was able to sound out words she did not know from sight. Daisy did not initiate conversations with peers and primarily only played with her brother during the social skills session she attended for two hours per week. She had trouble responding to basic questions and would often stutter.

Martin was a 5-year-old boy with an expressive language equivalent of 6 years as measured by the EVT-2 and a receptive language equivalent of 5 years, 7 months as measured by the PPVT-4. He was able to read through line 6 of the reading assessment and had quick recall for words he had just learned to read. Martin did not consistently

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

initiate conversations, and when he did initiate conversations, they were often prompted by his therapists. Martin often repeated phrases that were directed at him and would address himself in the third person.

Adrian was an 11-year-old boy with an expressive language equivalent of 8 years, 5 months as measured by the EVT-2 and a receptive language equivalent of 7 years, 11 months as measured by the PPVT-4. He was also able to read all ten lines on the administered reading pre-test on an iPhone. Adrian could initiate conversation, but would often use it to gain attention rather than sustain engagement with a peer. He would often ignore questions if they were not interesting to him and often made inappropriate noises or mumbled to himself. He could respond to simple social questions, but did not have age-appropriate speech.

Bradley was an 8-year-old boy with an expressive language equivalent of 9 years, 4 months as tested by the EVT-2 and a receptive language equivalent of 8 years, 5 months as tested by the PPVT-4. He was able to read all of the lines of the reading test. He was a very energetic boy who had a moderate amount of conversational speech but often would not use it unless prompted. He would often make loud noises in the place of responding or initiating conversation. He was also inflexible in conversation and would return to the same topic or repeat the same sentence.

Maven was a 10-years-old boy at the time of the study and had an expressive language equivalent of 15 years, 11 months as measured by the EVT-2 and a receptive language equivalent of 12 years, 7 months as tested by the PPVT-4. Maven was energetic with a high vocabulary and aptitude for speech but demonstrated marked delays demonstrating appropriate conversational language. He would engage with peers most

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

when playing outdoors but was more subdued and isolated during indoor activities. During conversation, Maven would often change the topic erratically and would not respond unless he was interested in the topic of discussion. He would oftentimes become inflexible when engaged in conversation and would become fixated on playing with or talking about one thing.

Brixton was a 10-year-old boy with an expressive language equivalent of 6 years, 3 months as tested by the EVT-2 and a receptive language equivalent of 6 years, 5 months as tested by the PPVT-4. Brixton was a quiet, subdued boy who often kept to himself. Brixton did not participate in conversation without prompting and his spontaneous speech was limited to expressing certain needs (such as going to the bathroom or wanting to see his mother). He would often prefer to read material during the social skills program rather than converse with his peers. Given his language delays (and other deficits), Brixton was considered a low-functioning child with ASD, and thus, his treatment and results are interpreted separately from the other 7 children in the study.

Five typically developing peers (ages 4-13) were also selected for participation in the study. Two of the typically developing peers (both 9 years old) were selected as partners during the entirety of the study. They passed the same general reading and language ability tests as the children with ASD. Adrian and Brixton both had typically developing peer partners who were at a similar age, demonstrated appropriate behavior during prior social skills sessions, and engaged in appropriate conversational language. Both children were familiar with their typically developing peers prior to this study. Three additional typically developing peers were selected to participate during only baseline and assessment peer probes of the study. They were not required to take a reading test because

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

they were only required to have a conversation with their peer, not participate in the intervention. All of the typically developing peers were paired with the children with whom they were most familiar with prior to the study. The experimenter recruited the typically developing peers by speaking with the parents of children who attended the university-based intervention program. The experimenter obtained signed consent forms from all participants prior to inclusion in the study.

### **Assessment of Child Reading and Verbal Behavior Skills**

**Pre-teaching Reading Assessment.** Participants were evaluated for participation prior to collecting baseline data with a pre-teaching reading assessment. Participants were assessed on their ability to read a selection of play-related questions on a smartphone device. The experimenter presented a sentence on a phone and prompted the child to read the presented words aloud. Verbal praise (ex. “Good job reading!”) reinforced the behavior if the child read or attempted to read the sentence on the screen. If a child was unable to read the initial message, the experimenter modeled the sentence and asked the child to try again. Subsequent sentences increased in difficulty and length as the child successfully read each line. In order to be eligible, the child needed to be able to read a simple sentence of at least three words. Appendix A shows a sample of the questions presented on the smartphone during the reading assessment. This pre-teaching assessment was necessary in order to gauge whether a child could be prompted to successfully read from an electronic device.

**Verbal Behavior Observations.** Prior to baseline collections, the experimenter assessed the mean length utterance (MLU), which ensured that the scripted text message conversation would be comprised of sentences similar in length to what the child typically

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

uses. The MLU (Leonard, Miller, & Brown, 1984) was calculated by counting the total number of morphemes (the smallest recognized unit of grammar or syntax) and dividing it by the total number of utterances made in two, five-minute periods of time. Appendix B provides a description of how observers calculated the MLU for purposes of the study.

### **Materials**

The participants' parents provided a cellular phone with texting capability. If parents were unable to provide a smartphone, then one was provided for them. A video camera was used to record the five-minute sessions. The toys and games that were provided were familiar to the children, and the children were not provided with any instructions on how to play with the toys.

### **Settings**

All assessments and baseline, training, and intervention sessions took place in a clinic that the participants attended on a weekly basis. A lounge that simulated a living room (with two chairs and a couch) was configured as a play environment with a large variety of toys and games intended for all ages placed in plastic containers. Generalization probes were conducted in a room adjacent to the clinic.

### **Procedure**

A multiple baseline design across subjects was used to assess the efficacy of the intervention. The independent variable was the text messaging intervention (i.e., the prompts presented via text message) and the dependent variable was the frequency and novelty of conversational speech. Children who attended a behavioral therapy program to increase social skills were involved as participants with permission from their parents/

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

guardians, who had been informed that the study involved research on the effects of text message prompting.

Prior to inclusion in the study, children were evaluated through a pre-teaching reading assessment to ensure all participants were capable of reading on a smartphone. The experimenter also observed the verbal behaviors of each child in order to collect an MLU score that was used to create a script that was appropriate to the skill level of the child. In this study, participants were separated into dyads that remained consistent during baseline, treatment, and assessment phases of the study. A therapist to aid in prompting was assigned to each child in the study, and these pairings remained consistent throughout the duration of the experiment.

**Baseline.** In this experiment, six of the children were partnered with other children with ASD, and two of the children had typically developing conversational peers. The length of the baseline phase was different for each dyad. For example, the first dyad participated in three, five-minute sessions during baseline, the second dyad participated in five, five-minute sessions, and the third dyad participated in seven, five-minute sessions. The fourth dyad, Brixton and his peer, was separately included in the study to demonstrate the impact of the intervention on a lower functioning participant; thus, his baseline involved five, five-minute sessions as well. Because the length of baseline differs for each dyad, treatment occurred at different points in time. This ensured that changes are likely to be attributed to the intervention, rather than chance or other threats to internal validity.

During the baseline condition, the children were seated across from each other on the floor in a large lounge area where familiar toys are available. The phone was placed directly next to the child. The experimenter stated “(Child’s name), it’s time to talk to

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

\_\_\_\_\_.” If a child was on a token board system for generally appropriate behavior, the participant’s therapist was allowed to reinforce the tokenized behavior but was instructed not to otherwise interact with the participant. Additionally, if the child began to play with the phone, he or she was instructed to place the phone back next to their side to be used later. No additional instruction, prompts, or feedback involving conversation were given to participants throughout the session. Sessions were recorded for later data analysis. Data was collected through video recording over a series of five-minute periods to record the number of contextually appropriate initiations and responses as a percentage of total opportunities to converse. In all subsequent video recorded sessions, frequency of initiations, contextually appropriate responses, amount of scripted language, and amount of unscripted language were collected as data.

**Text Message Intervention Treatment.** During treatment, participants (and typically developing peers, when applicable) were prompted to access a text message on a smartphone and were instructed how to properly read the script. The steps included hearing an alert from a phone, looking down at the message, and reading the script. During the play session, each dyad was seated approximately two feet away from each other on the floor of a large lounge room with toys and games. The phone was placed in front of the child and a therapist was seated directly behind each child. One therapist began by sending a social initiation question based on the child’s MLU. The therapist verbally and physically prompted the child, if necessary, until the child read the scripted phrase aloud. Once the child read the text message, the other child in the dyad was sent a contextually appropriate response by his/her therapist. Texted phrases were related to real time play and actions of the dyad. If the children initiated a new and appropriate conversation between messages,

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

the therapists would alter the texted prompts to fit the conversation. Five-minute sessions were video-recorded, and each child was given verbal praise for good reading and attention.

**Therapist Fading.** Once a child was able to read four out of five of the phrases via text message without prompting from a therapist, the therapist was instructed to sit a foot from the child during the play session. After the first step of fading the therapist, only two-lines of the script had to be read in a row for the therapist to again move back a foot. If it was clear that a child was reading clearly during a single five-minute play session, a therapist was allowed to move back twice (two feet). As the involvement and physical proximity of the therapist was faded, the phone was additionally moved six inches progressively away from the participant, until the phone was approximately three feet away from the participant's dominant hand. In this situation, the phone was no longer at the child's fingertips but was still easily readable. Unscripted conversation was also recorded but did not count towards meeting the criterion. This fading procedure continued until the therapist was out of sight. This point represented the fulfillment of treatment criteria, and therefore the phone was subsequently removed.

**Assessment.** After the therapist and phone were faded to the point of removal, the efficacy of the text message intervention was assessed. Five-minute testing sessions, following the same procedure as described in baseline, were recorded; however, the phone and therapist were removed from the room. Prior to a recorded session, the experimenter instructed individually to each child, "(Child's name), it's time to talk to \_\_\_\_\_." Data was collected on the frequency of each child's initiations as well as contextually appropriate responses as a percentage of total opportunities to speak. Both children engaged in the conversation were recorded without any other specific instructions,



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

feedback, or prompts. Conversational speech was marked as correct based on each individual child's ability to appropriately initiate or respond to their partner.

In order to meet learning criterion, the percent opportunity calculations from all baseline and treatment sessions were averaged. The child needed to exceed this average with each data point during the assessment phase in order to meet criterion and demonstrate the learned behavior. If either child did not meet criterion during the assessment phase, the smartphone text message intervention was reintroduced in the last step of the therapist fading procedure.. If the child did not meet criterion again during a subsequent assessment phase, the script-fading procedure was introduced until the final step where the phone could be removed and the child would speak independently (i.e., did not use the prompts).

**Brixton's Script-Fading.** For Brixton, the script needed to be introduced and faded twice during the study. Once the therapist had been faded out entirely, script-fading, a gradual process of removing one word from the scripted phrase until the script is no longer necessary, was utilized when mastery criteria was not met. Because Brixton was a lower-functioning participant, the script procedure was introduced immediately following treatment. The script-fading procedure was modeled after McClannahan and Krantz's (2005) guidelines as used by Grosberg and Charlop (*in press*) involving a gradual process of removing one word from the scripted phrase until the script is no longer necessary. However, in order to maintain a more natural-sounding conversation, the same line of a script was not repeated. In other words, because each line of the script varied, a script-fading procedure could have been: "Do you want to play?" then "I like your", then "I want", then "I", before the phone is removed. Once the script had been faded entirely, the phone was removed for assessment sessions. If learning criterion was again not met,

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

the phone and script-fading procedure were reintroduced and the process was repeated. When reintroduced, only levels 4 and 5 of the text message intervention fading were implemented, as shown in Table 2.

Table 2

## Levels of TMI Fading

<i>Fading level</i>	Remaining text content
<i>Level 0</i>	Full sentence on smart phone
<i>Level 1</i>	Last word removed
<i>Level 2</i>	Last two words removed
<i>Level 3</i>	All but first word removed
<i>Level 4</i>	First word removed
<i>Level 5</i>	Smart phone removed

**Generalization Probes.** Probes were conducted to assess generalization across settings and generalization across peers. To assess generalization across settings, research was conducted in a lounge area and a classroom adjacent to the clinic. The standard baseline, treatment, and a post-treatment assessment were conducted in a lounge area, so observations to see if the child generalized learned skills to novel settings were conducted in an unfamiliar room. Both the lounge area and foreign room were set up as play areas with the inclusion of a variety of toys on the floor between the children. For example, dolls, action figures, building blocks, and trains were provided for the children. As in all the other phases, the experimenter said, “(Child’s name), it’s time to talk to \_\_\_\_\_” and the participant’s frequency of appropriate and inappropriate verbalizations were collected over a five-minute period.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

The second type of generalization probe that was conducted involved peers. During baseline and assessment, a typically developing peer was used as a conversational partner in order to assess whether an increase in appropriate conversational phrases was generalizable. The same instructions as stated above were given to both children. The only additional instructions the typically developing peer was given was that he or she should engage with their partner as they normally would and respond with a contextually appropriate question or comment if the child with ASD spoke to them.

**Follow-up.** Follow-up probes were additionally conducted with six of the participants two weeks after the intervention had ended to assess whether the children had maintained their conversational skills. The follow-up sessions were conducted in the same manner as baseline and assessment.

### **Data Collection and Dependent Measures**

**Child Measures.** Data collection procedures (Appendices A-D) were modeled after the procedures described in *Teaching Conversational Speech to Children with Autism Spectrum Disorder Using Text-Message Prompting* (Grosberg & Charlop, *in press*). Data collection was also conducted using the same operational definitions for dependent measures and additional guidelines for scoring a text message intervention conversation. The dependent measure was frequency of conversational speech including social initiations (that begin a conversation) and responses to peers, and were presented as a percentage of total opportunities. The operational definition of initiations involves contextually and socially relevant comments or questions that were not contingent upon a peer's immediate prior utterance (Maione & Miranda, 2006). Responses occur whenever a child replies to the words or actions of the peer. Appropriate responses were

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

operationally defined as questions or comments that are related to or share the same topic of a prior question or comment and are linguistically and socially appropriate. Further definitions of appropriate responses that were used for coding (Grosberg & Charlop, *in press*) are included in Appendix C.

**Data Collection.** Data was scored by watching video recordings of all the sessions and by using a data collection instrument (Appendix D) to score all social verbalizations made by both children (Grosberg & Charlop, *in press*). The instrument recorded when an initiation or response occurred and whether or not it was appropriate, as well as a transcription of what the child said. Appropriate initiations were distinguished if it is an introduction, a request, a compliment, or an attempt to gain the attention of the peer as ancillary data. In order to gain a percent opportunity score, a lack of conversation was also tallied on the data collection instrument. If a child did not respond to the previous question or comment of his/her partner, a tally would be recorded. Additionally, if 20 seconds of silence passed without a child initiating conversation, the data would be recorded as a lack of conversation under the no response tally. Percent opportunity was calculated by summing the total appropriate initiations and responses and dividing that number by the total number of opportunities. The total number of opportunities to speak included using appropriate phrases, inappropriate phrases, and the number of no response tallies.

Scripted and unscripted conversational speech were also measured. Scripted conversational speech included responses identical to the text messages excluding conjunctions, articles, prepositions, pronouns, or verb tense. Unscripted conversational speech included any verbalizations that were two or more words different from the scripted

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

statements or entirely independent of the text message prompts (Grosberg & Charlop, *in press*).

**Inter-observer Agreement.** All sessions, including baseline, treatment, assessment, and generalization phases were filmed and scored by the primary experimenter. An individual unaware of the purposes of this study was trained how to use the data collection instrument and scored 33% of all sessions. In order to calculate the degree of agreement, the number of agreements was divided by the number of agreements plus disagreements and then multiplied by 100. The inter-observer reliability scores are listed in Table 3.

---

Table 3

Inter-observer Agreement scores

Child	Baseline	Text Intervention Treatment	Message Generalization	&
Alton	90%	92%	99%	
Jane	88%	97%	100%	
Martin	85%	87%	87%	
Daisy	94%	90%	91%	
Adrian	90%	89%	100%	
Bradley	85%	86%	97%	
Maven	85%	96%	87%	
Brixton	85%	89%	89%	

### Analyses

**TMI Data.** The data for each dyad was visually organized in a figure in order to portray the percentages of the child's appropriate conversational speech. To assess whether the

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

children were communicating at consistently low levels, stable levels of percent opportunity were evaluated during baseline within the multiple baseline design. During treatment and fading phases of the study, data were analyzed to assess whether there were improvements in the percent opportunity score while the child was receiving text messages and during the progressive removal of text messages. Assessment was measured and analyzed to evaluate whether the treatment resulted in percent opportunity rates that were above baseline without the phone, across settings, and across people (Grosberg & Charlop, *in press*).

## Results

### **Child Baseline, Treatment, Assessment, Generalization, and Follow-up**

**Data.** The results for Alton, Jane, Daisy, Martin, Adrian, Bradley, Maven, and Brixton are presented in Figures 1, 2, and 3. Adrian and Brixton both had neurotypical peer partners during all phases of the study. The data for their peers would demonstrate that 100% of opportunities were appropriately taken advantage of during all phases of the study, and thus is not shown. During baseline, the children with ASD all exhibited a low percent opportunity. As previously defined, percent opportunity is calculated by dividing the number of appropriate conversational phrases by the total number of opportunities to speak (including appropriate initiations or responses, inappropriate initiations or responses, and a lack of response). See Appendix C for a more detailed description of the dependent measures. All children met criterion during the treatment phase to remove the phone. During the assessment phase, all participants met criterion by exceeding the average of combined baseline and treatment levels of responding. Only two dyads needed to be reintroduced to the prompting phase via text message following the first phase of treatment, and Brixton required a more in-depth script fading as described in Table 3. Generalization across settings and peers was demonstrated for all children.

TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

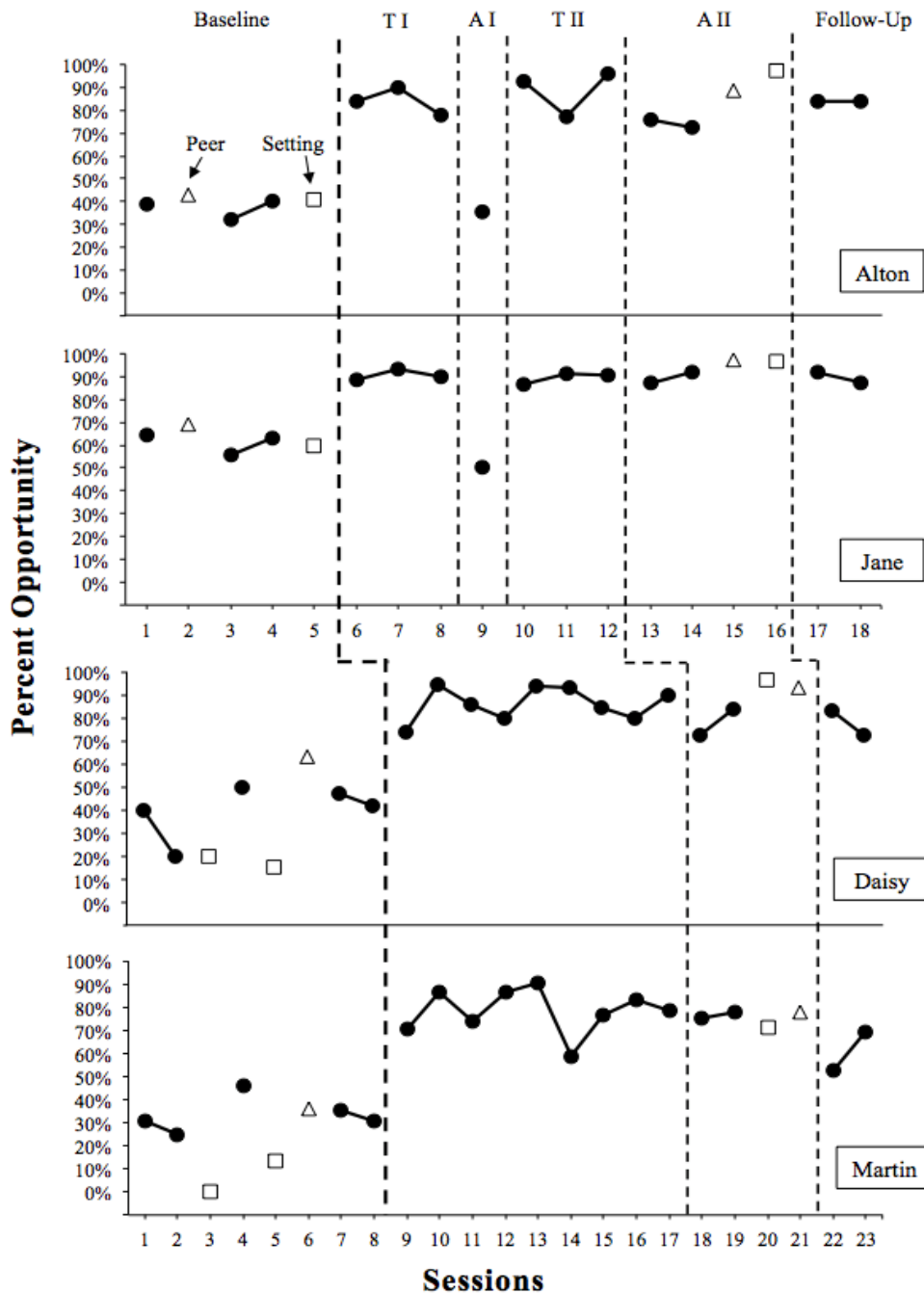


Figure 1. Baseline, Treatment, Assessment, Generalization, and Follow-up Data for Alton, Jane, Daisy, and Martin. T I is the first treatment phase, A I is the first assessment phase, T II is the second treatment phase, and A II is the second assessment phase.



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

As demonstrated in Figure 1, Alton demonstrated a stable percent opportunity score under 50% during baseline. After the treatment was first introduced, Alton met treatment criteria but was unable to meet learning criteria for the intervention because he scored too similarly to his baseline level during his first assessment session. Texting was then reintroduced in a second treatment period, after which Alton was able to exceed the mastery criteria. His percent opportunity scores during the final assessment phase exceeded the average of all prior sessions. In order to meet treatment criteria, Alton needed to correctly state all the phrases presented on the smartphone with both the phone and the therapist at the furthest possible pre-determined distance, which he was able to do at 72% and 96%. He was able to generalize his conversational skills across settings (97%) as well as across peers (88%) during the generalization probes. Alton needed to exceed a percent opportunity of 62% in order to meet mastery criterion, which he was able to demonstrate during sessions 13 and 14 at 86% and 92%, respectively. Alton also maintained his conversational skills at 88.46% with a typically developing peer during assessment, at 97% across settings, and at 84% during both sessions after two weeks.

Jane's percent opportunity were between 56% and 69% during all baseline sessions, including generalization across peer and setting, as shown in Figure 1. Treatment criteria were reached again during sessions eight and twelve at 90% in each. When the phone was removed at session nine for assessment, Jane's percent opportunity did not meet mastery criteria; however, she did meet mastery criteria during sessions 13 and 15 at 87% and 92% opportunity, respectively. Jane also maintained her conversational skills at 98% with a typically developing peer during assessment, at 97% across settings, at 92% and 88%, respectively, after a two-week follow-up. She maintained a consistently high percentage

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

opportunity score relative to the other participants throughout each phase of the study, picking up the intervention quickly and generalizing the treatment across settings and peers.

Daisy demonstrated consistently moderate levels of appropriate responding during baseline. She was able to meet treatment criteria during session 17, when the phone and therapist were at their furthest physical positions from her and she could still read aloud all presented text messages. Mastery criterion was met during sessions 18 and 19 at 73% and 84%, respectively, exceeding the average of all prior sessions (63%). Daisy also maintained her conversational abilities with her typically developing conversational partner (93%) and generalized the behavior across settings during assessment (97%). Daisy's generalization across settings probe during baseline were 20% and 15%, whereas her generalization across settings probe during assessment were at 97% (as shown in Figure 1), showing a vast improvement. During Daisy's two-week follow-up, she once again met her learning criterion and demonstrated a high percent opportunity (83%, 72%).

Martin exhibited a relatively lower baseline percent opportunity than his conversational partner, Daisy, between 0% and 46% opportunity. Mostly, the opportunities of which he took advantage consisted of complimenting his partner and requesting patterned responses from Daisy. Martin was able to meet treatment criteria with Daisy at session 17 and maintained his high percent opportunity to meet learning criterion during sessions 18 and 19 at 75% and 78% opportunity, respectively. Martin was also able to generalize the behavior across peers (78%) and settings (71%) during his assessment sessions. During Martin's two-week follow-up sessions, he was, on average, able to meet learning criterion. His first follow-up session dropped to 52% opportunity; however,

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

without additional prompting or instructions, Martin once again increased the number of appropriate conversational phrases for a 69% opportunity score. While one of his follow-up sessions did drop below learning criterion, it should also be noted that his opportunity score remained higher than his highest baseline score.

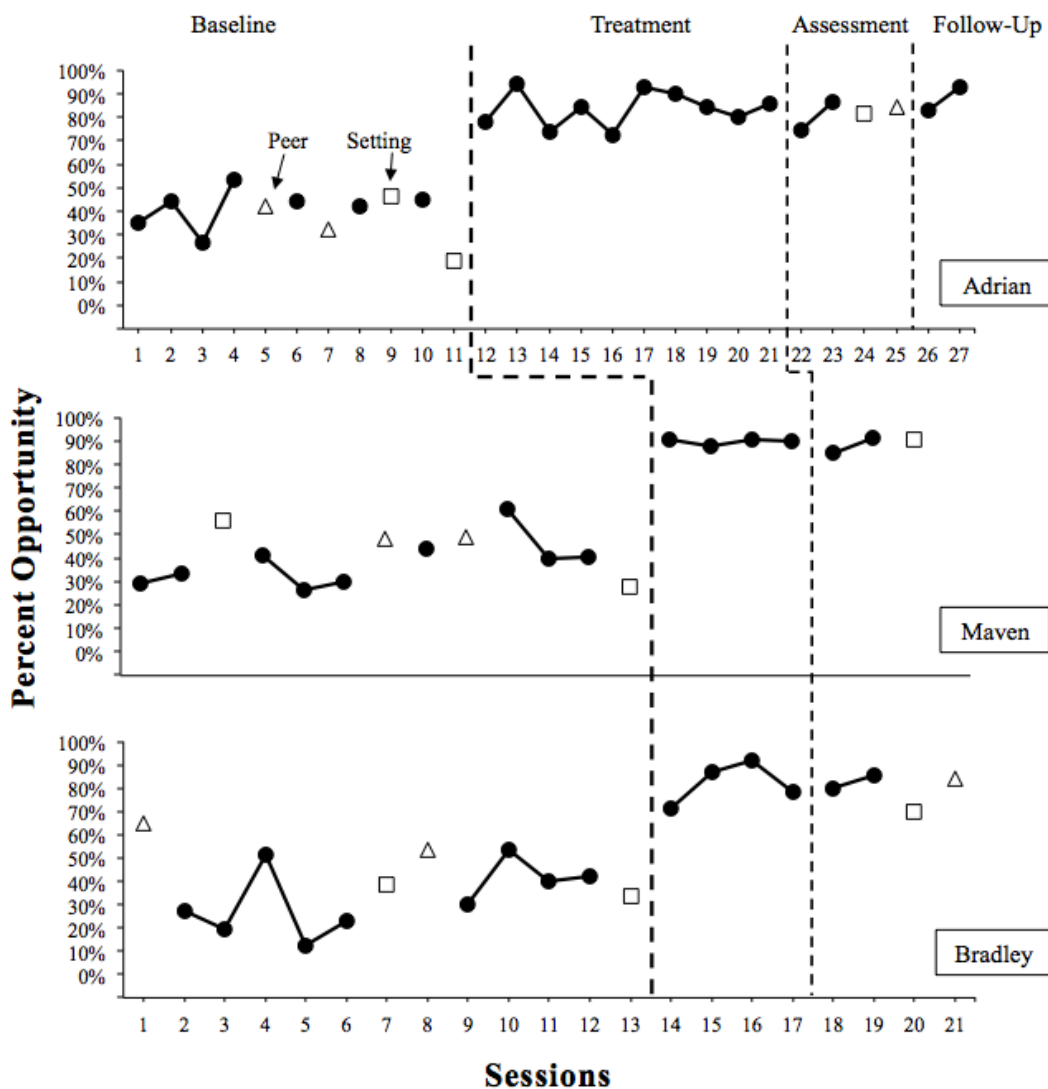


Figure 2. Baseline, Treatment, Assessment, Generalization, and Follow-up Data for Adrian, Maven, and Bradley

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Adrian demonstrated a percent opportunity score in baseline between 19% (during a generalization across settings probe in session 11) and 54% (during session 4). Adrian would often ignore the messages presented on the phone, which prevented him from meeting treatment criteria until session 21 at 86% opportunity. He was able to meet learning criterion at sessions 22 and 23 at 75% and 86% opportunity, respectively. Adrian also demonstrated that he maintained his percent opportunity score by generalizing the skills across settings (82%) and peers (85%). During the two-week follow-up, Adrian demonstrated maintenance of the target behavior and presented high percent opportunities of 83% and 93%. Adrian's conversational partner was a typically developing peer who consistently initiated and responded to Adrian appropriately as he typically would during a play conversation. His peer additionally read messages off a smartphone to maintain consistency throughout the study. His peer's results would show 100% for nearly every session, and thus are not presented in the figure.

Maven demonstrated a percent opportunity score between 26% and 61% during baseline, including the generalization probes. After only four treatment sessions with the text message intervention, Maven's percent opportunity was higher than any of the other participants. During treatment, his percent opportunity score remained consistently between 88% and 91%, which led him to quickly meeting treatment criteria. Maven met mastery criteria during sessions 18 and 19 with 85% and 91% opportunity, respectively. He showed demonstration of generalization across settings (90.48%) and peers (88.24%). Due to scheduling difficulties, follow-up data was unavailable.

Bradley demonstrated a wider range of conversational ability during baseline including generalization, with a high of 65% opportunity in session 1, and a low of 13%

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

opportunity in session 5. Partnered with Maven, Bradley met treatment criteria by session 17 with a percent opportunity of 78%. He maintained the target behavior during assessment at 80% and 85% during sessions 18 and 19, respectively. Bradley generalized his appropriate language across settings (70%) and peers (84.20%).

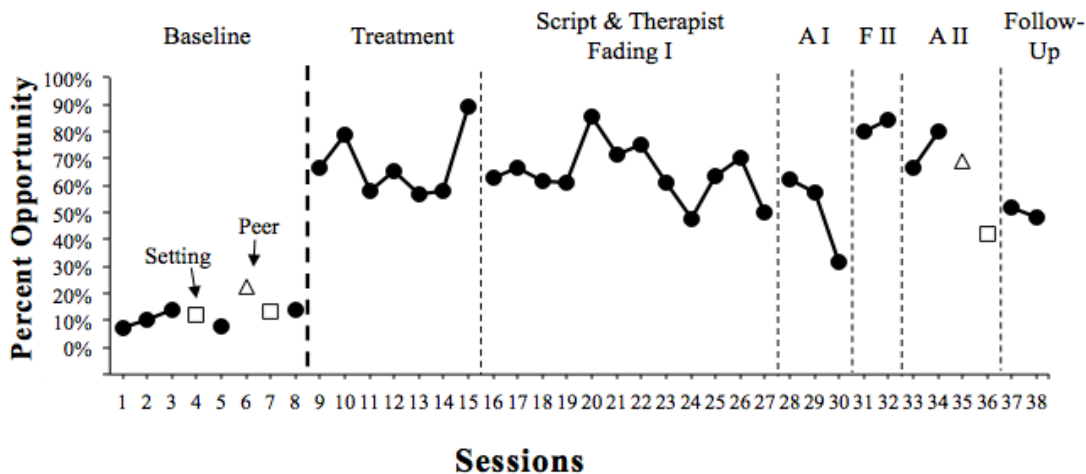


Figure 3. Baseline, Treatment, Script Fading, Assessment, Generalization, and Follow-up Data for Brixton. A I is the first assessment phase, F II is the second script and therapist fading session, and A II is the second assessment phase

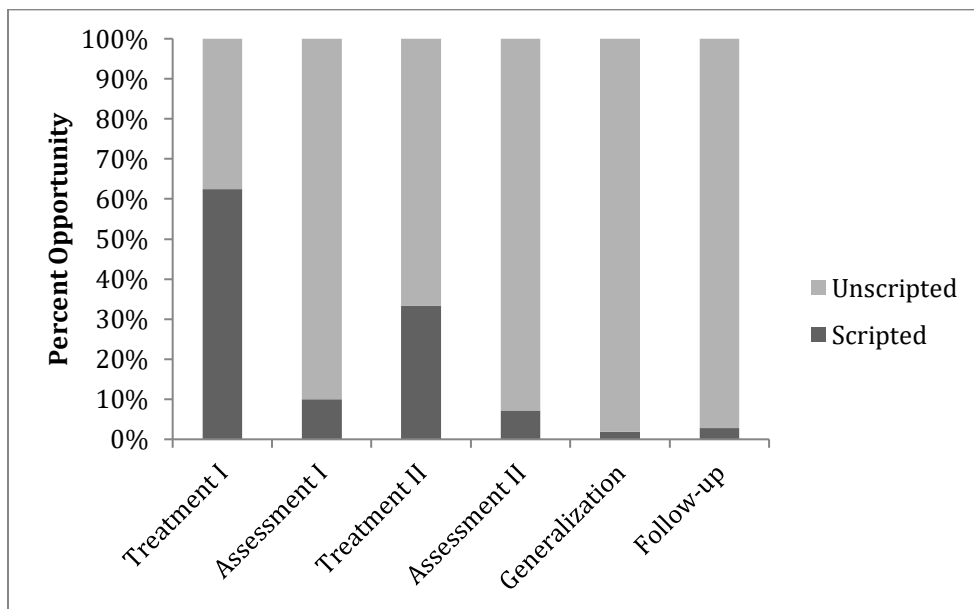
Similar to Adrian, Brixton was partnered with a typically developing peer who appropriately reached 100% opportunity or close for every session, and thus, his results are not presented. Brixton additionally is hyperlexic, demonstrating a higher reading capacity than his desire to speak, and presented the lowest baseline scores. Including generalization, Brixton demonstrated consistently low percent opportunity scores with a low of 7% during session 1 and a high of 22% during generalization across peers during session 6. Brixton's percent opportunity quickly rose to an overall high of 89% after only 7 treatment sessions. Brixton was the only participant to require a script-fading procedure to meet treatment

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

criteria. Because Brixton was a lower-functioning participant and was known to respond better to visual rather than verbal prompts, the script-fading procedure was implemented immediately following treatment. The script was faded in 11 sessions and Brixton met treatment criteria during session 27 at 50%. He was then assessed and met learning criteria for two sessions before falling to 32% opportunity during session 30. Script-fading was reintroduced for sessions 31 and 32 at the last step of script removal where Brixton's scores met treatment criteria once again and increased to 80% and 84% opportunity, respectively. He additionally met learning criteria during sessions 33 and 34 at 67% and 80% opportunity, respectively. Brixton generalized treatment effects across peers with a 69% opportunity score. However, Brixton's appropriate responding across settings was limited, scoring 42%. While Brixton did not maintain his percent opportunity at mastery criterion at the two-week follow up, his percent opportunity had greatly increased from his baseline sessions.

**Scripted and Unscripted Conversational Phrases.** All participants demonstrated an increase in unscripted conversational phrases as well as a decrease in the percent of scripted conversational phrases during treatment, fading, assessment, generalization, and maintenance probes.

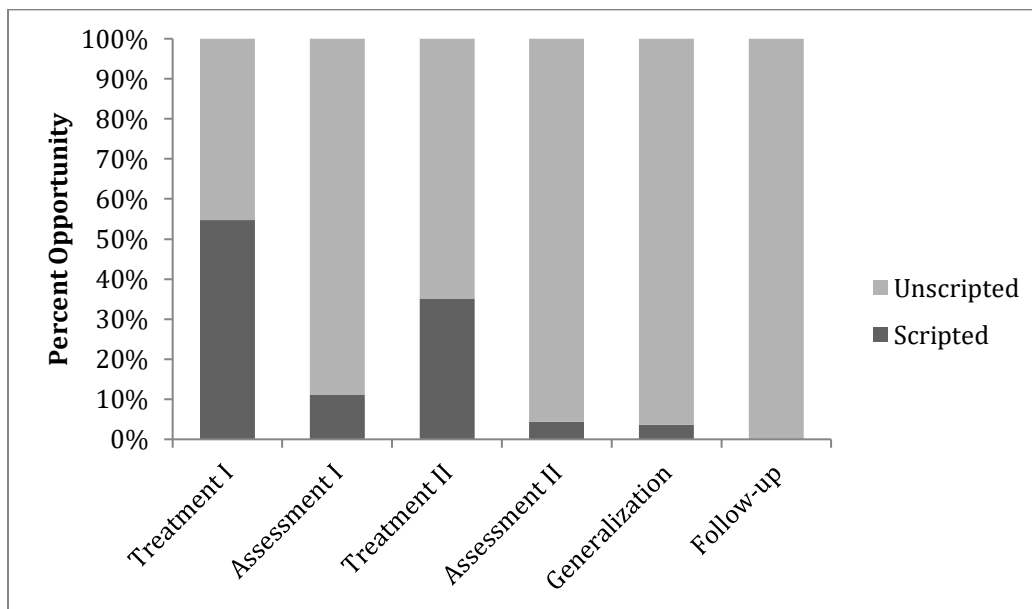
## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



*Figure 4.* Alton's scripted and unscripted conversational phrases

During the first round of treatment, Alton used a majority of scripted phrases (62%) to engage with Jane, as presented in Figure 4. During the second round of treatment, Alton's scripted phrases decreased to 33%, with the majority of appropriate conversational phrases being unscripted. When the phone was removed during both assessment phases, the number of scripted phrases dropped to 10% and 7%, respectively. During generalization and follow-up probes, Alton's scripted phrases fell even more to between 2% and 3%, respectively. In the last four sessions, he only used three phrases total that had been presented on the smartphone in the prior treatment sessions.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

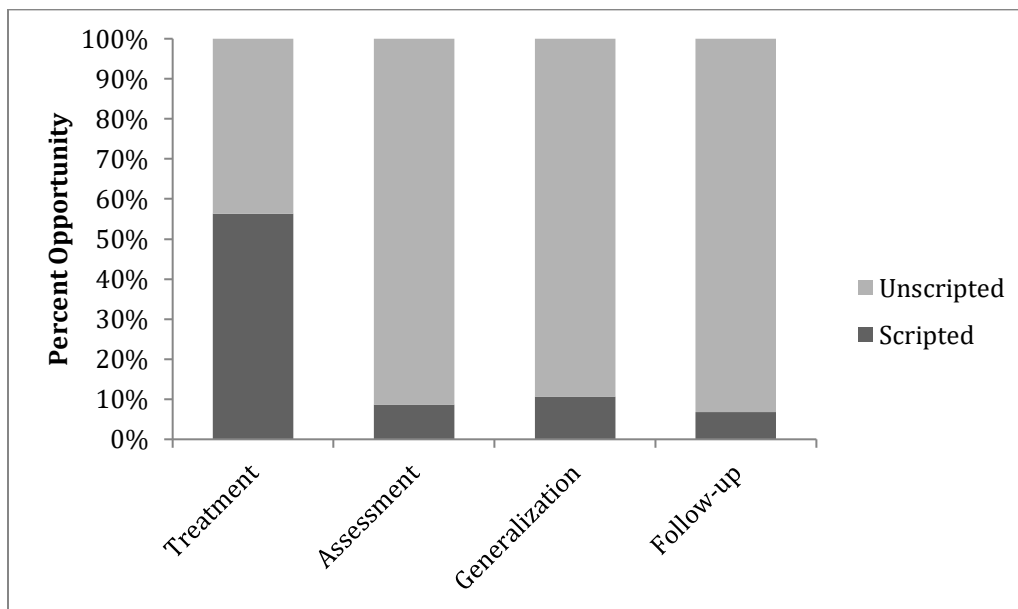


*Figure 5.* Jane's scripted and unscripted conversational phrases

Like Alton, Jane used a majority of scripted phrases (55%) during the first round of treatment as demonstrated in Figure 5. She similarly decreased the number of scripted phrases to 35% during the second round of treatment, with the majority of phrases being unscripted. When the phone was removed during both assessment phases, the number of scripted phrases once again dropped considerably to 11% during assessment I and 4% during assessment II. During generalization probes (4%), almost all of Jane's phrases were unscripted with only two of the phrases having originated from scripts previously presented. During both follow-up sessions, Jane did not include any scripted language in her conversations.



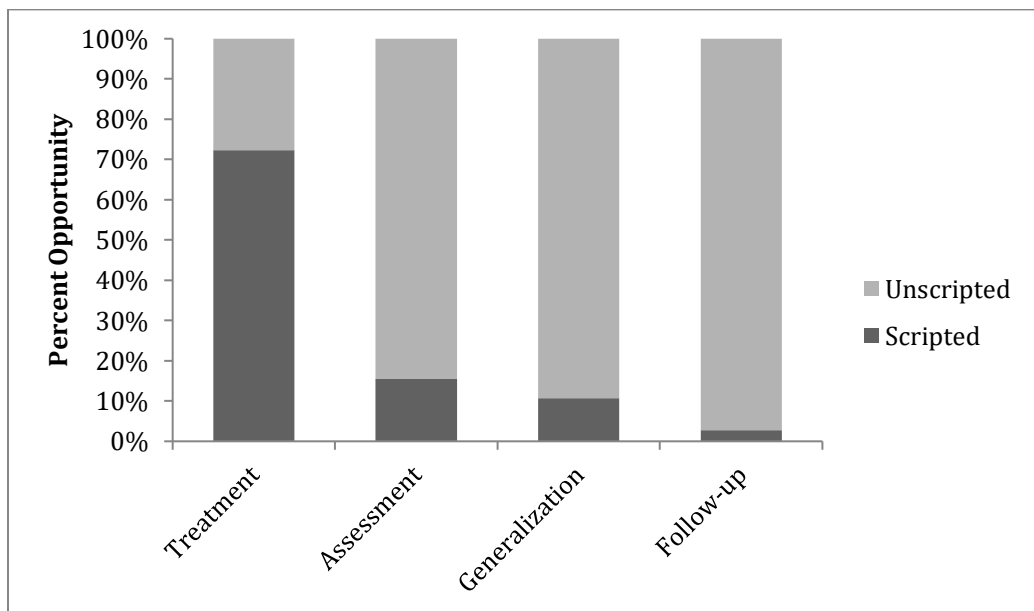
## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



*Figure 6.* Daisy's scripted and unscripted conversational phrases

Daisy used more scripted phrases than unscripted phrases during baseline at 56% as presented in Figure 6. She decreased the number of scripted phrases during assessment to 9%. Daisy was the only participant who increased the number of scripted phrases used during generalization (11%). During follow-up sessions, Daisy again decreased the number of scripted phrases to 7%. Within the multiple baseline design of higher functioning children with ASD, she maintained the highest reliance on the scripted phrases following the removal of the phone.

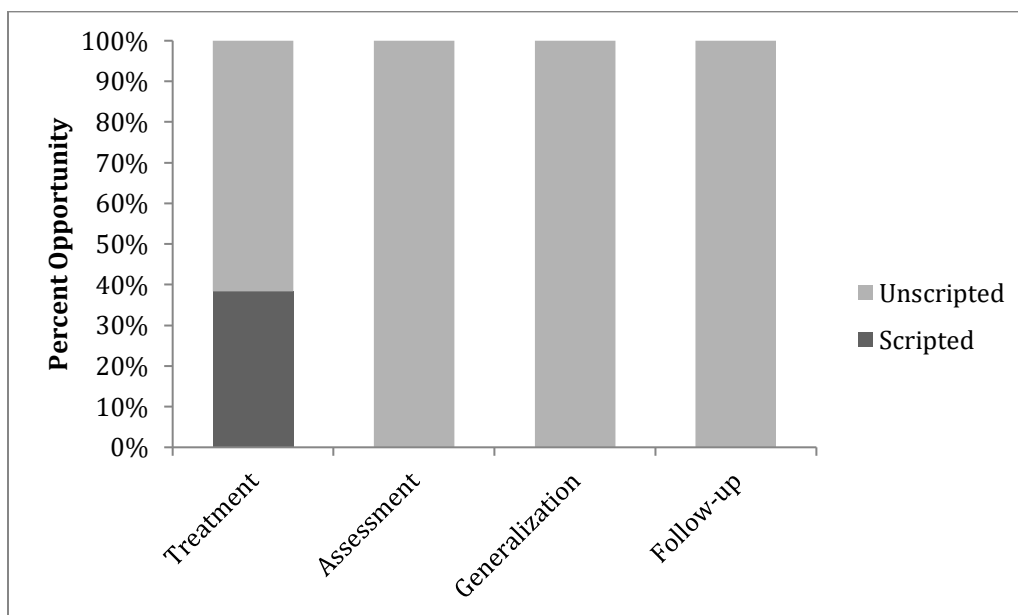
## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



*Figure 7.* Martin's scripted and unscripted conversational phrases

Martin used mostly scripted initiations and responses during treatment and depended on scripts more than any of the other high-functioning participants at 72%. However, during assessment, this percentage decreased dramatically. The number of scripted phrases Martin used during assessment was only 15% of total appropriate responses. This number decreased even further during generalization to 11%. During the two-week follow-up, Martin only used 3% scripted phrases, which included only three of the texted phrases during the sessions.

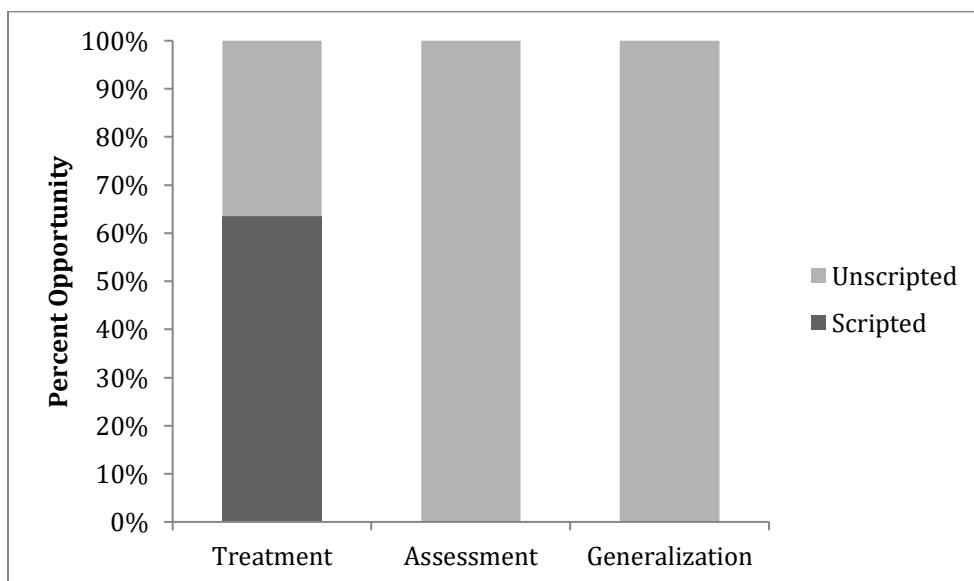
## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



*Figure 8.* Adrian's scripted and unscripted conversational phrases

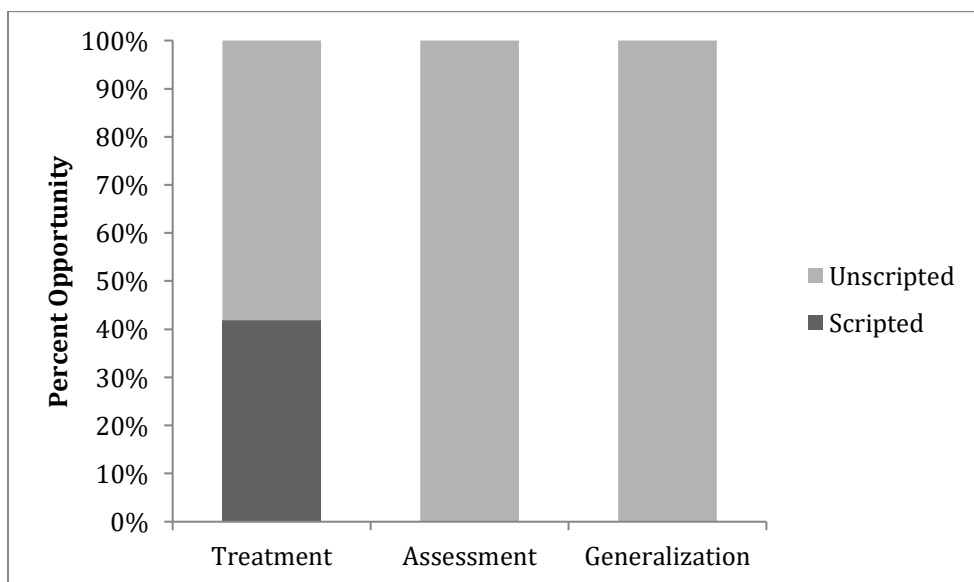
Adrian used the lowest number of scripted initiations and responses during treatment in the group (38%), which indicates a lower reliance on the text messages to converse with his peer. During assessment, generalization, and the two-week follow-up sessions, Adrian did not use a single phrase that had been scripted over text message. This indicates that he was able to generalize the appropriate behavior and speak entirely using novel phrases.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



*Figure 9.* Maven's scripted and unscripted conversational phrases

Maven used a majority (64%) of scripted phrases during the treatment phase and did not use any scripted language for the phases thereafter. Like Adrian, he was able to interact with his conversational partner using unscripted phrases at 100% of opportunities during assessment and generalization. Follow-up data was unavailable.



*Figure 10.* Bradley's scripted and unscripted conversational phrases

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Similar to Adrian and Maven, Bradley only used scripted phrases when texted during treatment. Even during treatment, only 42% of opportunities were used for scripted conversation. After meeting treatment criteria, he was able to converse with Maven without using scripted phrases during assessment and generalization. Follow-up data was unavailable.

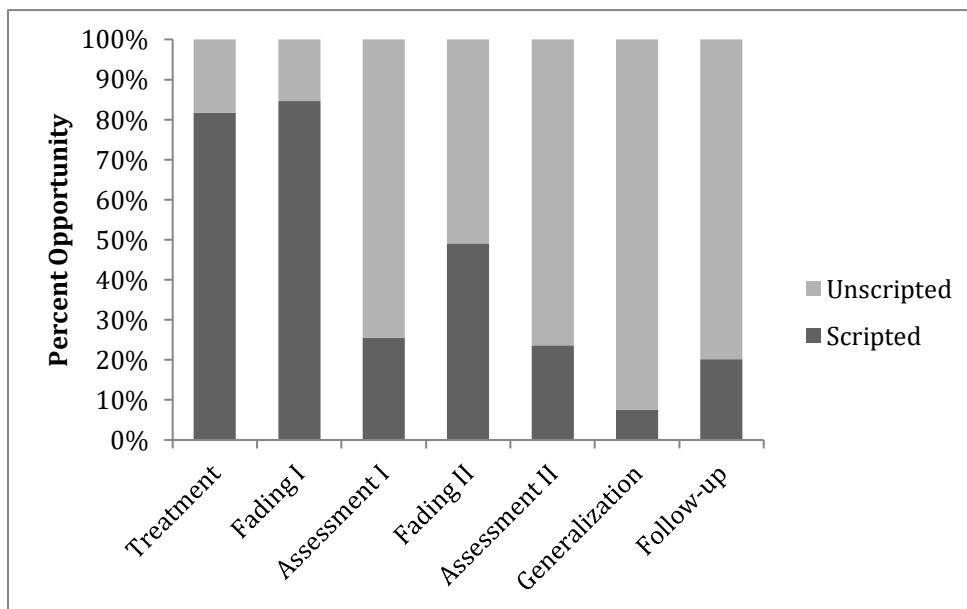


Figure 11. Brixton's scripted and unscripted conversational phrases

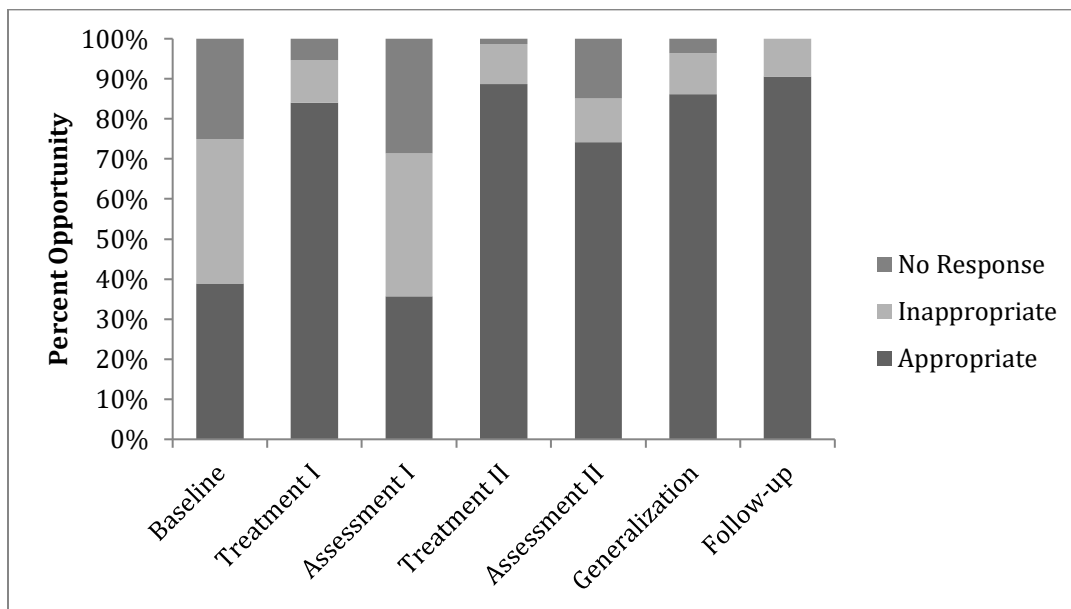
Brixton maintained the highest reliance on scripted conversation throughout the entirety of the study, which was to be expected as he was the lowest functioning participant. Throughout treatment I (82%) and fading I (85%), he used over 80% of the scripted phrases. After the phone was removed during assessment II, his reliance on the scripted language was cut by over a third where only 26% of his appropriate language was scripted. With a reintroduction of partial text messages during fading II, the use of scripts increased but only to 49%, demonstrating a higher number of novel initiations and responses, even

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

in the presence of the phone. During his final phase of assessment, Brixton decreased scripted language to 24%, almost equal to the amount used during the second phase of assessment. Brixton produced his highest rate of novel language during generalization, where only 8% of his opportunities to converse were comprised of scripted conversation. During two-week follow-up, Brixton's use of scripted language increased to a similar yet lower reliance (20%) as during the two previous assessment phases.

**Inappropriate versus Appropriate Conversational Language.** To develop a percentage for percent opportunity, the number of opportunities capitalized on with appropriate conversational phrases versus inappropriate phrases were coded for the present study (see Appendix C for coding definitions). Similarly, the number of times a participant did not respond to their peer was also recorded in order to be included in the percent opportunity calculation. All participants demonstrated an increase in appropriate initiations and responses and a decrease in the percent of inappropriate initiations, responses, and no response rates when comparing baseline with assessment and follow-up.

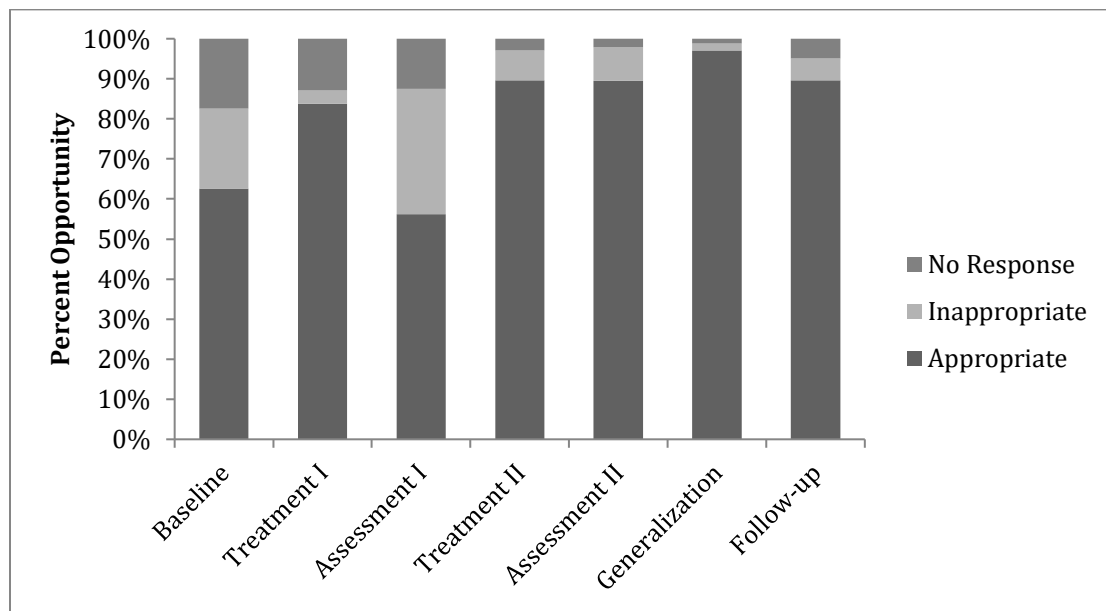
## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



*Figure 12.* Alton's inappropriate versus appropriate conversational language

During baseline, Alton demonstrated appropriate and inappropriate language at near equal proportions during each session at 39% and 36%, respectively. Many of his inappropriate remarks were filler phrases such as, “yeah... well.. anyways...” when he did not have an immediate response to a comment made by Jane. He would often talk quietly and play by himself rather than respond to Jane's initiations, which led to a no response rate of 25%. During the first treatment phases, Alton's use of appropriate phrases reached above 70% of total opportunities, with much less reliance on filler phrases and higher overall engagement when speaking with Jane. Alton demonstrated an almost equal usage of appropriate phrases during generalization probes as was used during the second phase of treatment (89% and 86%, respectively). It is additionally important to note that Alton's rate of no response decreased to a low of 4% during generalization probes and 0% during follow-up.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



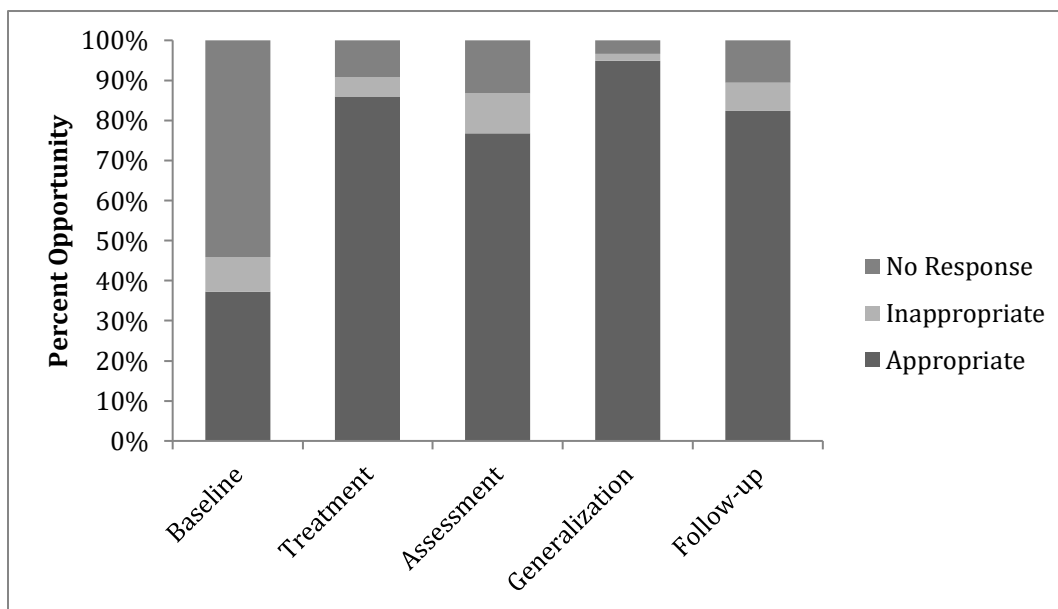
*Figure 13.* Jane's inappropriate versus appropriate conversational language

During baseline, Jane had the highest percentage of appropriate initiations and responses of all the participants at 63% appropriate phrases used over the 5 baseline sessions. The percentage of appropriate language quickly increased with intervention, also significantly reducing the no response rate. Though Jane met treatment criteria after the first 3 sessions, the intervention was ended prematurely, demonstrated by a lower percent opportunity during assessment I. When the treatment was reintroduced, 90% of opportunities were used for appropriate language with only 8% for inappropriate language and a no response rate below 3%. Jane presented nearly identical percentages for the next round of assessment as well, maintaining the behavior learned during the text message intervention. She showed dramatic increases with her use of appropriate language (97%), decreased inappropriate language (2%) and decreased the number of times she did not respond (1%) even further during generalization across setting and peers. During the two-week follow-up sessions,



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Jane's use of appropriate language was once again similar to that during treatment II and assessment II at 90%.

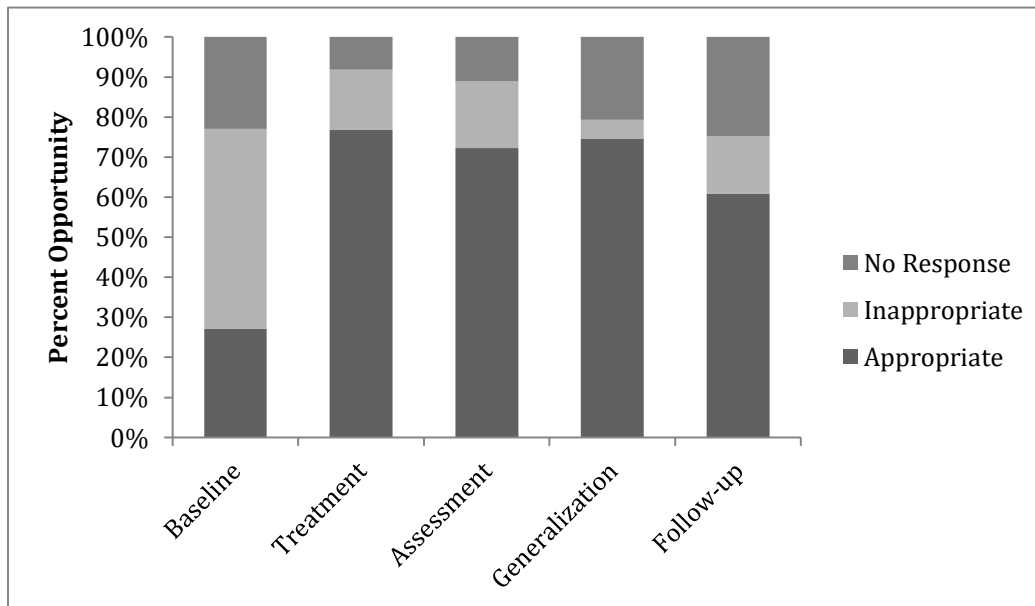


*Figure 14.* Daisy's inappropriate versus appropriate conversational language

During baseline, Daisy did not respond 54% of the time when she was presented the opportunity to speak. Only 37% of her spoken phrases were appropriate conversational language, with the other 9% being inappropriate. She quickly responded to the text message intervention during treatment and increased her appropriate phrases to 86% of all opportunities to speak. Additionally, her inappropriate phrases were nearly cut in half to 5% and her no response rate significantly improved to only 9%. After Daisy met treatment criteria, she was assessed with a 77% rate of appropriate language, a 10% rate of inappropriate language, and a 13% rate of no response. These numbers all improved further during generalization with 95% appropriate language, 2% inappropriate language, and 3% no response. During the two-week follow-up, Daisy slightly increased

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

inappropriate language to 7% and responded slightly less often with a rate of 10%. While higher than generalization, her percent opportunity had improved from assessment and demonstrated significant differences than baseline.

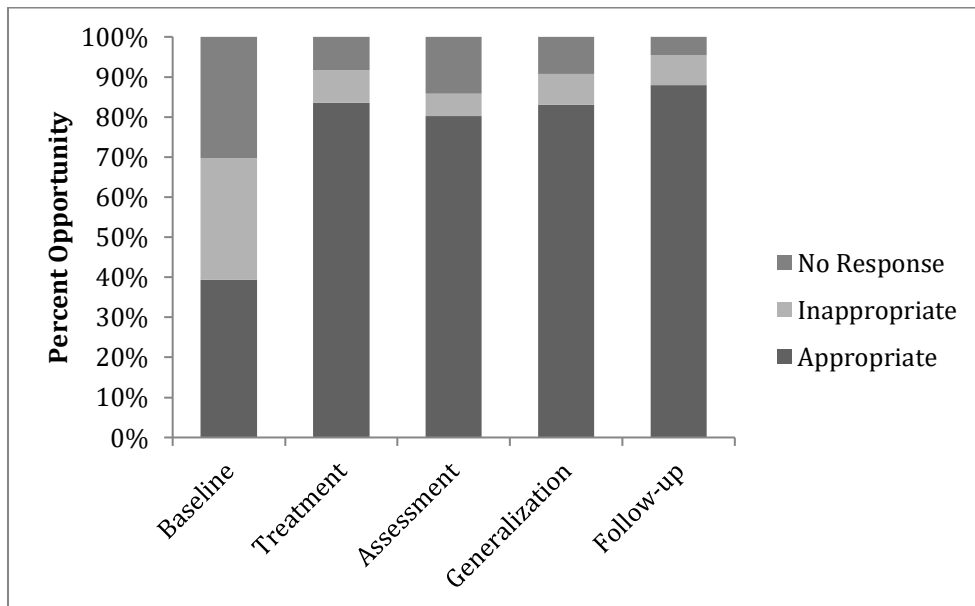


*Figure 15.* Martin's inappropriate versus appropriate conversational language

During baseline, Martin used a high number of inappropriate phrases (50%) along with a no response rate of 23%, as shown in Figure 15. Martin more than doubled the number of opportunities used for appropriate language from 27% during baseline to 77% during treatment. This was met with a steep drop in the number of inappropriate phrases used (15%) and a much lower no response rate (8%). During assessment and generalization, Martin maintained high rates of appropriate language at 72% and 74%, respectively. During the two-week follow-up, Martin's percentage of appropriate phrases dropped to 61% with an increase in his no response rate (25%), heavily influenced by his

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

first session of follow-up in which learning criterion was not met. While lower than treatment, assessment, and generalization scores, his results still demonstrated a marked improvement in the number of appropriate phrases and inappropriate phrases from baseline.

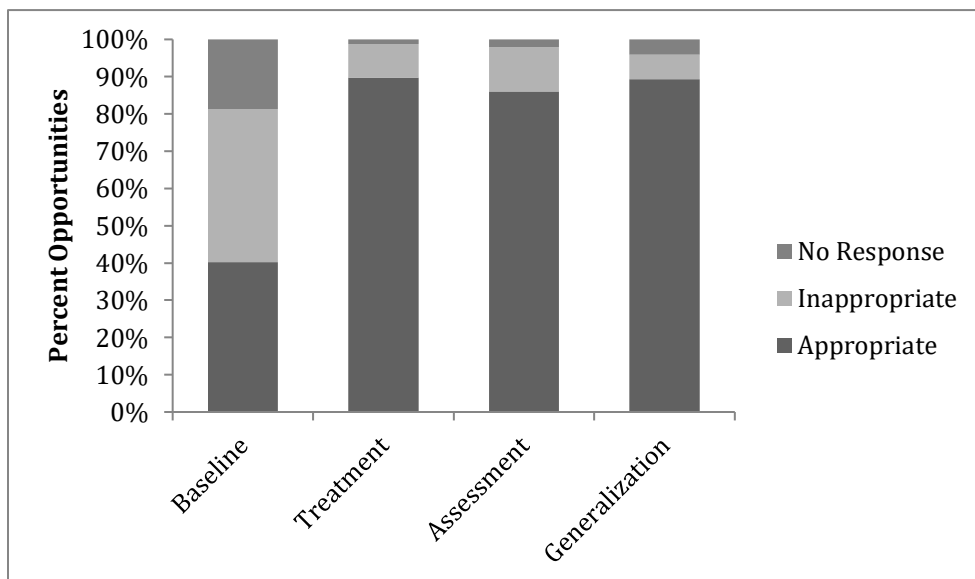


*Figure 16.* Adrian's inappropriate versus appropriate conversational language

During baseline, Adrian used 39% appropriate phrases, 30% inappropriate phrases, and did not respond 30% of the time. These percentages improved during treatment when appropriate conversational language increased to almost 84% of opportunities, inappropriate language decreased to only 8% of opportunities, and his no response rate decreased to only 8%. After Adrian met treatment criteria and the phone was removed, he continued to demonstrate improved conversational language with appropriate phrases remaining above 80% of opportunities. During assessment, there was a slight increase in response rate to 14% of opportunities; however, this decreased once again during

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

subsequent generalization (9%) and follow-up sessions (5%). Adrian similarly presented low rates of inappropriate responses during assessment, generalization, and follow-up at 5%, 8%, and 7%, respectively. Adrian's results demonstrate a marked improvement in conversational language, particularly decreasing the number of repetitive phrases he typically used when speaking with a peer.

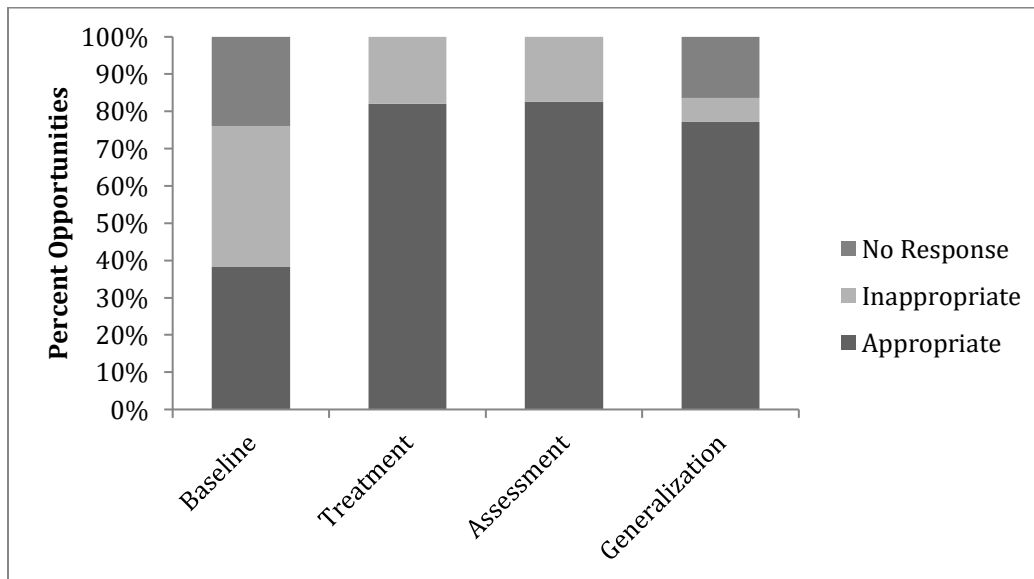


*Figure 17.* Maven's inappropriate versus appropriate conversational language

Maven demonstrated near equal amounts of appropriate and inappropriate language during baseline consisting of 40% and 41% of his total opportunities as shown in Figure 17. During baseline, he had one of the lowest no response rates (19%), similar to Jane. Maven decreased his no response rate even further to only 1% during baseline; in fact, he responded to 100% of opportunities during the last three of his treatment sessions. He additionally reduced the number of inappropriate phrases to only 9% during treatment and kept this rate low during assessment (12%). His no response rate also remained low at only

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

2% of opportunities, allowing his appropriate speech to comprise 86% of opportunities. Maven generalized his high appropriate speech (89%) across peers and settings. During generalization, his inappropriate speech reached a low of 7% with only a slight increase in his no response rate (4%).



*Figure 18.* Bradley's inappropriate versus appropriate conversational language

Similar to Maven, Bradley demonstrated equal amounts of appropriate and inappropriate conversational language during baseline at 38% of opportunities each. The remaining 24% of time, Bradley did not respond to his peer in conversation. During treatment, Bradley increased his conversational language to 82% with only 18% of opportunities used for inappropriate phrases. At similar rates, Bradley met learning criteria and increased his conversational language to 83% with inappropriate language used for 17% of opportunities. Bradley was the only child who responded to all presented opportunities during two consecutive phases; he maintained a 0% no response rate for both

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

treatment and assessment. During generalization, his no response rate increased to 16%; however, at the same time he decreased his inappropriate language to 7%. Bradley generalized his appropriate speech (77%) across settings and peers.

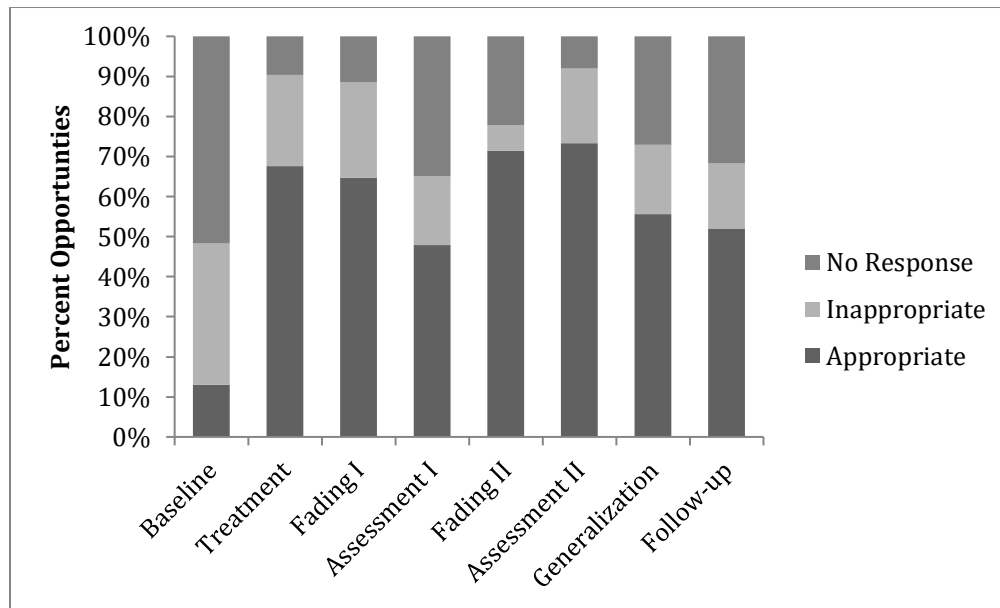


Figure 19. Brixton's inappropriate versus appropriate conversational language

Brixton began the study with the lowest percentage of appropriate conversational language (13%) as shown in Figure 19. During baseline, Brixton typically did not socially initiate or respond to his conversational partner (52%), and when he did choose to speak, he used a high rate of inappropriate phrases (35%). Brixton's conversational language quickly improved during treatment and fading I to 68% and 65%, respectively, with lower no response rates of 10% and 12%, respectively. During the first phase of assessment, his appropriate language dropped to 48%, though still decreasing the number of opportunities used for inappropriate phrases at 17%. When the phone was reintroduced during fading II, Brixton responded quickly with a high percentage of appropriate phrases (71%) and an

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

even lower percentage of inappropriate phrases (6%). After the phone was removed for a second time during assessment II, Brixton increased the number of opportunities used for appropriate conversational phrases to a high of 73%, and he decreased his no response rate to a low of 8%. During generalization and follow-up, the number of opportunities used for appropriate language decreased to 56% and 52%, respectively. While lower than treatment and the second phase of assessment, his generalization and follow-up results were all maintained at higher levels than baseline and during the first phase of assessment. In fact, Brixton's inappropriate language steadily declined during assessment II (19%), generalization (17%), and follow-up (16%).

### **Discussion**

The purpose of this study was to further assess the efficacy of a text message intervention as first suggested by Grosberg and Charlop (*in press*) with the use of a peer with ASD. This study reaffirmed that a text message intervention occasioned increases in the conversational speech of children with ASD, and additionally confirmed the hypothesis that this intervention is effective when another child with ASD is included as the conversational partner. Notably, all participants demonstrated response variation by verbalizing unscripted questions, initiations, and comments. All eight children in this study presented an improvement in the percentage of opportunities used for appropriate conversational language. Seven of the children were able to generalize this type of speech across settings and peers, and gains were still evident at a two-week follow-up. Only one participant was not able to meet learning criterion during both of the follow-up sessions; however, he still demonstrated a marked improvement from baseline levels.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Previous research has focused on text message interventions implemented with adults and typically developing peers (Grosberg & Charlop, *in press*). The text message intervention was used to simultaneously teach two children to use scripts, learn how to incorporate appropriate speech, and speak to each other all at the same time. The intervention effectively increased the appropriate conversational language, decreased inappropriate language, and decreased the rate of no response for children across this variation in participants.

In the present study, the experimenter modeled appropriate conversational initiations and responses through the text message intervention that participants then used to engage their peer. This is an improvement from traditional script studies that use conversation developed by adults and not tailored to the individual preferences of the children (e.g., Krantz & McKlannahan, 1993, Ledbetter-Cho et al., 2015). An abundance of previous studies has focused on a particular question or comment within a conversation or interaction (Raulston et al., 2013; Wicknick et al., 2009). Other studies with written scripts have targeted a behavior that involved a specific scenario like going to the store (Brown et al., 2008) or making comments about preferred snacks (Sarkokoff et al., 2001). The present study was designed so that the children had the freedom and flexibility to pick a preferred toy in a play-based environment, which allowed for a more natural progression of a play conversation. For example, on a few occasions, when a child picked up a block, a therapist sent a text asking if the peer would like to build a tower. The peer in turn engaged in a conversation in response and picked up a block to stack with their partner. This may have served as a natural social reinforcer encouraging the participant to maintain the behavior without visual prompts once intervention was



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

over. This often also occurred with more abstract topics, as well, particularly for the older, higher functioning participants.

The present study improves upon prior script-based studies similar in nature and methodology (e.g., Ledbetter-Cho et al., 2015) by introducing modern-day technology. While previous studies that have incorporated technology by using computer-based interventions have targeted a multitude of skills, results using this medium have been mixed, with positive effects mostly demonstrated when targeting social skills. Even so, there has been little substantive information that has demonstrated generalization across settings and to more natural scenarios (Ramdoss et al., 2012). Additionally, computer-based interventions situationally limit the research and capacity in which families can replicate the treatment at home. Through portable smart devices, such as iPads and iPhones, technology has aided the efficacy of a number of studies by ameliorating problems of inflexibility in regards to location (MacPherson, Charlop, & Miltenberger, 2014; Bereznak, 2012) and pre-determined content (Ganz et al., 2014). Furthermore, iPad and iPhone devices are more cost-effective and favored amongst parents, professionals, and children (Clark et al., 2015). Numerous applications have been created for children with ASD on smartphone devices, with a handful focusing on communication; however, there have not demonstrated meaningful results (Fletcher-Watson et al., 2015). Additionally, applications may be costly as they may cost money to purchase or may require data to run. Applications may also be time-consuming in that they need to be updated to stay current with the latest software.

During baseline, all participants exhibited inappropriate conversational language to some degree regardless of age or functioning level. Following treatment, all

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

participants demonstrated marked improvements in not only their appropriate language, but also the way in which they were able to engage with their peer. For example, during baseline, Jane would often engage in perseverative speech about dance without offering a more fluid back-and-forth conversation. During the text message intervention, the therapist modeled a more even-handed conversation that still included her preferred topics of interest. Not only did Jane's appropriate conversational language increase, but her inappropriate conversational language also decreased. While she clearly had preferred topics of conversation, she engaged in fewer tangents following the intervention. For the other children, the intervention was similarly efficacious in improving appropriate language while decreasing the amount of inappropriate language and periods of no response that occurred during baseline. For example, Alton decreased the amount of time he talked to himself, which occurred possibly because he demonstrated a more impactful interest in his peer (i.e., conversational partner). When given the structure for how to engage in a one-on-one conversation, he was able to appropriately reciprocate and spark conversation consistently at a higher rate. Adrian, Martin, and Daisy all improved, particularly in generating more complete sentences. Martin was the only high-functioning participant with a data point that did not meet learning criterion after successfully completing the treatment. However, at five years of age, Martin was also the youngest participant in the study and preferred to question the therapists in the room about unfamiliar toys. Though the same toys were present throughout the duration of the study, he chose to reorient himself with the environment two-weeks after assessment. Similar to Martin, Bradley's no response rate rose slightly during the latter end of his sessions. Notably, Bradley and Maven

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

anecdotally improved the rhythm of their conversation during assessment and generalization sessions. While typically inattentive and restless during a conversation, Bradley presented his thoughts slower and with more intention, as he was modeled during intervention.

The data on scripted versus unscripted language is of particular interest. Assessment data show that unscripted language increased dramatically following the text message intervention. One potential reason the children were able to generalize from the text message prompts with independent, appropriate phrases following treatment could have been due to the quickly changing conversational patterns. With the quick progression of conversation, the children were probably not given sufficient time to memorize many of the texted conversational phrases or the script as a whole. The scripts were fed in the moment rather than during a pre-training session and infinite variations of the scripts were possible, facilitating a lower likelihood for the children to become rote responders. Therefore, the present study also demonstrated a significant decrease in the number of scripted phrases once the phone was removed while still maintaining a higher level of appropriate conversational language than in baseline. Prior studies have tried to increase play-related language by introducing a script frame procedure attached to toys; however, none of the participants were able to generalize the language enough to have 100% unscripted language used post-intervention (Groskreutz et al., 2015). More novel phrases and decreasing reliance on scripted language during assessment, generalization and follow-up were likely a result of a dynamic that may not be evident with a traditional script or video-modeling program. The younger children in the study, with less history of language use, maintained use of some of the scripted language, likely because it was

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

simpler in subject and syntax, and because of their more limited vocabulary to generalize to other topics. Daisy and Martin frequently would ask each other their favorite colors and food, as modeled during treatment. While they oftentimes used the scripted phrase to initiate a new conversational topic, they responded with a more novel phrase.

Additionally, during baseline, Daisy stammered and stumbled over her own words. With the addition of a modified script, she was able to learn phrases and generalize these thoughts to other novel initiations and responses. Further, three of the participants were able to quickly generalize the conversational language and did not use any scripted phrases after meeting treatment criteria. The increase in novel interactions between the children is consistent with other studies that incorporate scripts (e.g., Wicknick et al., 2009; Pollard, Betz, & Higbee, 2012).

Brixton was considered a lower functioning participant due to his language deficits; therefore, his intervention was treated and recorded separately from the other dyads in the study. During the study, his appropriate conversational language as a percentage of total opportunities increased quickly during treatment and every subsequent session that included the phone. Brixton was able to meet learning criterion during assessment but did not demonstrate generalization across settings. He additionally did not meet learning criterion two weeks after treatment during his follow-up sessions. However, in comparison to baseline sessions, Brixton greatly demonstrated improvement in all facets of conversation, including an increase in appropriate conversational language, and decreases in inappropriate behavior and the no response rate. He additionally demonstrated the most notable changes outside of the text message intervention and assessment probes, qualitatively expressing more appropriate

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

conversation during the social skills group that he attended (as noted by student therapists). As a hyperlexic participant, Brixton is known for his preference reading prompts and responding rather than engaging in a spoken dialogue. However, the fast-paced nature of the text message intervention and social reinforcement quickly sparked a more verbal response from Brixton. In addition, he demonstrated the lowest rate of unscripted language during his generalization probes, signifying a generalization of the target behavior across settings and peers.

While the present study showed beneficial results for the participants involved, there are several ways in which the current study could have improved. Though a multiple baseline design across participants is a standard single subject design used in behavioral research, a small sample size encourages the need for replication studies. Attempting to replicate these findings with children who are of a wider range of functioning levels might also prove to be beneficial. For example, Brixton as a lower-functioning participant demonstrated marked improvements, despite not meeting criterion in follow-up. Including more children with more limited abilities could have strengthened the ability to generalize the text message intervention as a viable treatment for a wider range of functioning levels. Furthermore, conducting additional follow-up probes to assess whether gains are still maintained over a longer period of time could also be of value.

This study sets the groundwork for future studies to improve appropriate conversational language and also to assess the improvement of other related social behaviors in children with ASD. Notably, at one point in the study, Jane commented that she did not like talking to her designated peer because they did not have much in

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

common. After the second round of treatment, Jane and Alton not only engaged in more appropriate conversations, but they were also playing more together with the provided toys. This increase in appropriate play behavior was also evident in the recorded videos with Martin and Daisy, as previously mentioned. Similarly, Brixton not only engaged in more appropriate verbal behaviors but also actively participated in building towers and handing Michael the appropriately colored blocks rather than rubbing the wood against his face. While there was no dependent variable for this observation, it would be relevant to look at increased levels of play in future research. Perhaps improving appropriate back-and-forth conversational language and finding more topics for a mutually interesting conversation increases appropriate play scenarios. Other behaviors such as eye contact could additionally be monitored. Lastly, while the setting was more natural than previous studies involving scripts, this study does not demonstrate how their appropriate language would generalize to a more active play scenario. This was in a smaller, more isolated play environment and future research may include a more distracting environment, such as playing indoors in a group setting or participating in an outdoor play activity. For example, a child playing baseball on the field could be given an Apple watch for another variation of a text message intervention. Children could receive texts to model appropriate game-related phrases as they occur in real time.

In sum, the current study demonstrated that a text message intervention is an efficacious way to quickly increase appropriate conversational language in a naturalistic, play environment. All of the children included in the study demonstrated marked improvements in their conversational language. The present research adds to the literature on social skills interventions for children with ASD in several ways. First, following

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Grosberg's and Charlop's (*in press*) initial study, this is the second study to date that has used mobile phones as an intervention tool to teach conversational skills to children with ASD. This expands the existing research on using different modes to convey scripts that aim to increase language, and showed that the text message intervention serves as an aid for instruction for children with ASD. Second, following the original study, this is one of the first interventions that allows the script to be modified in real time in order to develop conversation that is relevant to the materials at hand and preferred topics of the children. This is an important addition to research using scripts because it allows for a more natural progression of a conversation. The children are able to choose preferred toys and topics of discussion that can then be seamlessly introduced into the texted messages. When the children are able to choose the topic of conversation, this is likely to be self-motivating and encourage the flow of conversation to continue. The strength of the text message intervention is demonstrated in high scores in generalization probes across peers and settings and after a two-week maintenance probe. One major advantage of this study is that the play-based setting of the intervention closely mimicked the children's' typical play setting (i.e., the natural environment), which may have facilitated generalization. This research further contributes to the literature by including children with ASD as conversational partners, which might be ideal for social skills groups designated specifically for individuals with ASD. Lastly, this intervention may be applicable to a wide range of functioning levels as it can be modified to be inclusive of different goals, including rhythm of speech, complexity of language, reading level, and general verbal abilities. The present study demonstrated positive results even with participants relatively new to reading and with limited spoken competency.

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD



### References

- Ayres, K. M., Mechling, L., & Sansosti, F. J. (2013). The Use Of Mobile Technologies To Assist With Life Skills/independence Of Students With Moderate/severe Intellectual Disability And/or Autism Spectrum Disorders: Considerations For The Future Of School Psychology. *Psychology in the Schools, 50*(3), 259-271. doi:10.1002/pits.21673
- Bereznak, S., Ayres, K. M., Mechling, L. C., & Alexander, J. L. (2012). Video Self-Prompting and Mobile Technology to Increase Daily Living and Vocational Independence for Students with Autism Spectrum Disorders. *Journal of Developmental and Physical Disabilities, 24*(3), 269-285. doi:10.1007/s10882-012-9270-8
- Brown, J. L., Krantz, P. J., Mcclannahan, L. E., & Poulson, C. L. (2008). Using script fading to promote natural environment stimulus control of verbal interactions among youths with autism. *Research in Autism Spectrum Disorders, 2*(3), 480-497. doi:10.1016/j.rasd.2007.08.006
- Charlop, M. H., Schreibman, L., & Thibodeau, M. G. (1985). Increasing spontaneous verbal responding in autistic children using a time delay procedure. *Journal of Applied Behavior Analysis, 18*(2), 155-166. doi:10.1901/jaba.1985.18-155
- Charlop, M. H., & Milstein, J. P. (1989). Teaching autistic children conversational speech using video modeling. *Journal of Applied Behavior Analysis, 22*(3), 275-285. doi:10.1901/jaba.1989.22-275

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

- Charlop, M. H., & Kelso, S. E. (2003). Teaching Children with Autism Conversational Speech Using a Cue Card/ Written Script Program. *Education and Treatment of Children*, 26(2), 108-127. Retrieved from <http://www.jstor.org/stable/42899741>
- Charlop, M. H., Gilmore, L., & Chang, G. T. (2008). Using Video Modeling to Increase Variation in the Conversation of Children with Autism. *Journal of Special Education Technology*, 23(3), 47-66. doi:10.1177/016264340802300305
- Clark, M. L., Austin, D. W., & Craike, M. J. (2015). Professional and Parental Attitudes Toward iPad Application Use in Autism Spectrum Disorder. *Focus on Autism and Other Developmental Disabilities*, 30(3), 174-181.  
doi:10.1177/1088357614537353
- Diagnostic Criteria. (2016, April 18). Retrieved April 10, 2017, from <https://www.cdc.gov/ncbddd/autism/hcp-dsm.html>
- Fletcher-Watson, S., Petrou, A., Scott-Barrett, J., Dicks, P., Graham, C., O'Hare, A., . . . Mcconachie, H. (2016). A trial of an iPad™ intervention targeting social communication skills in children with autism. *Autism*, 20(7), 771-782.  
doi:10.1177/1362361315605624
- Ganz, J. B., Kaylor, M., Bourgeois, B., & Hadden, K. (2008). The Impact of Social Scripts and Visual Cues on Verbal Communication in Three Children With Autism Spectrum Disorders. *Focus on Autism and Other Developmental Disabilities*, 23(2), 79-94. doi:10.1177/1088357607311447
- Ganz, J. B., Boles, M. B., Goodwyn, F. D., & Flores, M. M. (2013). Efficacy of Handheld Electronic Visual Supports to Enhance Vocabulary in Children With

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

ASD. *Focus on Autism and Other Developmental Disabilities*,29(1), 3-12.

doi:10.1177/1088357613504991

Garcia-Albea, E., Reeve, S. A., Brothers, K. J., & Reeve, K. F. (2014). Using audio script fading and multiple-exemplar training to increase vocal interactions in children with autism. *Journal of Applied Behavior Analysis*,47(2), 325-343.

doi:10.1002/jaba.125

Grosberg, D., & Charlop, M. (2012). *Teaching Conversational Speech to Children with Autism Using a Text Messaging Intervention (TMI)*(Unpublished doctoral dissertation). Claremont Graduate University.

Groskreutz, M. P., Peters, A., Groskreutz, N. C., & Higbee, T. S. (2015). Increasing play-based commenting in children with autism spectrum disorder using a novel script-frame procedure. *Journal of Applied Behavior Analysis*,48(2), 442-447.

doi:10.1002/jaba.194

Grynszpan, O., Weiss, P. L., Perez-Diaz, F., & Gal, E. (2014). Innovative technology-based interventions for autism spectrum disorders: A meta-analysis. *Autism*,18(4), 346-361. doi:10.1177/1362361313476767

Krantz, P. J., & Mcclannahan, L. E. (1993). Teaching children with autism to initiate to peers: effects of a script-fading procedure. *Journal of Applied Behavior Analysis*,26(1), 121-132. doi:10.1901/jaba.1993.26-121

Krantz, P. J., & Mcclannahan, L. E. (1998). Social interaction skills for children with autism: a script-fading procedure for beginning readers. *Journal of Applied Behavior Analysis*,31(2), 191-202. doi:10.1901/jaba.1998.31-191

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

- Lang, R., Regeher, A., Rispoli, M., Pimentel, S., & Camargo, H. (2010). Rehabilitation issues in autism spectrum disorders. *Developmental Neurorehabilitation, 13*(3), 153-155. doi:10.3109/17518421003607597
- Ledbetter-Cho, K., Lang, R., Davenport, K., Moore, M., Lee, A., Howell, A., . . . O'reilly, M. (2015). Effects of script training on the peer-to-peer communication of children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 48*(4), 785-799. doi:10.1002/jaba.240
- Lofland, K. B. (2015). The Use of Technology in the Treatment of Autism. *Technology and the Treatment of Children with Autism Spectrum Disorder Autism and Child Psychopathology Series, 27-35*. doi:10.1007/978-3-319-20872-5\_3
- Macduff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis, 26*(1), 89-97. doi:10.1901/jaba.1993.26-89
- Macpherson, K., Charlop, M. H., & Miltenberger, C. A. (2014). Using Portable Video Modeling Technology to Increase the Compliment Behaviors of Children with Autism During Athletic Group Play. *Journal of Autism and Developmental Disorders, 45*(12), 3836-3845. doi:10.1007/s10803-014-2072-3
- Maione, L., & Miranda, P. (2006). Effects of Video Modeling and Video Feedback on Peer-Directed Social Language Skills of a Child With Autism. *Journal of Positive Behavior Interventions, 8*(2), 106-118. doi:10.1177/10983007060080020201

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

- Mcpartland, J., & Volkmar, F. R. (2012). Autism and related disorders. *Neurobiology of Psychiatric Disorders Handbook of Clinical Neurology*, 407-418.  
doi:10.1016/b978-0-444-52002-9.00023-1
- Odom, S. L., Thompson, J. L., Hedges, S., Boyd, B. A., Dykstra, J. R., Duda, M. A., . . . Bord, A. (2014). Technology-Aided Interventions and Instruction for Adolescents with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 45(12), 3805-3819. doi:10.1007/s10803-014-2320-6
- Pollard, J. S., Betz, A. M., & Higbee, T. S. (2012). Script Fading To Promote Unscripted Bids For Joint Attention In Children With Autism. *Journal of Applied Behavior Analysis*, 45(2), 387-393. doi:10.1901/jaba.2012.45-387
- Ramdoss, S., Machalicek, W., Rispoli, M., Mulloy, A., Lang, R., & O'Reilly, M. (2012). Computer-based interventions to improve social and emotional skills in individuals with autism spectrum disorders: A systematic review. *Developmental Neurorehabilitation*, 15(2), 119-135. doi:10.3109/17518423.2011.651655
- Raulston, T., Carnett, A., Lang, R., Tostanoski, A., Lee, A., Machalicek, W., . . . Lancioni, G. E. (2013). Teaching individuals with autism spectrum disorder to ask questions: A systematic review. *Research in Autism Spectrum Disorders*, 7(7), 866-878. doi:10.1016/j.rasd.2013.03.008
- Reagon, K. A., & Higbee, T. S. (2009). Parent-Implemented Script Fading To Promote Play-Based Verbal Initiations In Children With Autism. *Journal of Applied Behavior Analysis*, 42(3), 659-664. doi:10.1901/jaba.2009.42-659

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

- Sarokoff, R. A., Taylor, B. A., & Poulson, C. L. (2001). Teaching children with autism to engage in conversational exchanges: script fading with embedded textual stimuli. *Journal of Applied Behavior Analysis*, *34*(1), 81-84. doi:10.1901/jaba.2001.34-81
- Shane, H. C., & Albert, P. D. (2008). Electronic Screen Media for Persons with Autism Spectrum Disorders: Results of a Survey. *Journal of Autism and Developmental Disorders*, *38*(8), 1499-1508. doi:10.1007/s10803-007-0527-5
- Volkmar, F. R., Rogers, S. J., Paul, R., & Pelphrey, K. A. (2014). *Handbook of autism and pervasive developmental disorders*. Hoboken, NJ: John Wiley & Sons, Inc.
- Wichnick, A. M., Vener, S. M., Pyrttek, M., & Poulson, C. L. (2010). The effect of a script-fading procedure on responses to peer initiations among young children with autism. *Research in Autism Spectrum Disorders*, *4*(2), 290-299. doi:10.1016/j.rasd.2009.09.016
- Xin, J. F., & Leonard, D. A. (2014). Using iPads to Teach Communication Skills of Students with Autism. *Journal of Autism and Developmental Disorders*, *45*(12), 4154-4164. doi:10.1007/s10803-014-2266-8
- Yakubova, G., Hughes, E. M., & Shinaberry, M. (2016). Learning with Technology: Video Modeling with Concrete–Representational–Abstract Sequencing for Students with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *46*(7), 2349-2362. doi:10.1007/s10803-016-2768-7

Appendix A  
**Pre-teaching Reading Assessment**  
(Grosberg & Charlop, *in press*)

Reading Test A

1. Red toy
2. Cool car
3. I like blocks
4. Give me lego
5. I want the book
6. I like insects too
7. Can you share the train?
8. Where is the yellow tractor?
9. I'm going to get the puzzle
10. Show me the dinosaur you want

Read Test B

1. Blue toy
2. Your turn
3. This is fun
4. Show me book
5. Play cars with me
6. You need to share
7. Where is the black truck?
8. Do you want to play?
9. I'm tired of playing this game
10. Let's pretend to sail our boats

Appendix B  
**MLU Scoring Guide**  
 (Grosberg & Charlop, *in press*)

<p><b>1. Don't Count:</b></p> <p>-all utterances where it is unclear what the child said.</p> <p>-exclamations, “<i>mm</i>”, “<i>oh</i>”, etc., except when they form the entire utterance</p> <p>-false starts, <i>want</i>, <i>-want drink</i></p>
<p><b>2. Count</b> the number of morphemes, both content and grammatical, counting as a single morpheme:</p> <p>-compound words, <i>choo-choo</i>, <i>birthday</i> etc.</p> <p>-words with ‘ie/y’, <i>mummy</i>, <i>doggie</i></p> <p>-irregular past tense, <i>went</i></p> <p>but including as separate morphemes:</p> <ul style="list-style-type: none"> <li>• Auxiliaries; <i>will</i>, <i>is</i>, ‘<i>s</i>’, <i>have</i>, ‘<i>ve</i>, etc.</li> <li>• All inflected endings ‘-s’, ‘-ed’, etc</li> </ul>
<p><b>3. Divide</b> the total by the number of utterances to get the MLU in morphemes</p>



## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

Appendix C  
**Coding Definitions**  
 (Grosberg & Charlop, *in press*)

**Social Initiation:** questions or comments not contingent upon a peer's immediately prior utterance (Maione & Mirenda, 2006).

**Response:** Any time the child replies to the words or actions of another person (Bishop et al., 1994).

### DEPENDENT MEASURE

#### Appropriate Social Initiations

**Include:**

1) Introducing a new idea or topic; 2) Requesting an action, object, or information; 3) Commenting about current observable events or something other than the current activity; or 4) Complimenting the peer or one's self; 5) Attempting to gain the peer's attention verbally.

\*\*To be scored for the dependent measure, the social initiation must also relate to and make sense given the linguistic and social context of the play situation.

### ANCILLARY DATA

#### Inappropriate Social Initiations

**Include:**

- Shouting at another child
- Perseverative speech- repeating the same phrase or word over and over or bringing up the same topic repeatedly when it is no longer appropriate.
- Echolalia-repeating words, phrases, intonation, or sounds of the speech of the peer

#### **Appropriate Responses**

**Includes:**

- A response that shares the topic of the previous utterance and builds on or relates to the question/comment prior to it (i.e., "I like playdough too!")
- A verbal response that keeps the conversation going (ex. A child saying, "Wow!" in response to a peer saying "look at my tower!")

#### **Inappropriate Responses**

**Includes:**

- Responses that are off topic or do not relate the verbal or nonverbal cues of the listener
- Perseverative speech
- Echolalia

## TMI: CONVERSATION BETWEEN TWO CHILDREN WITH ASD

## Appendix D

**Data Collection Instrument**  
(Grosberg & Charlop, *in press*)

**Child's Name:** \_\_\_\_\_

**Session Phase:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Directions:** Record the behavior of the target child. The total observation time is 5 minutes. For each turn of conversation, circle either **AI**= Appropriate Initiation + sub-category (Introducing, Requesting, Complimenting, Gaining Attention), **NAI**=Not Appropriate Initiation, **AR**=Appropriate Response, **NAR**=Not Appropriate Response. Then, write what the child said in the space below

<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>
<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>
What did the child say?  	What did the child say?  	What did the child say?  	What did the child say?  	What did the child say?  
<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>	<b>AI</b> <i>Introducing</i> <i>Requesting</i> <i>Complimenting</i> <i>Gaining</i> <i>Attention</i>
<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>	<b>AR</b> <b>NAI</b> <b>NAR</b>
What did the child say?  	What did the child say?  	What did the child say?  	What did the child say?  	What did the child say?  