3-3-2018

Using Video Self-Modeling to Increase Social Communication in Children with Autism Spectrum Disorder

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University of Connecticut, 2018

The need for effective interventions to improve the social communication skills of children with autism spectrum disorder (ASD) that are feasible to implement in the general education classroom has been well documented. Video self-modeling (VSM) interventions have produced rapid, durable positive behavioral changes that have been generalized beyond the intervention setting for individuals with a wide variety of conditions including ASD. In this study VSM was used as an intervention for increasing the use of spontaneous verbal communication during cooperative math activities with peers by three Hispanic boys ages 5 and 6 who had high functioning (HF) ASD. No defensible intervention effects were demonstrated in this experiment. It was likely that the target social communication skills were beyond the participants' current skill sets at least for the context in which those skills were used, a cooperative math activity. Possible implications, limitations, and future research were discussed.

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A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

at the

University of Connecticut

2018

APPROVAL PAGE

Doctor of Philosophy Dissertation

Using Video Self-Modeling to Increase Social Communication in Children with Autism Spectrum Disorder

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2018

ACKNOWLEDGEMENTS

I am very grateful for all the support I have received from my advisory committee, family, and friends. This study could not have been completed without the insightful suggestions and encouragement over the years from my major advisor, Dr. Melissa Bray. Whenever I did not know how to proceed, I could count on an immediate and knowledgeable response from her; she was always willing to share her expertise in video self-modeling and analysis of results. Dr. Thomas Kehle repeatedly challenged my assumptions about research during the many hours that Dr. Bray and I worked on research grant applications with him. I learned so much through observing their collaboration. Dr. Sandy Chafouleas's constructive remarks and recommendations improved the quality of this project. Her guidance helped me navigate the twists and turns of dissertation review process. Without the excellent suggestions I received from Dr. Deborah Fein I never would have explored the fascinating literature about imitation, the section I most enjoyed writing. I am grateful for the suggestions that Dr. Hariharan Swaminathan gave regarding the statistical analysis during my dissertation proposal defense. To Dr. Rachelle Perusse, thank you for sitting in for Dr. Kehle, who passed away a few weeks prior to my defense. My sons assisted me in many ways throughout this process. I am grateful for the words of encouragement I have received from many friends. Finally, I would like to thank the educators, parents, and students who participated in this study.

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Chapter 1

Introduction

Statement of the Problem

The need for effective interventions addressing the social communication deficits of children with high functioning autism spectrum disorder (HF-ASD) that are feasible to implement in the general education setting allowing that these children to benefit from inclusion was documented by several researchers (e.g., Gutierrez, Hale, Gossens-Archuleta, & Sobrino-Sanchez, 2007; Locke et al., 2015; Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010). From when autism was first described by Kanner (1943), difficulties related to the generalization of learning that occurred in one environment to another (for review, see Brown & Bebko, 2012). Social skills interventions for children with ASD that were implemented in the typical classroom setting had higher intervention, maintenance, and generalization effects than those done in pull-out groups or other contrived settings (Bellini & Akullian, 2007; Gresham, Sugai, & Horner, 2001). Over the past fifteen years, a number of interventions were effective for improving the social communication and interaction skills of children with HF-ASD (National Autism Center, 2015), but studies repeatedly found that these methods were rarely adopted or implemented in schools (Locke et al., 2015; Morrier, Hess, & Heflin, 2011; Stahmer, 2007; Tincani, Cucchiarra, Thurman, Snyder, & McCarthy, 2014). Instead, educators often used unestablished interventions such as Gentle Teaching, Social Stories, and Sensory Integration (Hess, Morrier, Heflin, & Ivey, 2008). The reasons why educators did not adopt well established included lack of resources, time away from academic instruction (Forman, Olin, Hoagwood, Crowe, & Saka, 2009), need for extensive staff training, and lack of administrative support (Dingfelder & Mandell, 2011; Odom, Cox, & Brock, 2013; Stahmer et al., 2015). To avoid these implementation pitfalls and increase the chance that a social communication intervention would be implemented in an inclusive classroom with fidelity, it needed to be low-cost, require minimal to no training, and require little time away from instruction (Bellini & McConnell, 2010).

An intervention that had been effective for improving social communication in some children with ASD was video self-modeling (VSM; Bellini, Akullian, & Hopf, 2007; Buggey, 2009; Hepting & Goldstein, 1996; Shukla-Mehta, Miller, & Callahan, 2010; Wert & Neisworth, 2003). VSM was an intervention that has students repeatedly observe their own behavior via brief, edited videos of themselves performing only the adaptive or desired target behaviors over several spaced sessions (Clarke, Bray, Kehle, & Truscott, 2001; Dowrick, 1999; Kehle, Bray, Margiano, Theodore, & Zhou, 2002). Typically, when VSM techniques were effective in changing a child's behavior, the response was immediate (within the first three viewings) and the target behaviors acquired from this short but efficacious treatment were generalized and maintained across person, setting, and materials without additional instruction. The only time away from academic instruction was a one-time 30- to 40-minute session for creating the intervention videos and a few minutes for viewing the two- to three-minute intervention videos. With the advent of smart phones and tablets with high-resolution video cameras and free video editing software, creation of the intervention videos had become easier and more accessible than it was even three to four years ago. Instructions for making intervention videos were readily available online at many websites (e.g., Autism Speaks, 2016; LaCava, 2008; Merrill & Risch, 2014) and on YouTube.

Purpose of the Study

The primary purpose of this study was to evaluate the efficacy of VSM for increasing the frequency of verbal initiations and contingent responses made by children with ASD ages 5 to 7 and the duration of their ongoing social interactions with peers. This expanded upon previous research using VSM with children who had ASD to increase verbal communication skills (Buggey, Toombs, Gardener, & Cervetti, 1999; Sherer et al., 2001; Wert & Neisworth, 2003). As the verbal communications occurred in the context of social interactions, this expanded on the study done by Bellini et al. (2007) using VSM to increase the unprompted social interactions with two preschool-aged boys with ASD. The subjects were from a population that had limited participation in published ASD treatment trials generally, and specifically in VSM treatment trials.

A secondary goal of this study was to contribute to the limited research documenting functional speech development after the fifth birthday. The participants had limited functional use of single words or word combinations and were ages 5 to 7. The procedures recommended by Tager-Flusberg and her colleagues (Tager-Flusberg et al., 2009) were used to provide accurate and detailed descriptions of the participants' characteristics and language usage. While not a focus of this study, if any of the participants used Spanish appropriately during their social interactions with Spanish-speaking typically developing (TD) peers when the treatment videos for VSM were prepared, their Spanish verbalizations were included in the edited videos. Most, if not all, published research using VSM had been done using treatment videos in English; if the videos include utterances in Spanish, this would have contributed information about the effects of VSM with children who were from bilingual backgrounds.

Specific Research Questions and Associated Hypotheses

1. Did VSM increase the frequency of verbal initiations and contingent responses made by children with ASD from diverse backgrounds living in an urban setting during social interactions with peers?

Hypothesis. It was hypothesized that VSM would increase the frequency of verbal initiations and contingent responses made by children with ASD from diverse backgrounds living in an urban setting during social activities with peers.

2. Did VSM increase the duration of the participant's engagement in ongoing interactions with peers?

Hypothesis. It was hypothesized that VSM would increase the duration of the participant's engagement in ongoing interactions with peers.

3. In comparison to the participant's utterances pre-intervention, were the length, rate, and complexity of the participant's utterances significantly higher post-intervention as measured by the analyses of the SALT transcripts?

Hypothesis. It was hypothesized that the length, rate, and complexity of the participant's utterances would be significantly higher post-intervention in comparison to their pre-intervention utterances as measured by the analyses of the SALT transcripts.

Chapter II: Literature Review

Synopsis of Autism Spectrum Disorder

ASD was defined as a complex and heterogeneous disorder characterized by enduring deficits across multiple contexts in two domains: social-communication and restricted repetitive behaviors (RRBs; American Psychiatric Association, 2013). Deficits in social communication included failing to initiate or respond to social bids, limited reciprocity during social interactions, abnormal use of nonverbal communication, and difficulties in developing, maintaining, and understanding social relationships. The RRBs comprised stereotyped or repetitive motor movements (e.g., hand-flapping, complex postures), echolalia, idiosyncratic phrases, ritualized patterns of verbal or nonverbal behavior, excessively circumscribed interests, and over- or under-responsiveness to sensory input. While there was substantial heterogeneity in the expression and severity of these behaviors across individuals with ASD (W. Jones & Klin, 2009; Rapin & Tuchman, 2008; Troyb, Knoch, & Barton, 2011), functional language skills and IQ were strong predictors of adult outcome (Anderson, Liang, & Lord, 2014; Howlin, Savage, Moss, Tempier, & Rutter, 2014) and usually provided an acceptable estimate of ASD severity (Lord & Bishop, 2015).

The most recent surveillance report from the Center for Disease Control and Prevention (CDC) provided a conservative estimated prevelance of ASD in children aged eight as being 14.6 per 1,000 (one in 68) in 2012 for the eleven Autism and Developmental Disabilities Monitoring (ADDM) Network sites in the United States (Christensen et al., 2016). The overall prevelance estimate for the ADDM Network sites in 2012 essentially was equivalent to the prevelence estimate of 14.7 per 1,000 (one in 68) in 2010. This was first two-year period between surveillance reports for which the overall prevelance estimate for the ADDM Network sites did not rise. In 2000, the first prevelance estimate for the ADDM Network sites was 6.7 per 1000 (Autism and Developmental Disabilities Monitoring Network Surveillance Year 2000 Principal Investigators, 2007) and the estimate rose in the reports for each subsequent two-year period until 2012. At the five sites that provided data on intellectual ability 68.4% of the children with ASD had an IQ above 70 including 43.9% who had an IQ 85 or above. Typically, high-functioning (HF) ASD was defined as having an IQ above 70; therefore a majority of these children had HF-ASD. Again, the estimated prevalence of ASD with and without intellectual disability did not change from the estimated prevalence in 2010. This was described as being notable because “the increase in estimated ASD prevalence that has occurred since 2002 has been accompanied by a greater increase in ASD without intellectual disability than ASD with intellectual disability (Christensen et al., 2016, p. 9).” Disparities in estimated ASD prevelance by race/ethnicity had been present in all of the previous reports and continued in the 2012 report. Overall, ASD prevalence in non-Hispanic white children was 20% higher compared to non-Hispanic black children, 40% higher compared to Asian/Pacific Islander children, and 50% higher compared to Hispanic children. In comparison with non-Hispanic white children, a lower percentage of non-Hispanic black and Hispanic children had their first comprehensive evaluation by age 36 months. This suggests that their diagnoses and treatment may have been delayed.

According to a chartbook completed by the Child and Adolescent Health Measurement Initiative (CAHMI) and the Johns Hopkins Bloomberg School of Public Health (2016), 84% of the school-aged children with ASD included in the National Survey of Children’s Health (NSCH) 2011/12 received services under an Individualized Education Plan (IEP). Currently, 8.3% of the children served under Individuals with Disabilities Education Act (IDEA) were identified with autism; most of these children were enrolled in general education classrooms and spent at least 40% of the school day with TD children (U.S. Department of Education, 2016b). CAHMI (2016) reported that among children ages 6 to 17 years, in comparison to children without ASD, a significantly greater proportion of children with ASD repeat a grade (9% vs. 22%), were absent eleven or more days of school in the past year (6% vs. 18%), and a significantly smaller proportion met the School Success Index (i.e., child was engaged in school, participated in extra-curricular activities, and usually felt safe at school; 31% vs. 62%). When they compared children with mild ASD to severe ASD, there were significant differences between their school experiences. For example, compared to children with severe ASD, a higher percentaged of children with mild ASD repeated a grade (24% vs. 17%) and met the School Success Index (41% vs. 14%). In addition, a much smaller proportion of children with mild ASD missed eleven or more days of school in the past year in comparison to children with severe ASD (11% vs. 49%). While these statistics suggest that children with ASD need more support in school, there are significant differences between the educational needs of children with mild and severe ASD.

Social Communication Deficits in Children with HF-ASD

Social communication were broadly defined as “the capacity for a child to respond to bids for interaction from a communicative partner and the frequency of initiating social interactions” (C. D. Jones & Schwartz, 2009, p. 432). During interactions with their peers, children with HF-ASD had difficulty using verbal behaviors such as engaging reciprocal conversation, responding to conversational partner’s cues, using unusual intonation along with exhibiting nonverbal behaviors such as using inappropriate facial expressions and poorly modulating their use of gaze (Bauminger-Zviely, Karin, Kimhi, & Agam-Ben-Artzi, 2014; Paul, Orlovski, Marcinko, & Volkmar, 2009). In comparison to typical developing childen with similar receptive and expressive language skills, children with HF-ASD made fewer attempts to initiate conversations, made fewer contextually appropriate responses to others’ conversational bids, and made fewer contingent comments to sustain conversations (C. D. Jones & Schwartz, 2009). The early deficits in reciprocal social interaction skills restricted the quality and quantity of social experiences for children with HF-ASD thereby limiting the opportunities for them to acquire higher level social communication and interaction skills. (W. Jones & Klin, 2009). Their persistent reciprocal social communication deficits restricted their ability to control their social environment, participate in cooperative activities, and establish reciprocal friendships

(McFadden, Kamps, & Heitzman-Powell, 2014). Multiple studies demonstrated that children with HF-ASD in inclusive classrooms generally had difficulty making friends and are on the periphery of social networks in their classrooms (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011; Shattuck, Orsmond, Wagner, & Cooper, 2011).

The disparity between TD peers' social skills and those of children with HF-ASD were found to increase during adolescence especially for those skills required in more complex social situations (e.g., maintaining intimate relationships or networking in the workplace; Marriage, Wolverton, & Marriage, 2009). In a longitudinal study done by Howlin, Moss, Savage, and Rutter (2013), the strongest predictor of outcomes for adults with HF-ASD was the Reciprocal Social Social Interaction domain score on the Autism Diagnostic Interview – Revised (Rutter, Le Couteur, & Lord, 2003) when their diagnosis was then reconfirmed in an earlier study (Howlin, Goode, Hutton, & Rutter, 2004). Improving the social communication skills of children with HF-ASD during their early schooling may improve the quality of their social relationships and enhance their functioning throughout their lifetime (L. K. Koegel, Kuriakose, Singh, & Koegel, 2012).

Currently, the majority of the children with HF-ASD have been included in general education classrooms for much of their school day with typical peer role models, and yet multiple studies have shown that while inclusion is necessary (Woodman, Smith, Greenberg, & Mailick, 2016), it has not been sufficient to promote the social communication skills needed by most children with HF-ASD (Kasari et al., 2011; Rotheram-Fuller et al., 2010). Studies have shown that children and adolescents with HF-ASD report having lower quality friendships and having higher rates of loneliness despite having a desire to have close friends (Kuo, Orsmond, Cohn, & Coster, 2013; Locke, Ishijima, Kasari, & London, 2010). High quality friendships have been shown to be a protective factor for TD children and adolescents from bullying and victimization and to be associated with better psychosocial adjustment (Bollmer, Milich, Harris, & Maras, 2005; Kendrick, Jutengren, & Stattin, 2012). Notably, for children who have low peer acceptance, having high quality friends has been associated with a lower likelihood of being victimized (Malcolm, Jensen-Campbell, Rex-Lear, & Waldrip, 2006). Children and adolescents with ASD were at higher risk of being bullied in comparison to TD children and the risk increased as the time spent in general education classroom increased and the child's overall functioning increased (Wainscot, Naylor, Sutcliffe, Tantam, & Williams, 2008; Zablotsky, Bradshaw, Anderson, & Law, 2014). If children with HF-ASD had at least one reciprocal friend, they were found to be more involved in their classroom's social network and to be more accepted by peers (Rotheram-Fuller et al., 2010).

Interventions for Improving the Social Communication Skills of Children with HF-ASD

The results of of systematic reviews and meta-analyses of interventions to improve the social communication or social skills of children with ASD varied by the research design the studies used (i.e., single subject design [SSD] or randomized clinical trials [RCT], intervention methods compared (e.g., social stories/narratives, Pivotal Response Training), video modeling interventions (VMI; includes VSM, video modeling [VM], and point-of-view modeling [POV]), peer mediated interventions (PMI), or a broader scheme of classification for social skills interventions (e.g., McConnell, 2002). Using McConnell's (2002) taxonomy to classify types of social skills interventions, a meta-analysis of school-based SSD social skills interventions for children with ASD found these interventions to be minimally effective (Bellini, Peters, Benner, & Hopf, 2007). They found similarly low treatment effects for collateral skills, peer-mediated, child-specific, and comprehensive interventions regardless of number of intervention sessions, hours of intervention, and length of intervention consistent the results of Gresham et al (2001). Nevertheless, a comparison of the treatment, maintenance, and generalization effects of interventions implemented in the child's inclusive classroom and those of implemented away from the generalization setting (e.g., separate classroom, off-site clinical setting) revealed that those implemented in the child's inclusive classroom were significantly more effective (Bellini, Peters, et al., 2007). Similarly, Wang and Spillane (2009) found that with the exception of VMI, social skills interventions (e.g., Social Stories, PMI, and Cognitive Behavioral Training [CBT]) were minimally effective for children with ASD. Meta-analyses and systematic reviews of SSD research of interventions using PMI to improve social communication and interaction skills of children with HF-ASD have found that it is effective in community and inclusive school settings (Chan et al., 2009; Watkins et al., 2015; Zhang & Wheeler, 2011). A meta-analysis of school-based peer-related social competence interventions for children with ASD found that PMI, multi-component, and adult-mediated interventions had more evidence for improving peer interactions in school than social narratives and VMI (Whalon, Conroy, Martinez, & Werch, 2015). They noted that both social narratives and VMI were often part of an intervention package and recommended further study to determine if the the other components in the package were required for these treatments to be effective with some participants.

In reviews of RCT to improve social skills in children with ASD, studies demonstrated the skills targeted by the interventions were improved in the clinical or laboratory setting, but generalization into other settings was not evaluated (Williams White, Keonig, & Scahill, 2007). In their best evidence synthesis of interventions to increase social interactions, Reichow and Volkmar (2010) found sufficient support in RCT to establish social skills groups for school-aged children with ASD as an established evidence-based practice (EBP) even though most of the studies were completed in a clinical setting. VMI for school-aged children was the only other social skills intervention that met the EBP criteria in that synthesis and they recommended further research to determine what type of model (e.g., peer, adult, point-of-view, self) was most likely to be effective to change which behaviors for whom under what conditions. For a majority of the group design intervention research one of the main goals was to change the child's behavior at school, although the research is done in another setting (Kasari & Smith, 2013). An exception was a study in which some of the participants of a larger, long-term social skills intervention study were observed on the school playground by graduate assistants and rating scales were completed by teachers and parents to determine if the frequency of play dates they had at home and the amount of conflict was related to their playground behavior (Frankel, Gorospe, Chang, & Sugar, 2011; Frankel et al., 2010).

A recent review of the external validity of RCT of social skills group interventions for children and adolescents with ASD (Jonsson, Choque Olsson, & Bölte, 2016) that included most of the RCT mentioned above along with others, found that the participants were mainly Caucasian whose parents had a relatively high level of education. In addition, few studies included blinded observations of the participants in their everyday environments along with follow-up of long-term effects. The studies rarely were implemented by staff who worked with the children with ASD in their everyday settings and information regarding the costs related to the interventions was not given. None of Kasari et al.'s RCT were included in this review.

The series of RCT evaluating school-based interventions to improve the social skills of children with HF-ASD done by Kasari and colleagues (e.g., Iadarola et al., 2015; Kasari et al., 2016; Kasari et al., 2011; Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012) included children from diverse backgrounds and were conducted in schools. The efficacy of the interventions was evaluated through observations of the children with ASD interacting with the peers on the school playground, social network surveys completed by the children with HF-ASD and at least 50% of their classmates, and teacher questionaires. In most of the studies, trained graduate assistants implemented the interventions during lunch or recess with the exception of one in which trained paraprofessionals administered the intervention during lunch or recess (Kretzmann, Shih, & Kasari, 2015). In one study, Kasari and her colleagues compared the effectiveness of a PMI to a child-specific one in which children with HF-ASD were trained individually to master the social skills that were determined to be difficient by their assessment (Kasari et al., 2012). Over six weeks, twice a week for 20 minutes during lunch or recess, the peer assistants for the PMI were trained to identify socially isolated children and specific strategies for encouraging these children to join play with their peers. In the PMI, the target children were never directly idenitified to the peer assistants; the peer assistants identified children who for example, were standing by themselves and watching ongoing activities, and invited them into those activities. The peer assistants were taught to identify appropriate and inappropriate play, iniciate play interactions, enable participation in games, and resolve conflicts. Target children who received the child-specific intervention were reinforced for attempting and engaging socially with peers; peer assistants in the PMI were reinforced for engaging appropriately with socially isolated children. The study found that target children who received both the PMI and child-specific instruction had significantly higher social network survey (SNS) scores in comparison to those who only received the child-specific instruction or those who did not receive either intervention (i.e., no PMI or child-specific instruction. Additionally, the scores on the SNS for the children who received both PMI and child-specific instruction had marginally significant difference with those of the children who received only the PMI. Treatment effects from the child-specific instruction only were smaller and more temporary than those from the PMI groups (i.e., PMI only and PMI plus child-specific instruction). At the 12-week follow-up, only those in the PMI groups decreased their solitary play and increased their engagement in play and conversations. Based on the results of the SNS, the peer assistants typically were the most socially adept children and they maintained their high social standing during the intervention and follow-up phases. There was no negative effect on the social standing for the peers who assisted. The authors recommended future effectiveness trials in which school staff do the interventions to increase the intervention dose and generalization of effects.

In one of the follow-up studies (Kretzmann et al., 2015), paraprofessionals were trained to specific strategies to encourage children engaged in solitary activities to join play with others, prompt children to play games with each other, and to facilitate appropriate interactions between children during recess. The intervention was effective for increasing the social interactions of the children with ASD and increasing the responsiveness of the adults on the playground and the treatment effects for the children were maintained in the follow-up period, but the paraprofessionals did not maintain their responsiveness. Kasari et al (2016) noted that it would have been more cost-effective and ecologically valid to train the school staff to implement the interventions, but described the challenges of having the interventions delivered with fidelity by school staff (Kasari & Smith, 2013).

VMI. In VMI, participants are repeatedly shown a brief video of the desired or target behavior being performed without prompting or errors. The person modeling the behavior can be an adult, sibling, or peer (video modeling [VM]) or an edited version of the participant him or herself (video self-modeling). Most of the VM intervention videos show the target behavior from a third-person perspective so that the participant views it as an on-looker, but recently there have been some VMI studies in which the target behavior is shown from the first-person perspective so that the participant observes the target behavior from the point of view of the one engaged in it (point-of-view video modeling [POV]; Mason, Davis, Boles, & Goodwyn, 2013; Shukla-Mehta et al., 2010). When VMI is used as a stand-alone intervention rather than as a component of a treatment package, participants view the intervention video and then are given opportunities to imitate the target behavior. When participants respond positively to VMI, they often do so within the first few brief sessions and the durable positive changes in behavior are generalized to other situations without need for additional intervention (Kehle, Clark, Jenson, & Wampold, 1986; Sherer et al., 2001). Smart phones and tablets with high-resolution video cameras and free video editing software have increased the cost-effectiveness and feasibility of having the school staff create and implement VMI.

Over 200 published studies have demonstrated that video self-modeling (VSM) is a highly efficient, unintrusive, and effective intervention for a wide range of treatment-resistant behaviors associated with a range of disorders including selective-mutism (Kehle, Madaus, Baratta, & Bray, 1998), stuttering (Bray & Kehle, 2001), emotional disturbance (Kehle et al., 2002), tic disorders (Clarke et al., 2001), and others (Hitchcock, Dowrick, & Prater, 2003). VSM has successfully treated many behaviors associated with autism spectrum disorders (ASD) as shown in recent reviews and meta-analyses (Bellini & Akullian, 2007; Mason, Davis, Ayres, Davis, & Mason, 2016; McCoy & Hermansen, 2007; S. Y. Wang, Cui, & Parrila, 2011), but some reviews (Darden-Brunson, Green, & Goldstein, 2008; Rayner, Denholm, & Sigafoos, 2009; Reichow & Volkmar, 2010), still raise questions about why some individuals with ASD respond quickly to VSM interventions but others do not, and if the investiment of time and effort to create individualized VSM treatment videos is worthwhile when video modeling using a typical peer as the model may be equally effective. Dowrick (2012a) argued that because VM and VSM are forms of observational learning, have the same purpose (i.e., increase adaptive behavior) and use the same underlying cognitive mechanism, the question should not be "'which is better' in a global sense" (p. 227). Instead, he suggested that future research should evaluate when or under what circumstances would one be more effective or feasible than the other.

Dowrick differentiated between two forms of self-modeling: positive self-review (PSR) and feedforward. PSR was conceptualized as being a reconstructive process in which the individual's performance of a target skill was recorded while maximizing it by using aides such as incentives and rehearsals and later edited to removed any imperfections. He stated, "PSR reconstructs an achieved, exemplary behavior, presumably in need of strengthening" (1999, p. 26). Examples of PSR included increasing on-task behavior in a classroom by editing out instances of inappropriate or disruptive behavior or boosting engagment in a low frequency activity such as physical exercise (Kehle et al., 2002). In feedforward, the treatment video combined or constructed a demonstration of the individual performing a skill that they had not yet achieved or performed in a certain context from their performance of the component subskills that were currently in behavioral repertoire (Dowrick, 1999). Dowrick, Kim-Rupnow, and Power (2006) explained that Vygotsky's zone of proximal development (ZPD) provided components of the theoretical framework for feedforward in that it created learning in the ZPD. Vygotsky defined ZPD as being "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (1978, p. 86). Through combining or reorganizing the component subskills into a new sequence or done in a novel context, individuals observed themselves performing "a previously unachieved, but possible future, or target, behavior" (1999, p. 26). Feedward self-modeling was used to combine components of sport skills to produce a fluid, successful performance or editing a video of a child with selective mutism answering her mother's questions so that it appears that she is answering her teacher's questions. Dowrick argued that the learning that occurred in self-modeling was a result of observing one's future behavior (1999).

Theoretical Basis of VSM

Social Learning Theory. There has been a strong interest in how audiovisual media affects learning and behavior for many decades; in the late 1950's and early 1960's a few studies regarding how observing aggression in films affected aggressive behavior in children and adults were published (e.g., Lovaas, 1961; Maccoby & Wilson, 1957; Siegel, 1956; Walters, Thomas, & Acker, 1962). At that time, operant conditioning and various stage theories (e.g., Freudian theory's oral-anal-phallic, Piaget's stages from sensorimotor to formal operational) were the two dominant learning theories. Bandura questioned how much of social responses could be acquired solely through differential reinforcement or ontogenetically through a series of stages (Bandura, 1962a, 1962b; Bandura & McDonald, 1963). He proposed that much of social learning occurs through informal observation of social models without being differential reinforced (Bandura, Ross, & Ross, 1961) and completed a series of experiments demonstrating that behaviors exhibited by *in vivo* and symbolic models (primarily video models) were imitated without need of reinforcement (e.g., Bandura & Kupers, 1964; Bandura & Mischel, 1965; Bandura, Ross, & Ross, 1963a, 1963b). In the mid to late 1960's, Bandura and his colleagues compared the efficacy of various interventions to extinquish avoidant behaviors including desensitization, symbolic (i.e., video) models, and modeling with guided participation (i.e., joint participation combined with graduated live modeling) with children and adults (e.g., Bandura, Blanchard, & Ritter, 1969; Bandura, Grusec, & Menlove, 1967; Bandura & Menlove, 1968). Symbolic modeling interventions were as effective in reducing avoidant behavior as desensitazation interventions, but the modeling procedures were more effective in reducing arousal and producing positive attitudes. Modeling with guided participation had the strongest effect and was the only procedure that resulted in participants with a long-term phobia of snakes to handle them without any need for protective gear (Bandura et al., 1969). On the post-test fear inventory, the participaants in the modeling with guided participation group reported the most extensive reduction in fear across a variety of threats including actual threats such as animals, physical injury, and interpersonal situations.

Bandura's social learning theory proposed that modeling promoted learning by exposing the observers to information that allowed them to form symbolic representations of the modeled activities and this symbolic representation was utilized as a performance guide (Bandura, 1975, 1977). Four interrelated processes permitted observational learning: attention, retention, production, and motivation.

Attention processes determined what models were observed closely along with which relevant features of the modeled behavior were selected and accurately perceived. Variables influencing attention included the observers' and models' traits, aspects of the modeled behavior, frequency of observation opportunities, and rewards for learning the modeled behavior. Observer features encompassed their previous learning experiences, personal preferences, cognitive ability, and arousal level. Attributes of the models that influenced attention comprised their perceived interpersonal attractiveness, similarity to observer, and prestidge. The nature of the modeled behaviors such as funtional value, salience, complexity, and frequency of exposure affected attention (Bandura, 1977, 1997).

Retention processes permitted observers to reproduce the modeled behavior when the models were no longer present by actively transforming and restructuring the modeled information into symbolic represention retended in memory. The two primary representational systems proposed were visual imagery and verbal coding. Visual imagery was particulary important for observational learning in early development prior to acquiring the requisite verbal skills and for learning behaviors not easily described in words. Bandura stated that behavior was regulated mostly by verbal cognitive processes rather than visual and that the verbal coding probably accounted for the speed and retention of observational learning by humans. Cognitive structuring and rehearsal of the coded information greatly enhanced the observational learning especially when observers visualized themselves appropriately performing the modeled behavior within their own everyday context (Bandura, 1977, 1997). In VSM, the observers would see themselves appropriately performing the modeled behavior repeatedly thus facilitating the cognitive structuring and rehearsal of coded information.

Production processes involved utilizing the cognitive representations (i.e., conceptions) of the model behavioral patterns to guide the observers' performances. "Conceptions guide the construction and execution of behavior patterns, and the adequacy of the action is compared against the conceptual model (Bandura, 1997, p. 90)." Observers who had the required subskills were better able to integrate them into the production of the new behavioral pattern. When they did not have the requisite subskills to perform complex patterns, these skills were developed through modeling and practice (Bandura, 1977, 1997). Bandura stated that the modeling could produce three separable types of effects depending on the processes used. First, the observational learning effect occurred when observers acquire novel patterns of behavior from watching others perform and the effect was demonstrated when the observers subsequently exhibited novel responses that were substantially identical to the modeled behavior. Second, modeling could strengthen or weaken inhibition of earlier learned behavioral responses when the observers saw model's behavior be rewarded or punished consequently. Inhibitory effects were shown when the observers exhibited lower levels of the modeled behaviors after seeing the model's behavior punished and, conversely, disinhibitory effects were shown when the observers exhibited higher levels of a previously inhibited behavior after seeing models perform anxiety-provoking or proscribed behaviors that either were rewarded (e.g., aggressive behavior rewarded with access to high quality toys) or did not result in any negative consequences (e.g., models handling snakes not harmed). Finally, response facilitation effects occurred when the behavior of others served as cues for the observers to exhibit previously learned, socially acceptable behavior (e.g., joining in cheers at sporting events) but this effect was differentiated from observational learning and disinhibitory effects because no new behavior was acquired (Bandura, 1975, 1977).

Motivation processes affected the likelihood that an acquired behavior was performed because not all learned behaviors were enacted. Primarily, three types of incentives motivated performance of observed behaviors: direct, vicarious, and self-produced. Observers were most likely to perform (i.e., imitate) the modeled behavior if their performance results in valued consequences for themselves (direct) or if others similar to themselves (i.e., the models) were observed to received valued consequences as a result of their performance (vicarious). Personal standards of conduct (self-produced), their own evaluative reactions to their behavior (i.e., self-efficacy), and performance of activities that contribute to the observers' satisfaction and sense of self-worth motivated the integration of the modeled information into novel behavioral patterns (Bandura, 1997).

Based on Bandura's suggestion that modeling procedures be used as an intervention to address socially inappropriate behavior, Creer and Miklich (1970) used VSM to increase a 10-year-old boy's socially appropriate behavioral responses to other boys' taunting and when interacting while he was hospitalized due to his asthma. The boy was used as the model in the treatment video to circumvent the administrative problems associated with obtaining another model. During the phases when the boy watched the edited treatment video, he immediately started exhibiting the desired socially appropriate behaviors. In the reversal phase when he was shown a video of his inappropriate behavior, his behavior abruptly changed and he began displaying inappropriate behavior. For the last two weeks, he was again shown the edited treatment video and immediately starting displaying the appropriate behavioral responses; he continued to use the socially appropriate behavioral responses for the remaining 6 months of his hospitalization. In addition, he improved his use of adaptive behavior in contexts that were not part of the treatment. Bandura interpreted the generalization in the participants' use of adaptive behaviors to other contexts found in this self-modeling study and others (e.g., Dowrick, 1991; Kahn, Kehle, Jenson, & Clark, 1990) to indicate that successful self-modeling produced a general increase the participants' self-efficacy that, in turn, had a positive effect on their performance in other areas (1997).

Research has shown that the greater the similarity of the model to the observer, the more likely that the modeling intervention will be effective (Kazdin, 1974; Kornhaber & Schroeder, 1975). In the discussion of a follow-up study, Miklich, Chida, and Danker-Brown (1977) stated that "no model could be more profoundly similar to an observer than himself" (p. 129). Additionally, they noted that by looking at pictures of oneself performing socially approved behaviors usually was a pleasurable, rewarding experience and these positive feelings may become associated with features of the modeled behavior thus becoming a secondary reinforcer.

Theories of change for VMI. Explanatory theories of change mediating the rapid positive modification of behavior produced by VMI have included aspects from Bandura's social learning theory (1986) such as maximal similarity to and identification with the model, autobiographical memory alteration, and changes in perceived self-efficacy (Bandura, 1997; Dowrick, 1999; Kehle et al., 2002; Margiano, Kehle, Bray, Nastasi, & DeWees, 2009). Recently, Dowrick (2012b) has argued that mental time travel (MTT), the ability to visualize future events and recall specific past events would be a better explanation of the "almost instanteous" (Dowrick, 2012a, p. 116) learning that occurs during video self-modeling than imitation, a fundamental component of social learning theory. He asserted that the link between immediate (automatic) imitation and the observational learning that can be used for future behavior has not been established (2012b). In the sections below, detailed evidence to support or contradict these theories will be presented along with how this may influence the response of individuals with ASD to VMI.

Imitation. Imitation of modeled behavior was an essential component in Bandura's social learning theory and other theories of observational learning. Its importance in learning social interaction skills and practical knowledge across the life-span had been well-established through many empirical studies (e.g., Bek, Poliakoff, Marshall, Trueman, & Gowen, 2016; Breazeal, Buchsbaum, Gray, Gatenby, & Blumberg, 2005; Chartrand & Bargh, 1999; Whiten et al., 2016). Similarly, Vygotsky stated "human learning to be of specific social nature and a process by which children grow into the intellectual life of those around them" (1978, p. 88) and regarded imitation as fundamental to this process. Through imitation of adults and peers, children performed “a variety of actions that go well beyond the limits of their capabilities” (Vygotsky, 1978, p. 88).

Within the recent scientific imitation literature, types of copying behaviors have been distinguished to facilitate the understanding of how different ways of copying had different functions and underlying processes. A few different copying behavior taxonomies have been used in recent literature, but the one described below has been the most commonly used (for an alternative model, see Whiten, 2006). Based on work from comparative psychology (Byrne & Russon, 1998; Want & Harris, 2002), Vivanti and Hamilton’s (2014) copying behavior taxonomy included the following three categories:

1. *Emulation*. This happened when the observer did not copy the specific actions that the demonstrator used, but copied or reproduced the end result of the action. For example, after a boy observed a peer counting her fingers and writing the answers down on a math worksheet, the boy started writing the answers down on the math worksheet, but did not use his fingers because he had memorized the math facts. The goal of the behavior was copied, (i.e., complete the math worksheet), but the specific actions performed were different.
2. *Imitation* (a.k.a. *true imitation* or *high fidelity imitation*). This ensued when the observer copied or reproduced both the actions and the end result (i.e., goal) of the demonstrator. For example, a child watched her brother make a snow ball and then copied his actions to make one herself. The action and the goal of the observed behavior were copied with high accuracy. Imitation was considered to be an adaptive behavior for sharing cultural and technological skills (Heyes, 2013)

3. *Mimicry*. (a.k.a. *automatic imitation*) This occurred when the observer unconsiously copied another's actions without awareness of a goal or instrumental value. For example, in the game, "Rock, Paper, Scissors," indecisive players often mimicked the gesture made by the first responder rather than using an alternative response. To provide a different response, the later responders had to intentionally inhibit the urge to copy the observed action made by the first responder. Mimicry proportedly increased the sense of social connectiveness, facilitated pro-social attitudes and behavior (Chartrand & Bargh, 1999), and underlied the spontaneous synchronization that occurred when walking or dancing while talking with friends (R. Cook, Bird, Lünser, Huck, & Heyes, 2012).

The primary differences between the forms of copying behavior were in the actions performed and the goals of the behavior. In emulation, the goal was copied, but the actions were not; in imitation, both the actions and the goals were copied, and in mimicry, the action was copied spontaneously without any conscious awareness of goals (Vivanti & Hamilton, 2014). True imitation was a mechanism for learning new sensorimotor behaviors such as riding on a skate board and mimicry was a mechanism to develop socio-cognitive skills such as rapport and affliation (Chartrand & Bargh, 1999; Hamilton, 2015; Kavanagh & Winkielman, 2016).

Imitation in ASD. For over 50 years, there has been an interest in the imitation skills of children with ASD. The first mention of possible imitation problems in children with ASD was made by Ritvo and Provence (1954) when they described how a toddler could not learn how to play pat-a-cake after observing his mother. DeMeyer et al. (1972) did the first experimental study of imitation skills that included children diagnosed with autism based on the Do-as-I-Do tasks from Hayes and Hayes imitation research with chimpanzees (1952) that has continued to be used in imitation research. Videotape presentation of the modeling tasks instead of live presentation was introduced by Hammes and Langfell (1981) because it eliminated the minor, but possibly significant inconsistencies, that may occur during live modeling presentations. Rogers and Pennington (1991) completed the first review of studies evaluating the imitation skills of children with ASD (Williams, Whiten, & Singh, 2004) and concluded that imitation of other's body movements was one of the three early social abilities that were deficits specific to autism. They predicted that the imitation deficit was most detrimental early in life but would have cascading effects on the future learning of children with ASD in areas such as the developments of self/other mapping and theory of mind (Rogers & Pennington, 1991).

Research has supported that there were imitation deficits associated with ASD, but the nature of those difficulties has continued to be investigated (Vivanti, Trembath, & Dissanayake, 2014). Questions have continued regarding the universality of the imitative difficulties among individuals with ASD, the profile of strenths and weakinesses in their imitation performances, and what the neurocognitive mechanisms for these differences may be. Much of the early imitation research was replete with use of colloquial definitions for copying behaviors such as loosely defining imitation as reproducing the model's actions or movements (Sevlever & Gillis, 2010; Vivanti & Hamilton, 2014) or expanded the meaning of emulation (i.e., copying the goal but not the means) to include learning about the affordances of objects and relationships between them (Byrne & Russon, 1998). In addition, there was limited standardization of methological procedures used across studies (e.g., instructions, materials, and task complexity varied between studies) restricting the comparison and generalization of the findings across studies. Sevlever and Gillis stated that "an inconsistent operational definition of imitation" in research examining the abilities of children with ASD to imitate was "at the root of the contradictory findings and varied interpretations" (p. 977).

Over and Carpenter (2012) argued that the broader definition for imitation (i.e., "matching the behavior [actions, opinions, and attitudes] of a model after observing it"; p. 183) allowed them to link imitation to other closely related areas such as normative learning and conformity. Additionally, they emphasized the need to understand children's imitative behavior within the social context where it occurred. They proposed that there were three primary influential factors in determining what children copy: "the children's own learning versus social goal in the situation, children's identification with the model and the social group in general, and the social pressure children experience to imitate in particular ways" (p. 190) consistent with social learning processes proposed by Bandura. The authors agreed that for certain studies it was useful to define imitation operationally such as when the study's aim was to access the participant's ability to reproduce meaningless (i.e., novel) actions or goal-directed actions with fidelity.

Several recent imitation studies used the copying behavior taxonomy given above to describe the strengths and weaknesses in imitation performance of TD children (e.g., Z. Wang, Williamson, & Meltzoff, 2015) and children with ASD (e.g., Edwards, 2014; S. J. Hayes, Andrew, Elliott, Gowen, & Bennett, 2016). Research on the imitation abilities of children with ASD primarily focused on the frequency of spontaneous versus elicited imitation and accuracy of imitiative performance (Vivanti & Hamilton, 2014). Imitation tasks were designed to evaluate if the performance of children with ASD varied depending on factors such as whether or not the actions were goal or object directed, were meaningful (e.g., familiar to the participant and probably part of their motor repertoire), or were casually irrelevant or unnecessary (i.e., over-imitation).

In an attempt to disambiguate the mixed findings of the ASD imitation literature, Edwards (2014) completed a meta-analysis of 53 studies that directly accessing the elicited imitative abilities of individuals with ASD behaviorally using experimental designs by evaluating the effects of critical factors proposed by Sevlever and Gillis (2010) and Over and Carpenter (2012). The majority of the participants were male (85.84%); the ages of the participants with ASD ranged from 4.6 months to 37 years (M = 9.28 years; SD 6.65 years) and the full-scale IQ ranged from 68.8 to 119 (M = 96.9; SD = 15.0). Only studies using elicited imitation were included because the meta-analysis's goal was to examine "whether children with ASD *can* imitate (with or without support) rather than whether children with ASD *do* spontaneously imitate" (Edwards, 2014, p. 365), but elicitation was defined broadly to include both explicitly prompting and implicitly after watching a model in structured tasks. No studies of vocal imitation were included because language development could have had a confounding effect on imitation. Studies that assessed facial and mouth actions (including affect), body and hand actions, or object-directed actions were included, unlike a previous meta-analysis (Williams et al., 2004) that only included studies that accessed imitation of hand and body actions. The scoring procedures used by the studies were examined and then coded according to the meta-analysis's operational definitions for being measures of high fidelity imitation, emulation, or both. Live demonstrations were used in 39 studies, digital demonstrations were used in 11, both live and digital demonstrations were used in two, and one did not provide this information. Other factors evaluated included whether or not verbal prompts were used (81% used verbal prompts), imitation of high- versus low-incidence actions, inclusion of single-action versus action sequences, use of explicit verbal instructions to imitate the researcher's actions (e.g., "Do what I Do"), and unfamiliar versus familiar settings (Edwards, 2014).

On the measures of imitation included in the meta-analysis, participants with ASD performed 0.81 standard deviations below participants without ASD (overall M weighted ES = .808, z = 8.02, p < .001). There was significant variability between the effect size magnitudes across studies. The meta-analysis's moderator analyses for the effects of participant characteristics found no statistically signficant effects on their imitative performances for age relative to matched participants without ASD (Edwards, 2014). Similarly, in a recent study using functional connectivity magnetic resonance imaging (fcMRI) and diffusion-weighted imaging (DWI) to examine functional and structural connectivity of the imitation network in children and adolescents with HF-ASD they did not detect any significant age effects on functional connectivity in the ASD group, but in the TD group, age was positively correlated with within-network functional connectivity (Fishman, Datko, Cabrera, Carper, & Müller, 2015). While Vivanti and Hamilton (2014) found that imitation impairments lessen over the time, they noted that the deficits continue to be evident across the lifespan. In contrast, Williams et al. (2004) stated that normal imitation development was delayed rather than an absolute deficit.

There was a significant, strong, negative association of the average Autism Diagnostic Observation Schedule (ADOS;Lord et al., 2012) score of participants with ASD in comparison to participants without ASD although only five studies of the 53 studies included in the meta-analysis reported scores on the ADOS. Participant groups with more severe ASD showed greater imitation deficits in comparison to participants without ASD in this meta-analysis consistent with the findings of Fishman et al. study using FcMRI and DWI (2015) and Vivanti and Hamilton's review (2014). Nebel et al. (2016) had comparable findings in a study using using resting state functional magnetic resonance imaging (fMRI) scans and performance on imitation of skilled gestures to compare the intricsic functional connectivity between visual and motor brain networks in children with HF-ASD to TD children. They found that the children with HF-ASD who exhibited more out-of-sync intrinsic visual-motor activity displayed more severe social deficits.

Edwards (2014) found that the magnitude of the imitation deficit for the ASD groups was not collerated with any of the cognitive ability measures reported. However, she noted that there may have been significant variability at the individual subject level that was masked by the use of the mean ability from each study's ASD group for the analysis. Additionally, gender did not have any significant effect on the imitation deficit for the ASD groups, but she noted that the variability in gender across studies may have been too limited to detect effects. No statistically significant effects between the groups' performances for the domains of the tasks being imitated (i.e., oral-facial, hand-body, object-directed). Additionally, no significant effects were found for the format of the demonstration (live versus video), explicitness of the verbal prompts, number of actions to be imitated, familiarity of the actions, or the setting on the performance of the participants with ASD comparative to those without ASD (Edwards, 2014).

Studies that compared the performance of children with ASD to those without ASD on high fidelity imitation tasks had significant, large, and negative effect sizes for the groups with ASD overall. The performance of children with and without ASD was very similar on imitation tasks that only evaluated emulation. While there was a high degree of variability between the results of studies measuring high fidelity imitation, there was no significant variability in those assessing emulation. These results indicated that the participants with and without ASD exhibited similar ability to emulate other's actions, however participants with ASD demonstrated significant deficits with copying another's actions used for achieving a goal, or they were unable to copy both the action and goal within the same response (Edwards, 2014). Similar results were found in several reviews (e.g., Colombi, Vivanti, & Rogers, 2011; Vanvuchelen, Roeyers, & De Weerdt, 2011; Vivanti & Hamilton, 2014). All the reviews noted that it is possible to successfully complete emulation tasks without copying the goals of the demonstrator, in other words, without emulating.

The participants could have achieved the goal through understanding the cause-and-effect relationships, a non-imitative cognitive process that was found to be intact in ASD or used the affordances of the object without engaging in a copying behavior. In some of the emulation studies the objects used in the imitative tasks had certain affordances or properties associated with them that induced or prompted certain actions such as a button may prompt pressing or a closed box may induce opening.

In conclusion, the meta-analysis found that the participants with ASD exhibited intact emulation along with impaired high fidelity imitation. There was significant variability within the participants in the studies measuring high fidelity imitation so that the performance by a number of the individuals with ASD matched that of the TD individuals. This suggested that under certain conditions, participants with ASD did copy the action and the goal of the demonstrator as accurately as TD participants (Edwards, 2014).

Automatic imitation. Recent carefully controlled research on automatic imitation (i.e., mimicry) comparing the performance of participants with ASD to that of TD participants shed light on the mixed results of the imitation studies described above. In these studies, automatic imitation was defined as the tendency to copy observed actions when they were not relevant to the target task and when they were copied, they could interfere with performance; it was a psychological phenomenon similar to the Stroop effect (Heyes, 2011). Researchers stated that automatic imitation was a laboratory equivalent of the motor (or behavioral) mimicry that occurred in naturalistic social situations, but unlike motor mimicry, it could be studied in tightly controlled experimental settings (e.g., Brass, Ruby, & Spengler, 2009; Chartrand & Lakin, 2013; R. P. Cooper, Catmur, & Heyes, 2013; Y. Wang & Hamilton, 2012). Researchers described it as being a “purer” or “cleaner” measure of imitation than voluntary imitation because it minimized demands made on non-specific mechanisms such as those required for reproducing complex movements or using higher-order cognitive abilities (e.g., Bird, Leighton, Press, & Heyes, 2007; Catmur & Heyes, 2013). In addition, automatic imitation was used to study the psychological functions of the mirror neuron system (R. Cook, Bird, Catmur, Press, & Heyes, 2014; Hamilton, Brindley, & Frith, 2007). Mirror effects happened when participants passively observed body movements without any need to respond similarly; the participants' muscles involved in doing the observed action were selectively activated (Heyes, 2011). All of the experiments described below studying automatic imitation were done with adult participants, except where otherwise specified.

Heyes (2011, 2013) proposed that simple or automatic (involuntary) imitation and complex, intentional imitation were mediated by the same psychological processes and therefore, automatic imitation could be used to study complex imitation. For example, using stimulus-response compatibility (SRC) procedure (a Simon-like procedure based on the classifications by Kornblum, Hasbroucq and Osman, 1990), Stürmer, Aschersleben, and Prinz (2000) had participants open and close their hands as quickly as possible after a color change (i.e., normal skin color to red or blue; the task-revelant stimulus) in the model's hand and to ignore the gesture (i.e., the model's openning or closing hand; the task-irrevelant stimulus). The stimulus and the response gestures were the same on the corresponding trials and on the non-responding trials they were different. Response times (RT) were faster for the corresponding trials when the irrevelant gesture matched the response gesture (i.e., when the openning hand stimulus was made when an open hand response was required) and slower for the noncorresponding trials. In a similar experiment, participants lifted their index finger or middle finger in response to being shown either number one or two (i.e., the relevant stimulus) shown between the fingers of the model's hand that was raising either the index or the middle finger (i.e., the irrelevant stimulus), but in this experiment there was a baseline condition in addition to the compatible and incompatible conditions (Brass, Bekkering, Wohlschläger, & Prinz, 2000). Brass et al. found that the RT was faster during the compatible trials than during baseline and the RT was slower during the incompatible trials than during baseline. They suggested that the observation of the movement wielded an automatic influence on the response movement facilitating responding during the compatible trials and interfering with the response during the incompatible trials. Other experiments demonstrated similar effects with various actions performed by fingers, hands, arms, feet, and mouth (for a review, see Heyes, 2011). Heyes (2011) operationally defined automatic imitation as "a species of SRC effect in which the speed and/or accuracy of behavioral performance is modulated by the relationship between the topographic features of the task-irrelevant action stimuli and the participant's responses" (p. 464). Unlike true (i.e., complex, voluntary, high-fidelity) imitation or motor mimicry, automatic imitation usually did not involve overt behavioral reproduction and it effected the RT during compatible and incompatible trials rather than the accuracy. Heyes explained that automatic imitation was "a covert form of imitation – related to imitation in much the same way as silent reading is to reading aloud" (p. 467). Studies demonstrated that automatic imitation was modulated by social and asocial contexts. For example, when participants were given instructions that shifted their attention from the movement endpoints to the kinematics of unnatural computer-generated stimuli, the automatic imitation effect was eliminated only for the biomechanically impossible actions, not the possible actions (Longo, Kosobud, & Bertenthal, 2008). Similarly, it was modulated by social input such as when the actor made eye contact with the participant just prior to presenting the motor stimulus, the automatic imitation effect was increased; when the motor stimulus was preceded by averted gaze or a flash of light, the automatic imitation effect was reduced (Y. Wang, Newport, & Hamilton, 2011). In another study, Wang and Hamilton (2013) found that automatic imitation was enhanced by prosocial primes when participants took a first-person point of view and by antisocial primes when participants took a third-person point of view.

In a recent study, Sowden, Koehne, Catmur, Dziobek, and Bird (2015) compared the automatic imitation effect for TD participants (*N* = 45; 26 male) and participants with ASD (*N* = 60; 39 male) using a SRC procedure in which participants were required to lift either their index or middle finger as soon as they saw a "1" or "2" on the screen. On 50% of the trials, the numbers were paired with a five-frame video of a human hand lifting the middle or index finger; the action either was compatible or incompatible to the required task. In the other 50% of the trials, the numbers were paired with three-frame videos in which the hand remained static and either the compatible or incompatible finger was covered by a semi-transparent green mask for the effector compatibility (EC; "the nonimitative tendency for any response made with an effector to be executed faster when cued by the same effector, than when cued by a different effector"; p. 293). The EC trials served as a nonimitative control. While the first experiment controlled for simple spacial compatibility effects, a second experiment was done to control for orthogonal spatial compatibility effects. In the second experiment, there were 18 participants with HF-ASD (2 female) and 18 age, gender, and IQ matched TD participants. The results of the experiments demonstrated that the participants with HF-ASD showed intact imitative behavior in comparison to the TD participants and higher automatic imitation was significantly correlated with higher ADOS severity scores indicating enhanced automatic imitation was associated with higher autism severity. These results were consistent with the results of other studies that exhibited elevated hyper imitative behavior being exhibited by individuals with ASD along with reduced social cognition (Bird et al., 2007; Grossi, Marcone, Cinquegrana, & Gallucci, 2013; Spengler, Bird, & Brass, 2010). Sowden et al. explained that the imitation deficits for individuals with ASD found in meta-analyses described in the previous section were studies of intentional or voluntary imitation in which participants either were explicitly told to copy an action or the need to copy the action was implied by the procedures. Performance on these tasks could be affected by higher-order cognitive and motivational processes that data generally indicated as deficits for many individuals with ASD such as set-shifting, planning, fluency, cognitive control, and social communication skills (i.e., pragmatic language; e.g., Brown & Bebko, 2012; de Villiers, Myers, & Stainton, 2013; Eigsti, 2011). The findings were interpreted as providing evidence against imitation deficits and a dysfunctional MNS in individuals with ASD (Sowden et al., 2015).

While no studies assessing automatic imitation in children were found, the two studies with TD children and children with HF-ASD that examined their activation patterns while viewing actions had similar findings to Sowden et al. (2015). Raymaekers, Wiersema, and Roeyers (2009) replicated the methodology used in an earlier study by Oberman et al. (2005), but with a larger number of subjects (20 in each group as compared to 10 in each group) and an age range from 8 to 13 years as compared to the age range from 6 to 47 years in the earlier study. In both studies, electroencephalography (EEG) data was collected while the participants watched their own hand open and close, watched a video of an experimenter openning and closing the hand in the same manner, watched a video of two bouncing balls, and watched a video of television static (i.e., visual white noise). Oberman et al. found that the HF-ASD group showed significant mu suppression to the self-performed hand movements but not to the observed hand movements and interpreted the ASD group's lack of suppression during the observed hand movement condition to support the hypothesis of a dysfunctional mirror neuron system (MNS) in individuals with ASD. In contrast, Raymaekers et al. (2009) reported that both the TD children and the children with HF-ASD groups showed significant mu suppression to both the observed and self-performed hand movements and stated that the results did not support the hypothesis of a dysfunctional mirror neuron system (MNS) in individuals with ASD.

Pokorny, Hatt, Colombi, Vivanti, Rogers, and Rivera (2015) reported similar results in a study comparing the encoding of transitive and intrasitive actions when children and adolescents with (N = 17; 3 females; age range 9 to 17 years) or without HF-ASD (N = 18; 4 females; age range 10 to 17 years) viewed videos of a hand reaching across a screen toward an object or toward where an object would have been while fMRI images were collected. The action observation network, areas of the brain reportedly activated when observing other's actions, was the focus of the analyses. There were no significant differences between the TD and ASD groups in any of the conditions and the results were interpreted as suggesting that there was not a global deficit of the action observation network in individuals with ASD while observing transitive and intransitive actions. In addition, they noted that action observation network had significant overlap with the MNS, and their study added to the evidence that there were no group differences in the functioning of TD individuals and individual with ASD for this area (Pokorny et al., 2015).

Cognitive mechanisms for imitation. While research studying the cognitive mechanisms of copying behavior has continued (see R. Cook et al., 2014; Heyes, 2011 for discussions of conceptual frameworks and related empirical evidence), based on the previously reviewed research, two sets complementory theories were described as having the strongest empirical support. The first one was the associative sequence learning (ASL) model of imitation

(Catmur, Walsh, & Heyes, 2009; Heyes, 2011) hypothesizing that the long-term sensory motor connections underlying automatic imitation were domain general processes of associative learning. The ASL model was very similar to another explanatory theory of imitation, the ideomotor theory of action control (Brass & Heyes, 2005) first proposed by James (1891); both were generalist theories and "assume that imitation is mediated by general learning and motor control mechanisms" (Brass & Heyes, 2005, p. 490). Second, the imitative performance was modulated or controlled by top-down social and asocial (e.g., instrumental) processes (Catmur & Heyes, 2013; Heyes, 2011; Marsh, Ropar, & Hamilton, 2014; Sowden et al., 2015; Y. Wang & Hamilton, 2012).

Both the ideo-motor theory of action control and the ASL models for automatic imitation had a common learning phase: the dual-route models of SRC (Brass & Muhle-Karbe, 2014; Catmur et al., 2009; Heyes, 2011; Heyes, Bird, Johnson, & Haggard, 2005). The SRC theoretical accounts assumed that the stimulus activates responses through two routes: the controlled (or intentional or conditional) indirect route and the automatic (or unintentional or unconditional) direct route (Kornblum et al., 1990, p. 195; Vu, 2011). The task-relevant stimulus or stimulus dimension (i.e., for inanimate stimuli, left-right spatial properties and for animate stimuli, topographical features) was identified through perceptual scanning and this activated the the correct response through the intentional route. This route was described as a short-term stimulus-response connection through "an excitatory link between a stimulus (or 'sensory') representation (or 'code') and a response (or 'motor') representation (or 'code')" (Heyes, 2011, p. 471) activated by the task's instructions and held in short-term memory until the task was completed. Through the automatic route, a similar or "corresponding response was activated by the task-irrelevant stimulus or stimulus dimension. This was described as a long-term stimulus-response connection or association (i.e., excitatory stimulus response link) that was established through learning (e.g., experience) and was held in long-term memory. When the intentional and automatic routes activated the same response representation, as occurred during compatible trials, the response was accurate and rapid. When the two routes activated different response representations, as occurs during incompatible trials, the response was slowed because the incorrect automatic response had to be inhibited before the correct intentional response. Contrary to Dowrick's assertion, a link between immediate imitation and the observational learning required for future performance has been provided in ASL.

Cook et al. (2014) presented strong evidence that ASL was complimentary to rather than conflicting with the ideomotor ideo-motor theory of action control and suggested that the differences between the two theories primarily lie in what was emphasized (Heyes, 2011). ASL emphasized the conditions and mechanisms required to establish the long-term associations; ideo-motor theory considered imitation to fall within its general account of motor control (Stürmer et al., 2000). In ideo-motor theory, an ideomotor representation was acquired through the association of sensory and motor codes, and as this learning progressed, "additional ideomotor representations are formed that resemble anticipations of the to-be-produced sensory consequences of an action" (Brass & Muhle-Karbe, 2014, p. 195). Learning the relationships between the responses ("stimulus" in ASL) and ensuing sensory effects ("responses" in ASL) allowed the ideomotor representations to grow. The primary function of the ideomotor representations was for motor control and through anticipating the sensory consequences, actions could be intentionally controlled. In ideomotor theory, the interference that occurred during incompatible SRC trials led to self-other confusion between externally (i.e., irrelevant stimulus) and intentionally (i.e., relevant stimulus) activated ideomotor representations (Brass & Muhle-

Karbe, 2014). Cook et al. (2014, p. 225) noted that traning experiments based on ASL (e.g., Catmur, Walsh, & Heyes, 2007; Cavallo, Heyes, Becchio, Bird, & Catmur, 2014; Heyes et al., 2005; Wiggett, Hudson, Tipper, & Downing, 2011) exposed the participants to the ideomotor "response" (i.e., execution) and "effects" (i.e., observation) that would have established the contingent relationship, but not in the typical order. The participants observed an action and then executed that action. As research has shown that associative learning was bidirectional (e.g., Proctor, Zhang, & Vu, 2013; Vu, Proctor, & Urcuioli, 2003), researchers using SRC methods typically presented the observed action first because they had greater control over the contingencies that the participants experienced. The assertion that associative learning was bidirectional has been supported in a study done by Wiggett et al. (2011) who replicated and extended this reseach by having participants execute the response prior to observing the action.

Both ASL and ideomotor ideo-motor theory of action control assumed that the long-term S-R associations controlling automatic imitation were learned through sensory-motor experiences, but this did not explain why specific sensory representions such as that of a hand grasping linked to a motor representation of hand grasping rather than to a hand openning or an eye blinking (Heyes, 2011). In addition, how could 'opaque' actions such as other's facial expressions be imitated without a mirror? In the case of imitating other's facial expressions, imitators could feel their own facial expressions but not see them, whereas the facial expressions of others were seen, but not felt (Brass & Heyes, 2005). This question often has been called the "correspondence problem" and empirical research supporting the solution proposed by ASL has been building (Heyes, 2016). ASL proposed that third-person visual representations of actions were connected through vertical associations with the corresponding proprioceptive representations, and that these connections were formed associatively during correlated sensorimotor experiences (i.e., experiences that occurred contiguially and were related contingently; Brass & Heyes, 2005; R. Cook, Johnston, & Heyes, 2013; Heyes, 2013). In a study using transcranial magnetic stimulation (TMS), Stefan et al. (2005) found evidence that observation of movements resulted in a kinematically specific memory trace of the observed motions. In the case of facial imitation by infants, they proposed that when infants made facial expressions repeatedly while looking in a mirror or being imitated by an adult, the infant experierenced contingencies between the observed facial expressions and their own performance. These experiences created and stregthened the excitatory connections between corresponding visual and proprioceptive representations of actions (R. Cook et al., 2013). An assumption in ASL theory was stimulus generalization; in other words, incoming stimulus excited the sensory component of a matching vertical association to the degree that the incoming stimulus was physically similar to the stimulus represented by the sensory component of the vertical association (Catmur et al., 2009). Motor mimicry has been considered an example of simple, unintentional copying of an action (i.e., automatic imitation that occurred outside of the laboratory setting, in natural contexts). For imitation of complex actions such as a copying a novel sequence of actions, ASL assumed that cognitive processes that encode the serial order of visual stimuli direct the process of matching vertical associations allowed the observer to learn the novel action sequence covertly. Then, to imitate this action sequence (i.e., produce the covertly learned matching actions), the matching vertical association for each step of the horizontal visual sequence represention had to be activated in the correct order (Heyes, 2013). This was the type of observational learning that occurred in feedforward VMI; the component subskills were in the individual's behavioral repetoire, but in the treatment video, the components were arranged into a novel sequence or performed in a novel context (Dowrick, 1999).

Alternatively, Meltzoff and Moore (1997) proposed that through the active intermodal-matching (AIM) model, facial expression and other forms of human imitation were mediated by an inate mechanism, supramodal representation of action, that allowed visual representations of facial expressions to be matched with their proprioceptive consequences. The study by Meltzoff and Moore (1977) demonstrating that neonates (Experiment 1 $N = 6$; Experiment 2 $N = 12$) could imitate both facial and manual gestures often has been cited to support the assertion that there was an innate, specialized mechanism for imitation as proposed in the AIM model. Reviews of the studies supporting neonatal imitation have found that they were underpowered and methodologically flawed (R. Cook et al., 2014; Paulus, 2014; Ray & Heyes, 2011). There was evidence that the behaviors observed by Meltzoff and Moore were not imitation and could be better explained by other mechanisms such as exploration (S. S. Jones, 1996, 2006, 2007) or patterns of mammilian neonatal behavior associated with the development of the aerodigestive system (Keven & Akins, 2016). Furthermore, a recently published comprehensive longitudinal study of neonatal imitation found that their infant participants ($N = 106$) did not imitate any of the nine social and two non-social models at 1, 3, 6, and 9 weeks of age (Oostenbroek et al., 2016). The authors stated that their results "undermine the idea of an innate imitation module and suggest that earlier studies reporting neonatal imitation were methodologically limited" (p. 1335). Additionally, a large-scale twin study of individual differences in imitative ability at age 2 years found that most of the individual differences were associated with environmental influences and only modestly to heritability (McEwen et al., 2007).

The AIM model hypothesized that supramodel representations of actions could be improved through practice without requiring any visual feedback such would be needed for imitating facial expressions or other opaque motor movements for which there was no visual model (i.e., referent). In the first study that assessed facial imitation with an automated objective measure, Cook et al. (2013) demonstrated that adults gradually improved the accuracy of their self-imitated facial expressions when they received visual feedback, but did not improve when they did not have visual feedback (i.e., only had their own proprioceptive input) consistent with the ASL hypothesis specifying that correlated visual-proprioceptive experince was necessary to improve imitation of facial expressions. Similarly, in a study with 162 typically developing infants ages 6, 8, 10, 12, 14, 18, or 20 months, S. S. Jones (2007) found that infants were not able to match, mimic, or imitate any of the 8 behaviors at 6 months, but at 8 months started matching 2 behaviors, mimicking a 2 behaviors at 10 months, and mimicking 2 more behaviors at 14 months, and mimicking the last 2 behaviors at 16 months. This was consistent with the ASL proposal that the ability to imitate other's behavior developed gradually "through associative learning – the same, evoluntionarily ancient learning mechanisms that mediate Pavlovian and instrumental conditioning – in contexts where humans experience a contingency between observation and execution of the same action" (R. P. Cooper et al., 2013, p. 627).

The tendency to imitate automatically has been shown to be affected voluntarily (i.e., intentionally) by social and asocial contextual aspects such as through modulation of input by interfering with or augmenting attention to the stimulus or of output by inhibiting or allowing overt behavioral responses (Heyes, 2011). Evidence showing that the magnitude of automatic attention could be modulated by attention was demonstrated in a study that varied the location of a colored dot relative to a body image and participants were to respond with their hand or foot depending on the color of the dot (Bach, Peatfield, & Tipper, 2007). When the dot color indicated that the participant should respond with his or her foot and the location of the dot on the image was close to the foot (i.e., a compatible trial) participants responded more quickly than when the location of the dot was close to the head (i.e., an incompatible trial); these results were consistent with the results from other studies (e.g., Lavie, Ro, & Russell, 2003; Liepelt & Brass, 2010; Longo & Bertenthal, 2009). Social cognitive processes have been hypothezied to modulate (i.e., influence) the magnitude of automatic imitation effects. A recent study demonstrated that contingency between the participant's actions and the experiments produced pro-social attitudes and behavior in adults (Catmur & Heyes, 2013). Again, other research have found evidence that social cognitive processes modulated the magnitude of automatic imitation effects (e.g., J. Cook, Barbalat, & Blakemore, 2012; R. Cook et al., 2012; Y. Wang et al., 2011).

There has been increasing evidence from behavioral and neuroimaging studies for automatic imitation as described in the ASL model being an early "bottom-up" lower-level process establishing the covert activations of the sensory to the motor components of a vertical associations and a later "top-down" higher-level cognitive processes modulating the execution of the overt imitative motor response (e.g., Andrew, Bennett, Elliott, & Hayes, 2016; Catmur & Heyes, 2013; Catmur et al., 2009; Schunke et al., 2016; Sowden & Catmur, 2015; Ubaldi, Barchiesi, & Cattaneo, 2015; Y. Wang & Hamilton, 2013). The proponents of ASL suggested that the higher-level cognitive processes guiding the imitative process operate from outside the essential mechanisms of imitation (i.e., those that solve the correspondence problem; Catmur et al., 2009).

The enduring, bimodal vertical associations of sensory or perceptual and motor features of actions (i.e., shared representational system) were activated automatically by the perception of a corresponding action producing an impulse or potential to imitate (Massen & Prinz, 2009). The shared representation system did not specify who performed the action (Jeannerod, 1999). Brass, Ruby, and Spengler (2009) proposed that the control of the shared representations by relevant processes such as self/other distinction, representing conflicting mental states was the link between the shared representations and mentalizing. One of the first steps in controlling automatic imitation was developing a sense of self and agency by learning to distinguish between sensory events in the environment caused by someone else's actions and those caused by their own actions. This development was the foundation of later developing cognitive processes including mentalizing and abstract mental state attributions along with formation, representation and integration of abstract mental content (Brass et al., 2009). Neuroimaging studies have found that the areas of the brain activated during self-referential tasks were associated with retrieval of autobiographical memory (Legrand & Ruby, 2009). The ability to make self-other distinctions and use the later developing cognitive processes to control the tendency to automatically imitate (i.e., mimic) observed actions by others gradually developed through sensorimotor learning (Catmur et al., 2009). This research may lend some support to the theory proposing that autobiographical memory alteration mediated the behavioral changes produced through effective VSM interventions.

Y. Wang and Hamilton (2012) proposed the STORM (i.e., social top-down response modulation) model for how mimicry changes relative to the social context. They suggested that this subtle control of when and who was mimicked increased social competence; impairment of the cognitive processes affecting this function could underlie the social-communication deficits found in conditions such as ASD and schizophrenia (J. Cook et al., 2012). Others have agreed that the top-down control was primarily social, but noted that more needed to be known about how other factors such as attention (e.g., enhanced input due to increased attention when an arrow points to a key feature), environmental contextual cues (e.g., where the use of a tool was observed), or executive functions (e.g., inhibition, sequence processing) affected imitation (Heyes, 2011; Massen & Prinz, 2009; Rumiati, Carmo, & Corradi-Dell'Acqua, 2009; Sowden & Catmur, 2015).

Overall, there was a substantial body of research supporting the ASL model for observational learning as being an early "bottom-up" lower-level process establishing the covert activations of the sensory to the motor components of a vertical associations. Later, "top-down" higher-level social cognitive processes modulated the execution of the overt imitative motor response. VMI relied on observational learning and ASL was a well-supported and elaborated model for how learning of adaptive behaviors may have occurred during a successful VMI with individuals with and without ASD. While more research was needed, the STORM model provided a feasible explanation of what and who was mimicked. Research indicated that the individuals with HF-ASD demonstrated intact imitative behavior in comparison to the TD participants and elevated hyper imitative behavior was associated reduced social cognition. The imitative performance of individuals with ASD could be affected by higher-order cognitive and motivational processes such as set-shifting, planning, fluency, cognitive control, and social communication skills.

Use of VMI with students who have ASD

Meta-analyses and systematic reviews. There have been a few meta-analyses of studies comparing the efficacy of interventions using VSM to other forms of modeling, most commonly video-modeling (VM) for children with ASD. In VM, another peer or adult was used as the model of the target behavior or skill. Bellini and Akullian (2007) analyzed 23 studies on the effectiveness of VM or VSM interventions for children with ASD ages 3 to 20 across the areas of social-communication, daily living skills, and behavioral functioning. All of the 23 studies analyzed used a single-subject design with 22 of these using staggered multiple-baselines across participants to demonstrate experimental control. Both VM and VSM were found to be equally effective interventions resulting in rapid skill acquisition; the target skills were generalized across person and setting, and maintained over time. Based on the criteria for single subject research in Horner et al. (2005), Bellini and Akullian stated that the results of their meta-analysis supported identifying VSM and VM as evidence-based practices. A more recent meta-analysis (S. Y. Wang et al., 2011) agreed with that conclusion (but also see Shukla-Mehta et al., 2010). Studies using social validity measures reported acceptable ratings by most parents and teachers (Bellini & Akullian, 2007; S. Y. Wang et al., 2011). S. Y. Wang et al noted that because video-based interventions typically were viewed in settings other than the classroom, were very brief, and were generalized across person, setting and materials without additional instruction, these interventions were social valid so long as the skills being taught were useful in the natural environment of the participants.

Although finding that both VSM and VM were effective treatment methods for individuals with ASD, other reviews (Delano, 2007; McCoy & Hermansen, 2007; Rayner et al., 2009; Shukla-Mehta et al., 2010) raised questions regarding participants' preferences for and responses to self versus other models. Areas that need further study included identifying characteristics of the participants and the tasks or skills being presented that influenced their response to video-based interventions. Participant characteristics proposed as affecting their response to video modeling include: attention and imitation skills (Buggey, 2009; Delano, 2007; McCoy & Hermansen, 2007; Nikopoulos & Keenan, 2003; Rayner et al., 2009), self-recognition in videos (Buggey, 1995a, 2005, 2009; Buggey et al., 1999), expressive language skills, disruptive behavior (Delano, 2007), and IQ (Rayner et al., 2009). A few studies using VSM for participants with ASD measured at least some of these variables prior to intervention (Buggey, 1995b; Cihak, 2011; Cihak, Fahrenkrog, Ayres, & Smith, 2010; Hepting & Goldstein, 1996; Lansater & Brady, 1995; Mechling & Moser, 2010; Sherer et al., 2001), but no consistent pattern of the participants' responses to VSM was found related to these pre-intervention skills or abilities. This was similar to findings in VSM studies with other target populations (Bray & Kehle, 1996; Clarke et al., 2001; Dowrick & Raeburn, 1995; Margiano et al., 2009). The pre-intervention participant characteristics anecdotally described as being necessary for VSM to be effective included that the participant be able to recognize themselves in the video and attend to the video presentation for 3 minutes without exhibiting disruptive behaviors (Beck, 1990; Buggey, 1995b).

The review by Shukla-Mehta et al. (2010) noted the limited number of studies that were done using children with ASD from culturally and linguistically diverse backgrounds. Among the few studies in which participants from diverse cultural or linguistic background, Buggey et al. (1999) included 1 child with ASD whose parents were from Columbia, SA and the child spoke Spanish and English. A number of VSM studies were done using participants from diverse backgrounds but who did not have ASD . Those participant's ethnic or racial backgrounds included: Mexican-American (Schunk & Hanson, 1989), African-American (Pigott & Gonzales, 1987; Schunk & Hanson, 1989), Filipine (Dowrick et al., 2006; Holmbeck & Lavigne, 1992), Hawaiian (Dowrick et al., 2006; Hitchcock, Prater, & Dowrick, 2004), Samoan, Japanese, and mixed ancestry (Dowrick et al., 2006). Ethinic and racial backgrounds did not affect the participants' outcomes in these studies as all studies reported positive results for most, if not all, participants.

Use of VSM to improve social communication skills in children with ASD. Previous research evaluating the effect of VSM on the development of social communication skills with children with ASD generally had positive findings. In Buggey et al. (1999), the study's purpose was to investigate the efficacy of VSM for teaching children with ASD to respond appropriately to questions. A multiple baseline across participants design was used with three participants ages 8 to 11 (two boys, one girl) who were diagnosed with autism. As mentioned above, one of the participants was from a family in which both English and Spanish were spoken. The participants' parents reported that they responded to direct questions, but did so infrequently, and at times, the participant's responses were not relevant. The authors reported that all participants' mean percentage of appropriate responses approximately doubled from baseline to intervention. Wert and Neisworth (2003) used VSM with 4 participants who were diagnosed with autism and between ages 4 to 5 ½ years old. Although the VSM intervention vidoes were made during play sessions conducted in the participant's homes and the videos were shown to the participants in the morning before going to school, the goal of the study was to increase the frequency of their spontaneous requesting in school, the generalization setting. All participants made marked increases in their spontaneous requests in school, even though the one participant who was not interested in seeing himself in the video had a delayed response to intervention. Bellini, Akullian, et al. (2007) increased the social engagement (including verbal initiations and responses) in 2 preschool boys ages 4 and 5 who had ASD with their peers during free playtime in their classroom using VSM.

Need for Common Terminology and Benchmarks of Spoken Language

As stated earlier, one of the best prognostic indicators for a positive outcome for young children with ASD was development of functional speech before age 5. Development of functional speech was the goal for many early intervention programs, but the definition of this has been found to vary widely across studies (Tager-Flusberg et al., 2009). A working group of experts in the areas of language disorders and language development was formed by the NIDCD to establish: (a) a recommended set of measures to evaluate the efficacy of interventions targeting spoken language in children with ASD, and (b) common terminology and benchmarks that could be used across studies allowing their outcomes to be compared.

The findings of Pickett, Pullara, O'Grady, and Gordon’s (2009) recent literature review demonstrated how not having this common terminology and benchmarks limits the utility and generalizability of results. The first sentence of the abstract stated that if children with autism failed to develop “useful speech by age 5, the prognosis for future development has been thought to be poor” (Pickett et al., p. 1). In publications from 1951 to 2006, they found a total of 167 individuals with autism whose development of speech after age 5 was documented, and 78 of these were reported in sufficient detail to determine that the children were diagnosed with autism and the age of speech development was clearly stated. The descriptions of the children’s initial speech were so vague that the researchers were unable to determine how many children were mute prior to acquiring some spoken language after age 5. About a third of the individuals only acquired up to imitated words, but in the remaining two thirds of these subjects, half acquired spontaneous phrase speech. While most of the individuals who acquired spontaneous word or phrase speech did so by age eight, a few subjects acquired spontaneous phrase speech after age 11.

Chapter III: Method

Participants and Setting

Prior to submitting the research application to the University of CT's Institutional Review Board (IRB), the student researcher obtained approval from a New England urban school system to conduct the study. The student researcher's contact from one of the schools recommended three male student participants with ASD ages 5 to 6 years old them as potential participants. They were recruited from a kindergarten classroom that had supports for children from a second language background. The researcher obtained the school principal and the classroom teacher's permission along with assent from all the children in the classroom to conduct research prior to obtaining consent from the parents of the students with and without ASD. She obtained consent from another classroom teacher and accent from her students, but the parent of the student with ASD declined consent. As a result, the second classroom was not included in the study. The school served 428 children enrolled in preschool to fifth grades; all the students qualified to receive free school lunches. Precise statistics for the diversity of the students was unavailable, but most of the students were from Hispanic backgrounds who were born in New England and their families were from a Puerto Rican background, although some of their families were from Central and South America.

The selection criteria for the student participants with ASD were that their HF-ASD was confirmed through a record review and the standardized measures that were administered prior to collecting the baseline data. In addition, their ability to recognize themselves and express enjoyment in seeing themselves in a video was verified along with their difficulty engaging in contextually appropriate social communications with peers (see Appendix A for inclusion criteria).

In addition to their classroom teacher, their special education teacher and the two paraprofessionals who worked in the kindergarten classroom were enrolled in the study along with 19 classmates, 5 of whom also were peer-assistants. The five peer-assistants were nominated by their teacher as being children who had well-developed social communication and interaction skills and enjoyed interacting with the three students with ASD. Additional assent and parent consents were obtained for the three girls and two boys who were peer assistants who played and worked cooperatively with the target children during the creation of the treatment videos. All staff members and children were Hispanic and from a bilingual background (English/Spanish). Both Spanish and English were spoken in the classroom, but almost all instruction and most behavioral corrections were provided in English. Spanish primarily was used to correct the children's behavior when they did not follow directives previously given in English. The classroom teacher and the special education teacher had master's degrees and had between 25 to 30 years of teaching experience. Both paraprofessionals had at least high school degrees and had passed the CT exam as required for employment as a paraprofessional.

Standardized measures. To measure the participants' skills in the areas of cognition, and expressive vocabulary prior to baseline, the following individually administered, norm-referenced measures were given. While these measures were not timed, 5 to 15 minutes was required to administer each of these three measures.

The PTONI: Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2008), a nonverbal measure of cognitive ability, developed for use with children from ages 3.0 to 9.11 from diverse backgrounds, was administered. The minimal verbal directions were provided in English for Students 1 and 2, and in Spanish for Student 3. For each item, the students were asked to look at an array of pictures and point to the one that does not belong with the others on the page. According to the manual, the test included items that measure reasoning skills such as visual and spatial perception, analogical and sequential reasoning, and categorical formulation. Reliability coefficients for internal consistency and test-retest were in the .90s range (England & Malcolm, 2010).

The Expressive One-Word Picture Vocabulary Test: Spanish Bilingual Edition (EOWPVT; Brownell, 2000) was used to obtain an estimate of the participants' expressive vocabulary in English and Spanish. This measure was normed on a representative sample of bilingual English/Spanish speaking children living in the United States and allowed the bilingual children ages 4.0 through 12.11 to be questioned and to respond in English or Spanish. The reliability coefficients for internal consistency and test-retest reliability were from .91 to .98 (Jenkins, 2005).

To confirm the participants' ASD diagnoses and measure the participants' symptoms of autism, the children were assessed using the Childhood Autism Rating Scale, Second Edition—Standard Version (CARS2-ST; Schopler, Van Bourgondien, Wellman, & Love, 2010). The CARS2-ST was a diagnostic instrument designed to measure the presence, intensity, and duration of symptoms related to the diagnosis of ASD with individuals under age 6 or older individuals with IQs under 80 or without spontaneous functional speech. An internal consistency estimate of .93 was obtained in the CARS2-ST verification sample (Schopler et al., 2010); the interrater reliability estimate for the CARS2-ST was not provided but the interrater reliability estimate for the CARS was .84 (Vaughan, 2011). Ratings for the CARS2-ST were based on the observations made during the administration of structured play activities in the Performance subtests of Psychoeducational Profile-Third Edition (PEP-3; Schopler, Lansing, Reichler, & Marcus, 2005), a measure designed to evaluate the learning strengths and weaknesses of children with ASD ages 2 to 7. The PEP-3 test-retest coefficients for raw scores were .94 or higher, the average coefficient alphas were .90 or higher for the Performance subtests, and .97 for the Composites (Mirenda, 2007). The normative sample for the developmental age score was 148 typically developing children, a very small sample. This score was not was not calculated or reported for the participants because the measure was administered to provide a structured observation of the participants, not as a measure of their development.

Participants with ASD. *Student 1* was a 5-year-old diagnosed with ASD when he was approximately 2.6 years old (diagnosis later confirmed by a developmental pediatrician) and he received early intensive intervention services from an autism-specific Birth-to-Three (B-3) provider. After his third birthday, he entered a half-day inclusion preschool program in the community school where this research was completed. In addition to receiving 2.5 hours a day of special education instruction, he also received support from the speech/language pathologist (SLP) and the occupational therapist (OT). All his B-3 and preschool services were provided in English. In kindergarten, his special education services were reduced to 2 hours a week because he had made good progress in learning academic skills. In addition to the services provided by the SLP and OT, school social worker services were added to improve his social skills. All his standard scores on the standardized measures administered prior to the start of this study were in the average range or higher. On the PTONI, he achieved a standard score of 102, 95% CI [94, 110] and his standard score on the EOWPVT was 145, 95% CI [137, 153]. All his responses on the EOWPVT were in English. In comparison to other individuals with ASD ages 2 to 12 years, his *T*-score of 52, 95% CI [47, 57] fell in the severe symptoms of ASD range. Across the two pre-baseline 10-minute observations, his average mean length of utterance in words (MLU_w) was 2.56 (*SD* = 0.78). Although his academic skills in all areas were at grade level and he consistently followed rules, he needed frequent prompts to stay on-task and often engaged in atypical behaviors such as repeatedly saying lines from his favorite children's story quietly to himself or staring off into space while twirling his finger in his hair.

Student 2 was a 6-year-old student who was diagnosed with PDD-NOS by a developmental pediatrician when he was around 4 years old. Both Spanish and English were spoken in his home, but English was his primary language. He did not receive any B-3 services but did attend a half-day inclusion preschool program for a year in another elementary school within the school system where this study was conducted. In addition to special education services, he received services from the SLP and OT. Most of his first year in kindergarten was spent in a classroom with very little structure and no specialized supports for English language learners. Although he had support from a bilingual special education teacher, bilingual SLP, bilingual paraprofessional, and OT, he exhibited high levels of challenging behaviors such as refusing to comply with his teacher's directives, eloping from the classroom, and repeatedly asking to go home. These behavioral problems continued until a PPT recommended that he be placed in the well-structured kindergarten classroom where this study was completed for the last few months of school. For the 2011-2012 school year, he was retained in that classroom because his academic skills were very limited and because he had responded well to the structure. Prior to the start of this study, school social worker services were added to improve his social skills. His classroom teacher and the paraprofessional who worked with him expressed concerns about the need to frequently redirect his attention to instruction or tasks and his tendency to engage in stereotyped or repetitive behaviors such as lining up objects, circumscribed interest in dinosaurs, and difficulty learning academic skills in all areas. On the PTONI, he achieved a standard score of 82, 95% CI [74, 90]. His standard score of 124, 95% CI [116, 132] on the EOWPVT in the superior range was significantly higher than his PTONI standard score; all his responses were in English. The researcher's ratings on the CARS2-ST resulted in a T-score of 48, 95% CI [43, 53] that indicated that he had mild-to-moderate symptoms of ASD in comparison to other individuals with ASD ages 2 to 12 years old. During the first 10-minute pre-baseline observation, his MLU_w was 2.50, but during the second observation, he only made one utterance and that was not enough to calculate a meaningful MLU_w.

Student 3 was a 6-year-old who was diagnosed with autism by a neurologist in Puerto Rico (PR) at age 4 years and his ASD diagnosis was later confirmed by a clinical psychologist shortly after his family moved to the city where this study was completed. In PR, he received B-3 services to improve his adaptive, social, communication, and motor skills prior to briefly entering a Head Start program. He had severe temper tantrums during the short time that he attended that program. When he moved to CT in fall 2010, he entered kindergarten in another city for a few months prior to transferring to the kindergarten classroom where this study was completed. In both schools, he received inclusion support services from the special education teacher, SLP, and OT. He adjusted well to the classroom's routine, but his academic skills were significantly lower than those of his peers and he was retained in kindergarten for the 2011-2012 school year. His teacher stated that he often made noncontingent comments in English and Spanish; he seemed to be interested in playing with his classmates, but did not seem to know how to participate in social interactions. By spring 2012, student 3 mostly spoke in English at school during interactions with staff members and children. At home, he primarily spoke Spanish with his parents, but used some English when conversing with his older brother. Approximately once a week, he left school early to attend counseling sessions at an outside agency. His standard score of 84, 95% CI [76, 92] on the PTONI was lower than his standard score of 101, 95% CI [93, 109] on the EOWPVT; fifty percent of his responses were given in Spanish on the EOWPVT. On the CARS2-ST, the researcher's ratings resulted in a T-score of 43, 95% CI [38, 48]; this indicated that he had mild-to-moderate symptoms of ASD in comparison to other individuals with ASD ages 2 to 12 years old. His average MLU_w for the two pre-baseline observations was 2.42 (*SD* = 0.18).

Recently, the academic skills children were expected to learn had been markedly increased, and like many kindergarten teachers, the classroom teacher was concerned that her students may not learn the expected skills if she allowed them to engage in the arts and crafts activities they had done in previous school years or to consistently have 10 minutes of recess. The participants with ASD were in different reading groups and their literacy center activities were scheduled around other pull-out services such as speech/language services and English as a second language instruction. It would have been very difficult to schedule observations during the literacy center activities. Based on pre-baseline observations and an interview with their classroom teacher, it was decided that the 10-minute videotaped observations would be conducted during math center period. This period usually followed their direct math lesson and used the kindergarten enVisionMATH program's (Charles, 2011) center-based activities with a partner. Initially, the teacher led these activities while the student researcher video-recorded the students; later the researcher led the activities while two video cameras recorded the students' interactions. While the researcher led the activities with the assistance of one paraprofessional, the classroom teacher administered various required academic tests to individual children in the back of the classroom.

Dependent variables. Definitions of the dependent variables were drawn from the work by Boyd, Conroy, Asmus, and McKenney (2011); Davis, Brady, Hamilton, McEvoy, and

Williams (1994); Delano and Snell (2006); Hanley-Hochdorfer, Bray, Kehle, and Elinoff (2010); and Thiemann and Goldstein (2001). The primary dependent variables were the frequency of unprompted verbal initiations and contingent responses during social interactions with peers, and the duration of ongoing interactions. Verbal initiations included “seeking attention, initiating comments, and initiating requests” (Delano & Snell, p. 32). Initiating comments and requests were coded if the participant made them “following a 3-s interval after a peer’s last utterance” (Thiemann & Goldstein, p. 430). Participant requests included asking for “information, actions or objects” (Delano & Snell, p. 32). Initiating comments encompassed participants making “a comment about an ongoing topic or activity. The comment may describe the activity, compliment” or reinforce a peer, “or express enjoyment about the activity or interaction” (Delano & Snell, p. 32). Seeking attention included requesting attention from peers, calls the peer’s name, or using gestures such as tapping the peer on the shoulder (Delano & Snell). Contingent responses were coded if the participant “responds (verbally or nonverbally) to a peer’s utterance within a 3-s interval. This response could involve acknowledging the peer (e.g., “Huh”), agreeing, answering a question, responding with a related comment, or clarifying the peer’s comment or questions” (Delano & Snell, p. 32). Ongoing interactions were a sequence of reciprocal social behaviors between the participant and a peer that continued after the original initiation-response (e.g., Initiation-Response-Interaction). Once the third behavior in the sequence occurred, the interaction began (Boyd et al., 2011; Davis et al., 1994). A stop code was used after a 3-s lapse of social behaviors between the participant and peer signaling the end of an ongoing social interaction. If the participant temporarily went off camera, no data was recorded (R. L. Koegel, Vernon, & Koegel, 2009).

Instrumentation

Digital videos with software. Participants were video-recorded for all phases of the study during inclusive classroom math center interactive pairs activities in which they have opportunities to interact freely with typically-and delayed-developing peers. Wireless microphones were used so that the video-taping could be done at a distance to not interfere with the children's activities, but still obtain clear audio input.

The Behavioral Evaluation Strategy and Taxonomy (BEST) Recorder (Sharpe & Koperwas, 2012b) software was used to code events and duration. The BEST software collection was designed for collecting, coding, and analyzing real-time data on the frequency and duration simultaneously. Event codes were used for instances (frequency) of initiations and contingent responses, and a duration code was used ongoing interactions. The BEST Recorder software was used to code the 10-min observation videos created throughout the study and the results of the coding were saved in data files that gave the frequency for events (initiations and responses) and duration of interactions. The BEST Analysis software (Sharpe & Koperwas, 2012a) was used for comparing the researcher's observation data files to those produced by the other graduate student to establish IOA.

The videos were transcribed and time-stamped using the transcription software, f4transkript (f4; Dresing, Pehl, & Schmieder, 2012) that allowed the replay speed to be slowed 50% without distorting the sound pitch, automatic rewinding the recording for a few seconds after it was paused, and inserting text blocks such as a code for identifying the speaker. After the transcribed files were copied and pasted into the Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2012) software. The transcriptions and the codes first were evaluated to ensure their compliance with SALT formatting, and then they were analyzed. The SALT software was used to provide detailed descriptions of the participants' language in all phases of the study as recommended by Tager-Flusberg et al. (2009). SALT was selected because it used a simplified transcription system of English and Spanish language samples and provided a standardized analyses of syntax, semantics, discourse, fluency, and speaking rate. MLU_{word} was used as a measure of syntax and morphology and was calculated using utterances that were complete (i.e., not abandoned or interrupted), intelligible (i.e., did not contain any unintelligible segments), and verbal (i.e., excluded utterances that did not contain at least one verbalized word); words/minute was used to measure rate of speech (Miller, Andriacchi, & Nockerts, 2011a). Complexity was measured using the subordination index (SI) composite score that was calculated by dividing the total number of clauses by the total number of utterances (Miller, Andriacchi, & Nockerts, 2011b).

Interobserver agreement. Observer training on recording the instances of the dependent measures was completed using the participants' pre-baseline videos. Training continued until both researchers achieved at least 90% agreement in their data and transcriptions on two consecutive videos. At least 20% of all videotaped observation sessions for each participant across all phases of the study were randomly selected for rating by another graduate student; interobserver agreement (IOA) was calculated for the dependent variables using the BEST Analysis software. Both the student researcher and other graduate student had experience using computer-based observational software to collect continuous observational data.

In the time-window method that was used to establish IOA for the event codes, the continuous data record was not be divided into intervals prior to analysis; instead, "windows of opportunity for agreement are opened around an event … with the size of the window being twice the tolerance plus 1 s (e.g., a 5-s window for a 2-s tolerance)" (Mudford, Martin, Hui, & Taylor, 2009, pp. 536-537). Second-by-second comparisons were made across the two data files with a ±2 s tolerance (i.e., a 4-s window) for events and duration using BEST Analysis; an agreement occurred when both records had a recorded response. There was no way to add another second to the window with BEST Analysis. Any second that had only one record of an event was scored as a disagreement. Percentage of IOA was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100% (Mudford et al.).

Another graduate student who was blind to the purpose of the study transcribed 23% of the videotaped observations that were randomly selected across all phases. These were compared to the researcher's transcripts to evaluate the accuracy of the transcription at the word and morpheme level, rate, and utterance segmentation. Calculation of the percent agreement values by dividing the total number of agreements divided by the total number of agreements and disagreements (Heilmann, DeBrock, & Riley-Tillman, 2013).

Treatment fidelity. Fidelity to the treatment protocol was measured using a check list protocol that was completed at the end of each session by the researcher when the video was shown (see Appendix A). The student researcher monitored the treatment fidelity checklist and maintained treatment fidelity above 90% for all of the treatment sessions. Procedural fidelity data was collected for all of the sessions for all stages of the study using a checklist (see Appendices B – E).

Treatment acceptability. The Usage Rating Profile—Intervention (URP-I; Chafouleas, Briesch, Riley-Tillman, & McCoach, 2009) was used to assess the teachers' impressions toward using this intervention in the areas of: acceptability, understanding, feasibility, and systems support after adapting it slightly to be applicable to the procedures used in this study (see Appendix E). This study did not require the teacher to implement the intervention; she was asked to complete the adapted URP-I, let the student researcher know when she could create the intervention videos with the child participants, observe the students during the math interactive centers, and later, allow the student researcher to manage the centers with the assistance of the paraprofessional while the teacher assessed children individually in the back of the classroom. Reliability estimates for URP-I's four subscale's internal consistency range from .84 to .96 (2009). This scale was modified and translated by the student researcher because some of the scale's items were specific to the classroom or school (e.g., items about the need for support from administrators or co-workers) and one of the parents needed it translated into Spanish (see Appendices F and G). The participants were not able to read so the researcher read questions from a consumer satisfaction questionnaire to the participants, and asked them to select a response from two faces (e.g., happy or sad) to indicate whether they enjoyed the various aspects of the intervention (see Appendix H).

Design

The experimental design was single subject multiple baseline replicating the effect of the independent variable, the idiosyncratic VSM videos, staggered across participants with ASD.

Procedures

Pre-baseline. The participants' two pre-baseline videos allowed the student researcher to identify environmental (e.g., seated in chairs vs. moving about the classroom, materials placed in the center of the tables vs. students searching for them in the classroom) and activity (e.g., tasks that required frequent interactions for completion vs. ones that could be completed independently and then discussed) features that required standardizing to reduce the random variability (Dugard, 2009). Students were seated at tables in groups of six and the materials they needed to complete activities were in bins placed in the center of the tables for one of the pre-baseline activities and for the other activity, the students moved about the classroom in pairs measuring various objects (e.g., chairs, computer monitors, book shelves) and recording their findings. The student researcher and the classroom teacher decided that the materials from enVision MATH interactive activities would be placed in the center of the tables. These activities required the students to ask their partners math activity related questions to complete the tasks. By having the students seated at tables and using two cameras, the student researcher could videotape two participants' 10-minute observations simultaneously with one camera and use the other camera to videotape the third participant at the same time. The time required for the participants to be engaged in the math center activity was about 15 minutes.

Baseline. All the participants' baseline data for the three dependent variables was collected continuously prior to the stagger introduction of the intervention. The participants' intervention videos were created prior to the last baseline observation. By collecting data on the days immediately after the intervention videos were created demonstrated that practice effects were not a threat to internal validity (Dowrick & Raeburn, 1995) because there was no change in the dependent variables (i.e., target behaviors) after creating the intervention videos. Baseline data was collected via the 10-minute videotaped observations of the participants engaged in interactive activities with typically developing classmates selected by their classroom teacher. The digital video recorded observations were coded using the BEST recorder software. Experimental control was demonstrated by collecting baseline data simultaneously across the three participants. Before introducing the independent variable, the last 3 to 5 data points in the baseline were analyzed for the stability of the level and trend along with a zero-celerating or contratherapeutic trend direction. The baseline data was considered stable if 80% of the data points within the baseline condition fell within a 20% range of the median level of all the baseline data point values. The relative level of change within the baseline was calculated to determine the direction of the change (Gast, 2010). It was expected that the pre-baseline data would allow the researcher to reduce the random variability, but if not, the independent variable was introduced first to the participants whose baseline data was stable. An immediate change in level for the dependent variable demonstrated better experimental control than if the response was delayed (Gast, 2010).

Intervention videos. To make the intervention videos, Dowrick's (1999) feedforward technique "hidden supports" was used to increase the frequency, quality, and quantity of verbal initiations and responses. These "hidden supports" included frequently requesting that the TD peers elicit verbal responses from participants with ASD (e.g., withholding materials until participant requested them, waiting for the participant to invite them into the activity or to take a turn), and the student researcher prompted the participants to exhibit the target behaviors (e.g., request materials, offer to share, make a compliment). The participant and peers consistently used English during these activities so all the researcher's encouragement or prompts were provided in English. A digital microphone was clipped onto the participant's clothing to provide a well-defined audio tract of their verbalizations. The participant's prompted interactions were filmed for about 45 to 60 minutes during different activities.

Initially, when creating the intervention videos, the student researcher tried using activities and materials (e.g., blocks and other attractive manipulatives) from enVisions MATH program, but the participants with ASD did not interact with their peers when these materials were used even with prompting and verbal encouragement. Then, the researcher gave them toys such as trucks, action figures, and dinosaurs to use with the math materials, the participants with ASD responded to the peer mentors' attempts to elicit responses and said or did what the researcher prompted. While it had been hoped that there would be enough material to create two 2- to 3-minute edited videos, there only was enough for one 2- to 3-minute edited video depicting Student 1 and 3's socially and contextually appropriate verbal initiations with, and contingent responses to peers during interactive endeavors without any supports or prompts from others. Two intervention videos were created for Student 2.

Intervention. On the school day following the last day of baseline collection, the intervention phase began. About 10 minutes prior to their class's math centers activity, the student researcher asked the participant to come with her and told him that he would be watching a video of themselves in researcher's office, nothing more. If they were moving around, talking, or looking away as they were shown the intervention video, they were reminded to, "Watch the video," and the number of reminders required was recorded. The participant's attention to the video was rated from 1 (*rarely*) to 3 (*almost always*). Immediately after watching the video, the participants returned to their classroom and the interactive math activity started. There was a break of 48 hours between the showing of the intervention videos to create a "spacing effect"(Dempster, 1988). As stated previously, throughout all phases videotaped observations were completed during the interactive math activity. During the observations, no prompts or other encouragement were provided to the participants or the TD peers who were working with them. After six intervention sessions with the first participant, the intervention was provided to the second participant for three sessions, and then, to the third participant for three sessions. The follow-up phase was completed for two of the three participants two weeks after intervention was terminated. Due to time constraints (i.e., end of the school year), no follow-up phase was possible for the third participant.

Post-intervention. After the last observation session, the participants with ASD were asked to complete the customer satisfaction questionnaire as the evaluator read the questions to them. Their classroom teacher was asked to complete the adapted version of the URP–I and their parents were interviewed by the evaluator using a modified version of the URP–I. Two of the three parents were interviewed in English.

Analyses

Line graphs were constructed for visual analysis of the data for the dependent variable, frequency of unprompted verbal initiations and contingent responses, and duration of ongoing interactions across the phases of the study. Visual analyses were conducted as recommended in Gast (2010). The level, trend, and trend stability of the data series were examined within each phase and the slope for each phase was calculated. Between each phase, the changes in trend, direction, level, and stability along with the absolute, relative, or mean change were determined. As the expected outcome were increases in the dependent variables, Nonoverlap of All Pairs (NAP), a measure of data overlap between phases was used as an indicator of performance differences between phases (Parker & Vannest, 2009). Manolov, Solanas, Sierra, and Evans (2011) reported that NAP "performed adequately" "in the presence of serial dependence or change in data variability" (p. 533) when used to evaluate AB designs. Tau-U was used to calculate effect size (*ES*) because it was a non-overlap technique that could correct positive baseline trend conservatively by controlling monotonic trend (i.e., the tendency for scores to increase over time; Parker, Vannest, & Davis, 2011). A web-based calculator designed for single case research was used for calculating NAP with *SE* and Tau-U along with its *SE*, 90% CI, and *p* value (Vannest, Parker, Gonen, & Adiguzel, 2016). Further correction of positive baseline trend was permitted for Tau-U (Corr Tau-U) by using this web-based calculator following the procedures described by Parker, Vannest, Davis, and Sauber (2011). Language transcriptions were analyzed using SALT and comparisons were made between the complexity, length, and rate of the participant's pre-and post-intervention utterances.

Chapter IV: Results

BEST data from the 10-min videotaped observations was used to evaluate the efficacy of the VSM intervention to increase the frequency of verbal initiations and contingent responses made by the participants with ASD and the duration of their ongoing social interactions with peers. The coded transcriptions of these videos were analyzed with SALT to determine if the participants' post-intervention utterances were significantly higher in length, rate, and complexity as compared to their pre-intervention utterances.

BEST Frequency and Duration Data

Visual analysis of data patterns within and across phases was used to determine if the results allowed a causal inference based multiple baseline design logic. That is, (a) Were there concurrent baselines when the first two participants entered the intervention phase? (b) Did the baseline data show undesired improvement? (c) Were the changes from the baseline phase (A) to intervention phase (B) in the intended direction for all participants and all behaviors? (Parker & Vannest, 2012) Finally, were the improvements sustained in the follow-up phase (C) for two of the participants? Descriptive statistics were used to supplement the visual analysis by providing directly interpretable results from the baseline to intervention phase contrasts (2012); these were given in Table 1. Figure 1 provided the BEST frequency data for initiations and responses. The BEST data for interaction duration in min was depicted separately in Figure 2 because differences between the short durations were not visible when the data was graphed using the same scale as used in Figure 1.

Student 1. Baseline frequency data for initiations had a slight positive trend (slope = 0.70) and slight variability (mean = 1.8, SD = 2.17, range 0 – 5). After introducing the intervention, the variability of the data increased somewhat (SD = 3.15, range 2 – 9) and a U-shaped line was produced by his data. His first and last data points for the phase were notably higher than the remaining 4 point that were slightly higher than his mean initiation frequency during baseline. In the intervention phase, his mean rate of initiations during the 10-minute observations was 4.5 and there was a slightly negative trend (slope = -0.14). The percent of non-overlapping data between the baseline and intervention phases as measured by NAP was 76.7%, CI 90% [-.067, 1]. If the results had been defensible, this NAP would have indicated the intervention had medium effects. To control for the positive baseline trend and marked percentage change in slope of from baseline to intervention (-120.41%), Tau-U with a statistically controlled baseline (Corr Tau-U) was used to calculate effect size (ES). Corr Tau-U was .433 CI 90% [-.167, 1] that indicated no significant intervention effect at p = .235. Without baseline control, the Tau-U would have been .533, a somewhat, but not significantly, higher *ES* (p = .144). The mean frequency of initiations over the three follow-up data points dropped to 1.67 during the 10-min observations, a -62.96% change in mean interactions from the intervention phase mean. The *SD* of 1.15 and range of 1 to 3 indicated a stable level and the slope of 0 indicated a level trend.

During baseline, he responded contingently a mean of 4.8 times in the 10-min videotaped observations and the frequency of his responses were moderately variable as indicated by the *SD* of 4.27 and range of 1 to 12. The baseline trend was moderately negative (slope = -1.20). With the introduction of the intervention, his response rate fell during the first two observations and then increased, but continued to be moderately variable (*SD* = 3.89, range 1-11). The intervention phase response's mean was 5.5 and the trend was positive (slope = 2.16). Again, the NAP of 55%, CI 90% [-.501, .701] indicated moderate intervention effects, but the results were not defensible. There was zero percent change in the overall baseline and intervention slope indicating that no correction was needed for the baseline data when calculating Tau-U. The Tau-U was .1 with a 90% CI [-.501, .701] along with the *p* of .784 indicated that there was no significant evidence of intervention effect. There was a high level of variability over the three follow-up data points as evidenced by a *SD* of 9.29 and range of 1 to 18 for a mean of 7.33. The slope (7.50) was positively skewed by the final data point of 18 and there was a 33.33% change from the intervention phase's mean to the follow-up phase's mean.

Visual analysis of Student 1's baseline data for the duration of interactions revealed stable data with a mean level of 0.55 min, *SD* of 0.77, a range from 0.00 to 1.79, and a slightly negative trend (slope = -0.25). After the introduction of the intervention, the level lowered to a stable mean duration of 0.28 min with a *SD* of 0.359, range of 0.00 to 0.97, and no trend (slope = 0.00). The NAP of 50%, 90% CI [-.601, .601] indicated moderate intervention effects but these were not defensible. No correction baseline correction was needed; the Tau-U was .00 with a 90% CI [-.601, .601], and a *p* of 1. These results were consistent with the visual analysis of the data; no intervention effect was demonstrated in the data for the duration of interactions between the baseline and intervention phases. During the follow-up phase, no interactions occurred during the first two observations, but on the last day of the study, he engaged in interactions for 2.51 min. Over the three observations, the mean duration of interactions was 0.84 min (*SD* = 1.45, range 0.00–2.15) and the trend was ascending (slope = 1.26).

Anecdotally, Student 1's level of engagement in the activities seemed to vary by his level of fatigue. The school system had a 7-hour school day and the math partner activities were scheduled for the last hour in the afternoon most days. Some days he seemed to have more energy than others. When he was tired, he tended to stare off into space while twirling a strand of hair for a few minutes at a time and only responded when his attention was deliberately caught. The last observation session was completed during the morning because of end of the school year events and that day, Student 1 responded contingently more frequently and sustained interactions longer than during any other session. Fatigue may have been one of the uncontrolled situational factors that affected the outcome of the experiment, especially with Student 1.

Student 2. The BEST frequency data for Student 2's initiations during baseline was slightly variable around a phase mean of 3 initiations during the 10 min observations (*SD* = 2.23, range 0–7) and a slightly negative trend (slope = -0.14). The last three baseline data points were stable (*M* = 0.67, range 0–2). After the intervention was introduced, visual analysis indicated no significant intervention effect because there was no observable change in the level of the data (*M* = 1, *SD* = 1, range 0–2) and there was a slightly higher negative trend (slope = -0.5). The NAP of .278, 90% CI [-1, .173] indicated no to weak interaction effect. Trend between phases was in the same direction; the percent change in slope from the baseline to intervention phase was high (250% change) and therefore, trend was controlled using Corr Tau-U. The overall change in the frequency of initiations between baseline and intervention while controlling for baseline trend was 6.7% (Corr Tau-U = .067, 90% CI [-.550, .684], *p* = .859). Intervention did not have any defensible effect on the frequency of initiations. Over the three follow-up phase observations, Student 2 did not make any initiations (*M*, *SD*, range, and slope = 0) and this supported the conclusion that there was no intervention effect demonstrated on the frequency of initiations.

Visual analysis of the baseline frequency data for Student 2's contingent responses showed high variability around a mean of 8 (*SD* = 5.96, range 0–21) with a slightly ascending trend (slope = 0.22). The last three baseline data points had a significant ascending trend with a mean of 12.67, *SD* of 4.93, range of 7 to 16, and slope of 4. After the introduction of the intervention, the frequency of his responses lowered to a stable level with a mean of 4 (*SD* = 1, range 3–5) and descending trend (slope = -0.50) during the three 10-min observations. Visual analysis indicated a significant negative effect on the frequency of his responses after the intervention was introduced and this conclusion was supported by the NAP of .233, CI 90% [-1, .084]. To correct the high variability and positive trend in baseline data, Corr Tau-U was used to calculate percent of change from the baseline to intervention phase. Corr Tau-U was -95.6%, 90% CI [-1, -.338], and p = .0109 indicating that the intervention had a strong negative effect on the frequency of responses. Yet, the data for the three follow-up observation sessions showed a highly variable increase in his response frequency to a mean of 15.33 with a *SD* of 18.82 and range of 3 to 37; the low response frequency during the intervention phase was not sustained during the follow-up phase. The high variability in his response frequency in the baseline phase and again in the follow-up rendered the intervention effect on response frequency indefensible.

Student 2's interaction duration data showed a high rate of variability during baseline with a mean of 0.94 min, *SD* of 1.40, and range of 0.00 to 5.19 during the 10 min observation sessions. There was a very small negative trend (slope = -0.06) over baseline phase, but a notable change in trend for the last three baseline observations to a slope of 0.62, mean of 1.50 min, *SD* of 1.11, and range of 0.35 to 2.56. After the intervention was introduced, there was a lower stable trend (slope = 0.03) with a mean of 0.02 min, *SD* of 0.03, and range of 0.00 to 0.05. The NAP of .167 90% CI [-1, -.05] indicated no to weak intervention effects. The Corr Tau-U of

-.778, 90% CI [-1, -.161], and *p* of 0.038 approached significance but the high level of variability in the baseline along with the positive trend for the last three baseline observations limited the defensibility of this apparent intervention effect. During the follow-up phase, the level increased to a mean of 0.31 min of interactions during the 10-min observations with a *SD* of 0.22, a range of 0.21 to 0.57, and a slightly positive trend (slope = 0.31).

During informal observations, Student 2 was unable to do some of the grade level interactive partner math center tasks. Even when the researcher, paraprofessional, and peer partners explained and demonstrated how to do some of the tasks, he did not seem to comprehend what he was supposed to do. He attempted to do some of these tasks, but was unable to do them correctly. During one of the follow-up observations, after making a few mistakes when he attempted to do the task, he used some of the phrases he had been prompted to use during the treatment video (e.g., “Good job!” “It’s your turn.”) to encourage his partner to do the task for him. A few of his TD peers exhibited similar difficulties completing these tasks. Sometimes, he engaged in stereotypical behaviors such as lining up manipulatives of the same color or repeating the same noncontiguous phrase repeatedly instead of participating in the activity. Student 2 often ignored his partner’s attempts to engage him in the assigned tasks when he engaged in these repetitive behaviors. Other times, he completed the tasks with his partners without any difficulty. These factors may have been some of the uncontrolled factors affecting the results in this study.

Student 3. The BEST frequency baseline data for initiations was highly variable with a mean of 9 initiations (*SD* = 5.83, range 1–22) and trend was slightly negative over the phase (slope = -0.58). Trend was markedly negative for the last three baseline observations (slope = -3.00) with moderate variability (*M* = 9.67, *SD* of 3.21, range 6 to 12). After the intervention was introduced, the level of initiations dropped (*M* = 5), variability continued to be moderate (*SD* = 3.00, range 2–8) and trend was positive (slope = 1.50). There was not a defensible intervention response demonstrated by this data. The NAP of .267, 90% CI [-1, .15] indicated a weak intervention effect. With the high variability in the baseline, Corr Tau-U was used to estimate the effect size; Corr Tau-U was .133, 90% CI [-.484, .750], and *p* = .722. These results were consistent with the visual analysis and indicated no defensible intervention effect.

The visual analysis for the frequency of Student 3's responses during baseline showed that he responded a mean of 6 times over the 10-min observations, but the data was highly variable as indicated by the *SD* of 6.36 and range of 0 to 24. Over the baseline phase the trend was positive, but over the last three baseline data points prior to intervention, the trend was steeply descending (slope = -10.50) with a range of 3 to 24. The mean for the last points was 11.33 and *SD* was 11.15; high variability continued over these three points and during the intervention phase although the mean continued to be 11.33 (*SD* = 5.86, range 7–18). The trend continued to be descending, but at a lower rate (slope = -5.50). There was no defensible intervention effect although NAP was .811, 90% CI [.005, 1]. The high levels of variability and trend required correction; Corr Tau-U was -.044, 90% CI [-.662, .573] and *p* = .972; there were no significant intervention effects.

During baseline, the duration of interactions for Student 3 was moderately variable with a mean of 1.10 min, *SD* of 1.12, and a range of 0.00 to 3.95 and no significant trend overall (slope = -0.06). For the last three baseline observations, there was a descending trend (slope = -0.95) with continued moderate variability at a lower level (*M* = 0.77 min, *SD* = 1.09, range 0.12–2.03). After intervention was introduced, there was a moderately variable, slight increase for the interaction duration level to a mean of 1.22 min (*SD* = 1.37, range 0.20–2.78). The trend (slope

= -0.24) was less negative than it had been over the previous three baseline data points. The NAP was .556, 90% CI [-.506, .728] that suggested medium effects, but these effects were not defensible due to the moderate variability and trend in the baseline data. The Corr Tau-U was .244, 90% CI [-.373, .862] with a *p* of .515 supporting the conclusion that there were no significant effects for the intervention. No environmental factor could be identified that may have been related to the variability of the observed behavior during informal observations.

In summary, the BEST data shown in Figures 1 and 2 demonstrated that there were concurrent baselines when the first two participants entered the intervention phase, but much of the baseline data across participants and target behaviors showed moderate to high variability along with elevated trend during baseline. Most likely, these problems with the data indicated that there were confounding variables affecting the results of this experiment that were beyond the student researcher's control (J. O. Cooper, Heron, & Heward, 2007). In addition, there was no immediate change in the level and trend when the intervention was introduced for any of the target behaviors for any of the participants. Therefore, there were no defensible intervention effects observed (Riley-Tillman & Burns, 2009).

SALT Analyses of Transcriptions

The transcriptions were analyzed using SALT (Miller & Iglesias, 2012) and the analyses' results were given in Table 2. Overall, the results of the transcription analysis were similar to the BEST data in that there was there was very little change in the data across phases for all the participants. There was little to no improvement in the length, rate, and complexity of participants' utterances post-intervention in comparison to their pre-intervention utterances.

Attention to Intervention Video

The participants' attention to the intervention video was rated from 1 (rarely) to 3 (almost always) immediately after each viewing (see Table 3). Students 1 and 3 had mean ratings of 3 (*SD* = 0.0) and rarely, if ever, needed their attention redirected to the video. Student 1 had a mean of 0.25 (*SD* = 0.46, range 0–1) redirectives during the viewing sessions and Student 3 did not require any redirectives during the three viewing sessions. Student 2's mean attention to the intervention video ratings was slightly lower than the other two participants with ASD (*M* = 2.67, *SD* = 0.58, range 2–3). He required more redirectives during the viewing sessions to maintain his attention (*M* = 2.33, *SD* = 0.58, range 2–3). Overall, the participants' ratings for attention to the video were high and few, if any, redirectives were needed to sustain their attention to the intervention videos.

Treatment Fidelity

Fidelity of treatment was 100% for all intervention video viewing sessions and procedural fidelity was 100% for video observation, BEST video coding, transcription, and IOA sessions.

Interobserver Agreement

Mean interobserver (IOA) was calculated for frequency of initiation and responses, and duration of interactions (see Table 4). The mean IOA for the frequency of initiations was 95.0% (*SD* = 15.8, range 50–100) and of responses was 88.4% (*SD* = 23.63, range 33–100), and for the duration of interactions was 97.5% (*SD* = 7.9, range 75–100). IOA was lower for a few sessions when there was a low rate of initiations or responses and when it was difficult to precisely identify when the interactions started or stopped, especially when they were very short. For the transcriptions, high IOA was achieved using the f4 transcription software that allowed the replay speed to be slowed by 50 percent without distorting the sound pitch and automatic rewinding the recording for a few seconds after it was paused (see SALT transcription IOA results in Table 4). In addition, the student researcher included detailed notes and time stamps in her transcripts. This allowed the researchers to resolve most of the disagreements between transcriptions by replaying the audio files and coming to a consensus. Mean IOA was 97.67% at the word and morpheme level (*SD* = 0.03, range 91–100), 97.41% for rate of speech (*SD* = 0.02, range 92–100), and 97.17% for utterance segmentation (*SD* = 0.04, range 90–100).

Treatment Acceptability and Usability

Treatment acceptability and usability for the teacher was measured with the adapted Usage Rating Profile-Intervention (URP-I; Chafouleas et al., 2009) and for the parents, with the modified URP-I (one parent needed a Spanish translation; see Appendices E – G). The teacher and parents rated their agreement with the items' statements with 1 indicating strong disagreement and 6 indicating strong agreement. Their mean ratings and SD across the four domains summarized in Table 5.

With the adaptations and modifications made to the scale, the *Acceptability* domain measured the respondent's belief that the intervention was appropriate for addressing the behavior of concern and their enthusiasm for implementing the intervention. The *Understanding* domain measured the respondent's comprehension of their role in the study (e.g., provide times when the videotaped observations could be done, allow their child to be videotaped and participate in the intervention). The *Feasibility* domain measured the respondent's belief about how possible it would be to implement the intervention as described with treatment fidelity in the classroom. A high score in the *Systems Support* domain indicated that the respondent believed that assistance or support from other adults at the school was required for the intervention to be implemented successfully (Chafouleas et al., 2009).

The classroom teacher's high mean rating of 5.69 (*SD* = 0.75) for *Acceptability* indicated that she felt that the intervention was appropriate for improving the participants' social communication and interaction skills and was enthusiastic for it to be implemented in her classroom. Her ratings on the items associated with the *Understanding* domain indicated that she understood her role in the study (*M* = 5.25, *SD* = 1.75). On the items for the *Feasibility* domain, her responses indicated that she felt it was feasible for the student researcher (or another school psychologist) to implement the intervention in her classroom with strong treatment fidelity (*M* = 5.25, *SD* = 0.35). Finally, her high mean rating on the *System Support* items (*M* = 6.0, *SD* = 0.0) indicated that she did not feel that the intervention could not be implemented without support from other adults. Informally, she stated that she did not have the equipment or the technical skills required to make the intervention videos, and would not have been able to take time away from group instruction for creating the videos.

The parents' ratings were similar to those of the classroom teacher in that they gave high ratings in the areas of *Acceptability* (*M* = 5.75, *SD* = 0.43), *Understanding* (*M* = 5.67, *SD* = 0.58), and *Feasibility* (*M* = 6.0, *SD* = 0.0). Overall, they expressed support for the intervention being a feasible approach that could potentially improve their child's social communication and interaction skills. In addition, all stated that their child enjoyed participating in the study and that they did not regret allowing them to participate even though the results did not demonstrate any intervention efficacy. Their responses on the Systems Support items were mixed (*M* = 4.0, *SD* = 2.56) and indicated slight agreement that they would need support and assistance to implement this intervention at home. Informally, they stated that they would need support with creating the videos, but would be able to show them to their child without difficulty.

On the Child Customer Satisfaction Survey, all the participants with ASD were in 100% agreement with the three items (see Table 6). They stated that they enjoyed making and watching their movies along with a desire to make more movies like them again.

Chapter V: Discussion

The primary purpose of this study was to evaluate the efficacy of VSM for increasing the frequency of verbal initiations and contingent responses made by children with ASD ages 5 to 7 and the duration of their ongoing social interactions with peers. All of the participants in this study were Hispanic from homes in an urban setting where both Spanish and English were spoken. In most intervention research for children with ASD (Jonsson et al., 2016) including those using a VSM intervention, most participants are from Caucasian, English-speaking backgrounds (Shukla-Mehta et al., 2010).

Another purpose of this study was to replicate and expand on previous research demonstrating that a standalone VSM intervention was effective for improving social communication skills in children with ASD. Bellini, Akullian, et al. (2007) used VSM to successfully improve the unprompted social engagement of two preschool children with ASD during the "free-choice" time in their preschool classroom. In that study, the two preschool children's percent of non-overlapping data (PND) was 80% for the intervention phase and 100% for the maintenance phase. In Bellini, Akullian, et al. (2007), both children's data showed a rapid increase in the percent of intervals that they were engaged in social interactions after the introduction of the intervention, but with significant variability in the data for the intervention and maintenance phases. Based on the data shown in the study's graphs, during the four observations during baseline, the percent of intervals in which Roger, the first child to receive the intervention, was highly variable with a mean of 3.5 percent, *SD* of 4.73, range of 0 to 10, and descending trend overall (slope = -2.6). After the intervention was introduced, there was an immediate, but highly variable increase in level (*M* = 42.7 percent, *SD* = 26.31, range 4–76) over the 10 observations. Although there was a slight positive trend over the intervention phase (slope = 1.47), for the last three intervention data points, there was a descending trend (slope = -7.5) with continued large variability at a similar level (*M* = 41 percent, *SD* = 32.91, and range 4–67). In the maintenance phase, there was a continued moderately variable increase in level over five observations (*M* = 51.8, *SD* = 19.56, and range 27–72), but there was a descending slope of -6.5. Over the last three maintenance phase data points, the level was lower as was the variability and the slope was ascending (*M* = 40, *SD* = 15.39, slope = 10.5, and range 27–57).

The data of the other child in the study by Bellini, Akullian, et al. (2007), Dylan, was somewhat less variable across all phases, but the increases in levels across phases was smaller than they were for Roger. Over the five baseline observations, the variability was moderate with little trend (*M* = 5.83, *SD* = 4.21, slope = 0.66, range 0–13), but there was an undesirable positive trend over the last three baseline data points along with an increase in variability (*M* = 5.67, *SD* = 6.66, slope = 6.5, range 0–13). During the intervention phase, there was an immediate change in level with high variability (albeit less than in Roger's intervention data) and a slightly positive trend across the ten observations (*M* = 24.4, *SD* = 14.06, slope = 2.42, range 0–50). For the last three intervention phase data points, there was less variability, an increase in level, but a descending trend (*M* = 29, *SD* = 10.58, slope = -10, range 17–37). Once again, there was an increase in level over the 4 moderately variable maintenance phase data points (*M* = 36.75, *SD* = 9.74, slope = 0.5, range 27–50). The variability was somewhat less and the level was somewhat higher for the last three data points in the maintenance phase, but there was a descending trend (*M* = 40, *SD* = 8.89, slope = -8.5, range 33–50). Overall, the results of Bellini, Akullian, et al. (2007) and other studies (e.g., Buggey et al., 1999; Wert & Neisworth, 2003) demonstrated that VSM was an effective intervention for improving social communication skills for children with ASD.

In this study, the videotaped observations were coded and analyzed using the BEST software collection (Sharpe & Koperwas, 2012b) that allowed for for collecting, coding, and analyzing real-time data on the frequency and duration simultaneously. Then, the videotaped observations were transcribed and analyzed using SALT (Miller & Iglesias, 2012) to provide detailed information using common terminology about the intervention's effect on the children's spoken language. It was hypothesized that the length, rate, and complexity of the participant's utterances would be significantly higher post-intervention in comparison to their pre-intervention utterances as measured by the SALT analyses of transcripts.

Summary of Results

Visual analysis of the BEST frequency data for frequency of verbal initiations and contingent responses revealed that there were concurrent baselines when the first two participants entered the intervention phase and there was follow-up data for these two participants. It was not possible to collect follow-up data for the third participant because the school year ended after his third intervention observation. Over the last three data points prior to the introduction of the intervention, the baseline data for at least two out of the three behaviors being observed was either relatively stable or had a negative trend. Across all phases for all participants, most of the frequency data was moderately to highly variable and there was little to no change in level after the introduction of the intervention. The duration data for ongoing interactions was more stable (range 0.0–5.19), but again there was no observable change in level after introducing the intervention. The results of this study showed no reliable positive effect of the VSM intervention on the primary dependent variables, frequency of socially appropriate initiations and contigent responses, and duration of ongoing social interactions. The variability showed poor experimental control and this indicated that confounding variables affected the results (J. O. Cooper et al., 2007).

The results of the Tau-U and Corr Tau-U supported the conclusions of the visual analysis. The Tau-U *ES* or the Corr Tau-U *ES* corrected for trend ranged from -.956 to .433 (*SE* = .365) for the frequency of initiations and contiguent responses. While the -.956 Corr Tau-U *ES* for Student 2's frequency of contigent responses suggested a negative intervention effect, visual analysis of the follow-up data did not support that effect because Student 2's frequency of responses increased from a mean of 4 (*SD* = 1) during the intervention phase to a mean of 15.33 (*SD* = 18.82) during the follow-up phase (See Table 1 & Figures 1–2). For the duration of ongoing interactions, the Tau-U or Corr Tau-U *ES* ranged for -.778 to .244 (*SE* = .375). Again, Student 2's Corr Tau-U *ES* of -.778 indicated a negative intervention effect over the three intervention phase observations, but visual analysis of his data over the three follow-up observations demonstrated that the negative effect was not sustained. The mean interaction duration increased from a mean of 0.02 min (*SD* = 0.027, range 0.00–0.05) during the intervention phase to a mean of 0.31 min (*SD* = 0.22, range 0.21–0.57) during the follow-up phase with a slight positive trend (slope = 0.31).

The SALT analyses of the transcriptions produced information about the length ($MLU_{w)}$, rate (words/min), and complexity (SI score) of participants' utterances across the phases. The results of these analyses were summarized in Table 2 and did not show any notable changes across phases after introducing the intervention. The mean MLU_w and SI scores were stable across phases for all participants; mean MLU_w ranged from 1.81 to 2.8 and mean SI scores ranged from 0.37 to 0.83. There was greater variability in words/min within phases for all participants as evidenced by the relatively large ranges and it was similar to the variability observed with the initiation and contingent response frequency data. For example, Student 2's mean words/min during baseline was 5.26 with a *SD* of 5.89 and range of 0.0 to 21.67. During baseline, his mean contingent response frequency was 8 (*SD* = 5.96; range 0–21).

The mean IOA for the BEST coding and the transcriptions of the videos was high. The mean IOA for the frequency of initiations was 95.0% and of responses was 88.4%, and for the duration of ongoing interactions was 97.5%. For the transcriptions, mean IOA was 97.67% at the word and morpheme level, 97.41% for rate of speech, and 97.17% for utterance segmentation.

All the students met the inclusion criteria for recognizing themselves in videos and attended well to their intervention videos as demonstrated in their mean attention ratings and the number of redirectives required to sustain their attention (see Table 3). On the consumer satisfaction survey, they reported that they enjoyed making and watching their videos (see Table 6). Results on the standardized measures administered prior to baseline data collection showed that all the participants had low average to average nonverbal ability (PTONI quotient range 82–102) and had expressive vocabulary skills in the average to very superior range as measured by the EOWPVT standard scores (range 101–145). Therefore, the participants' attention to the videos, pleasure in seeing themselves in these videos, and global nonverbal ability and expressive vocabulary did not seem to be factors that influenced the intervention response.

Factors that may have increased the variability of their data across all phases may have been fatigue because almost all the intervention and observation sessions were at the end of the 7-hour school day. There were days when Student 1 appeared to be more tired than other days and while his fatigue was apparent, the other 2 boys also could have been tired. Another factor that may have increased the variability was their ability to complete the interactive activity (e.g., comprehension of the instructions). For example, there was one activity that required the students to place a block on a line drawing and tell their partner where it was in relation to a desk or a window (e.g., the block is on the desk that is next to the window). This activity was difficult for all the participants and some of their TD classmates; all the children had a lower level of task engagement when they had trouble completing the tasks. Their TD peers who were working with other TD children usually engaged in social conversations when they had difficulty completing the task or were uninterested in it, but the participants with ASD usually did not engage in these conversations.

The participants' motivation to participate actively in the partner math tasks varied. Some days, Students 2 and 3 perseverated on lining up blocks of certain colors repeatedly and would not engage in the assigned activity with their peer partners at least for a few minutes during the 10-min observation. Their peer partners attempted to engage them in the activities and when they could not, they completed their portion of the activity. In addition, there were at least six children who were partners with the participants during the interactive math activities. The participants seemed to prefer working with some of these children than others and there were individual differences in how well each of the partners interacted with each of the participants. Motivation to actively participate in the assigned math partner tasks with their assigned peer partners may have been factors affecting the participants' use of the target behaviors. They may not have been motivated to display the behaviors shown in the intervention video, an important factor for engaging in a modeled behavior per Bandura (1977).

Beyond the variability observed across phases, there was no defensible response to the VSM intervention. The first indication that the goals of this intervention may have been beyond the participants' ZPD or that they did not have the required component skills was during the creation of their individualized intervention videos. Even with prompting and support from the student researcher and the peer-assistants, the participants with ASD did not engage in the prompted social interactions when they were engaged in same math activities used in their classroom. Action figures and more playful ways of using the math manipulatives were required for them to eagerly engage in social interactions or even to imitate the prompted behaviors such as looking at the peer-assistant when speaking to them or to provide a contingent response to a peer-assistant's question. Possibly, by requiring the participants to use both academic and social interaction skills during the partner math activities required more than was in the participants' ZPD.

In addition, the participants' intervention videos showed them interacting appropriately with peers in play rather than academic social activity, and therefore, the skills depicted may have been different from those required to interact socially during a cooperative math activity rather than playing with math manipulatives. The dissimilarity of the situations may not have allowed for a generalization of skills across the settings even if the required skills were the same. Not only were the depicted skills different, but the participants may have perceived themselves as interacting successfully with peers in a play rather than in a cooperative academic activity and, therefore, their sense of self-efficacy to exhibit the target behaviors participating in the cooperative academic activity may not have increased.

There was good fidelity to the treatment and procedural checklists designed to avoid or at least document common problems such as equipment failures, inconsistent instructions to participants, and omitted procedural steps. They did not prevent the unanticipated need for the observed activity to have a strong academic component along with the social communication opportunities.

The results of the modified URP-I indicated that the classroom teacher and parents strongly agreed that the VSM intervention was appropriate for improving social communication skills with students who have ASD, that they understood what their role in the study was, and that the intervention was feasible to use in school. The teacher and to a lesser extent, the parents felt that they would need assistance from other adults to implement the intervention.

Implications for Practice

There continues to be a strong need for effective, brief, school-based interventions to improve the social communication skills of children with ASD. As a single subject design study, the findings cannot be generalized to the larger population. Even though there are no defensible intervention effects in this study, there may be some implications for practice. If VSM is used to improve the social communication skills of children with ASD, it is suggested that educators identify the component skills required for doing the target skill and then, determining if the children have those component skills. One possible way to evaluate if participants have the component skills would be to determine if the child can perform the target skill when provided with the adult and peer-assistant supports that would be given when creating the intervention video. Use the same activity and materials that the child would use in the target setting. If the child is unable to do the activity with supports, then VSM may not be the appropriate intervention. Alternatively, it may be possible to use VSM to perform lower level component skills, if they are within their ZPD.

While increasing social communication during play would not have been a socially valid goal within the classroom for the teacher in this study, it probably would have been considered a valuable goal for the child in the context of speech/language therapy or social skills instruction with the school social worker. VSM may have been an effective intervention for increasing these participants' social communication skills during play-based activities with a small social skills group. Use of these skills in the generalization setting (e.g., playground or gym class) could be reinforced using a token economy. In hindsight, it would have been better if the student researcher revised her inclusion criteria to include a semistructured interview of the classroom teacher to elicit a detailed description of the curriculum and center activities where data would be collected. With this information, the evaluations of the participants with ASD completed to determine if they met the inclusion criteria could have included an evaluation of their skills for participating in the math center activities. Alternatively, after examining the math curriculum, the student researcher could have determined that the verbal skills required to complete the curriculum's math centers were more advanced than those of typically developing children from a second language background. In either case, she would have needed to recruit different participants who met the criteria and who were willing to participate in the study.

In this study, VSM was used as a standalone intervention, but VSM usually is used as a component in an intervention package (Whalon et al., 2015). If the child with ASD has the component skills, using an external reward system such as a token economy to encourage children with ASD to use the social communication skills depicted in the intervention video may increase the perceived usefulness of that behavior. Children are more likely to imitate behavior that they perceive as being useful for achieving a valued goal or objective (Bandura et al., 1977; Dowrick, 2012b).

Limitations

In this study, stable baselines were not established prior to the introduction of the independent variable, the VSM videos, but for at least 2 of the three dependent variables there was a negative slope for the last three baseline data points or a stable baseline. This compromise demonstrated lower experimental control than would have been shown with stable baselines for all dependent variables. In addition, participants were not randomly assigned for the staggered introduction of the independent variable so there was a possible selection threat to internal validity. There was no immediate change in level for the dependent variables after the introduction of the independent variable across participants so there was no defensible intervention effect. High reliability percentages for interobserver agreement and fidelity to treatment protocol reduced the threat of instrumentation. The moderate to high variability and occasional undesirable positive baseline trend limit the experimental control and defensible statements that can be made about functional independence or functional similarity. This study used a multiple baseline across participants design that required concurrent repeated measurement of the target behaviors across at least three similar participants with staggered introduction of the intervention. There were only three intervention sessions for the last two participants although it was unlikely that more opportunities to receive the intervention would have improved their responses. Follow-up data was collected for only two of the three participants. Limitations of this design in this study included the lack of intra-subject replication and the delayed, limited number VSM intervention sessions for last two participants possibly caused ethical concerns (Gast, 2010). A final limitation was that because this was a single-subject design experiment, the generalizability and external validity were limited without further replications (Cohen, 1994).

Future Research

This study contributes to the literature base on the use of VSM interventions for students with ASD in that it may illustrate how important it is that students have the component skills for performing the target behavior. If participants are unable to perform the target behaviors with supports while doing a task that is similar to the selected activity prior to collecting baseline data, researchers could identify more appropriate target behaviors, a different setting, or select other participants who that have the requisite component skills. In addition, while the goal of this intervention study had social validity for the classroom teacher and the students' parents, it may not have been perceived as valuable by the students. Use of external reinforcement for displaying the target behaviors may have increased their perceived value by the students and increased the likelihood that they would have imitated the behaviors depicted in the intervention videos (Bandura, 1975).

Finally, the transcription of the videos was very time-consuming and did not seem to contribute much useful information in this single-subject design study. The information from the participants' transcripts about their social communication skills probably would be more useful in RCT intervention studies because Tager-Flusberg et al. (2009) recommendations were developed for reviewing research grant applications.

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Table 1

BEST Frequency and Duration Data

Initiation (Frequency)

	Baseline				Intervention				NAP	TauU ES	Corr TauU ES
	M	*SD*	Range	Slope	*M*	*SD*	Range	Slope	(*SE*)	(*SE*)	(*SE*)
Student 1	1.8	2.17	0-5	0.70	4.5	3.15	2-9	-0.14	0.767 (0.365)	0.533 (0.365)	0.433 (0.365)
Student 2	3	2.23	0-7	-0.14	1	1	0-2	-0.50	0.278 (0.375)	-0.444 (0.375)	0.067 (0.375)
Student 3	9	5.83	1-22	-0.58	5	3	2-8	1.50	0.267 (0.375)	-0.467 (0.375)	0.133 (0.375)

Response (Frequency)

	Baseline				Intervention				NAP	TauU ES	Corr TauU ES
	M	*SD*	Range	Slope	*M*	*SD*	Range	Slope	(*SE*)	(*SE*)	(*SE*)
Student 1	4.8	4.27	1-12	-1.20	5.5	3.89	1-11	2.16	0.55 (0.365)	0.1 (0.365)	0.067 (0.365)
Student 2	8	5.96	0-21	0.22	4	1	3-5	-0.50	0.233 (0.375)	-0.533 (0.375)	-0.956 (0.375)
Student 3	6	6.36	0-24	0.51	11.33	5.86	7-18	-5.50	0.811 (0.375)	0.622 (0.375)	-0.044 (0.375)

Interaction (Duration in min)

	Baseline				Intervention				NAP	TauU ES	Corr TauU ES
	M	*SD*	Range	Slope	*M*	*SD*	Range	Slope	(*SE*)	(*SE*)	(*SE*)
Student 1	0.55	0.77	0.00-1.79	-0.25	0.28	0.359	0.00-0.97	0.00	0.5 (0.365)	0 (0.365)	0.033 (0.365)
Student 2	0.94	1.40	0.00-5.19	-0.06	0.02	0.027	0.00-0.05	0.03	0.167 (0.375)	-0.667 (0.375)	-0.778 (0.375)
Student 3	1.10	1.12	0.00-3.95	-0.06	1.22	1.370	0.20-2.78	-0.24	0.556 (0.375)	0.111 (0.375)	0.244 (0.375)

Table 2

SALT Analyses of Transcriptions Data

Student 1

	Baseline			Intervention			Follow-up		
	M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
MLU_{word}	2.11	0.11	2-2.25	2.8	0.7	1.75-3.63	2.13	0.33	1.89-2.5
Words/Minute	3.01	2.26	0.44-5.9	4.04	2.62	0.69-9.1	3.11	2.38	1.3-5.8
SI Score	0.81	0.24	0.5-1	0.83	0.26	0.33-1.15	1	0	1

Student 2

	Baseline			Intervention			Follow-up		
	M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
MLU_{word}	1.95	1.08	0.0-2.9	1.81	0.32	1.44-2	2.14	0.75	1.67-3
Words/Minute	5.26	5.89	0.0-21.67	2.12	1.03	1.4-3.3	3.27	2.88	1.25-6.57
SI Score	0.63	0.35	0.0-0.79	0.37	0.34	0.0-0.67	0.53	0.50	0.0-1

Student 3

	Baseline			Intervention		
	M	*SD*	Range	*M*	*SD*	Range
MLU_{word}	2.67	0.49	2.19-3.8	2.37	0.58	1.73-2.87
Words/Minute	12.77	4.17	7.6-18.52	13.8	4.74	10.76-19.26
SI Score	0.82	0.19	0.63-1.24	0.67	0.09	0.58-0.76

Table 3

Mean Attention to Intervention Video Ratings and Number of Redirectives Required

		Attention 1 Rarely – 3 Almost Always	No. Redirectives
Student 1	*M*	3	0.25
	(*SD*)	(0.0)	(0.46)
	Range	3	0 – 1
Student 2	*M*	2.67	2.33
	(*SD*)	(0.58)	(0.58)
	Range	2–3	2–3
Student 3	*M*	3	0
	(*SD*)	(0.0)	(0.0)
	Range	3	0

Table 4

Interobserver Agreement

Point by Point IOA for BEST Observations

	Mean % Agreement	*SD*	Range
Initiations	95.00	15.81	50–100
Responses	88.41	23.63	33.33–100
Interactions	97.50	7.90	75–100

IOA for SALT Transcriptions

	Mean % Agreement	*SD*	Range
$MLU_{Word/Morpheme}$	97.67	0.03	91–100
Words/Minute	97.41	0.02	92–100
Utterance Segmentation	97.17	0.04	90–100

Table 5

Modified Usage Rating Profile-Intervention (UPR-I) Mean Ratings

Factors		Teacher (*n* = 1)	Parents (*n* = 3)
		1 Strongly Disagree – 6 Strongly Agree	
Acceptability	*M*	5.69	5.75
	(*SD*)	(0.75)	(0.43)
Understanding	*M*	5.25	5.67
	(*SD*)	(1.75)	(0.58)
Feasibility	*M*	5.25	6.00
	(*SD*)	(0.35)	(0.0)
Systems Support	*M*	6.00	4.00
	(*SD*)	(0.0)	(2.56)

Table 6

Child Consumer Satisfaction Survey Results

Items	% Agreement (*n* = 3)
It was fun to make my movies.	100%
I like watching my movies.	100%
I want to make some more movies like this again.	100%

Figure 1

BEST Frequency Data for Initiations and Responses

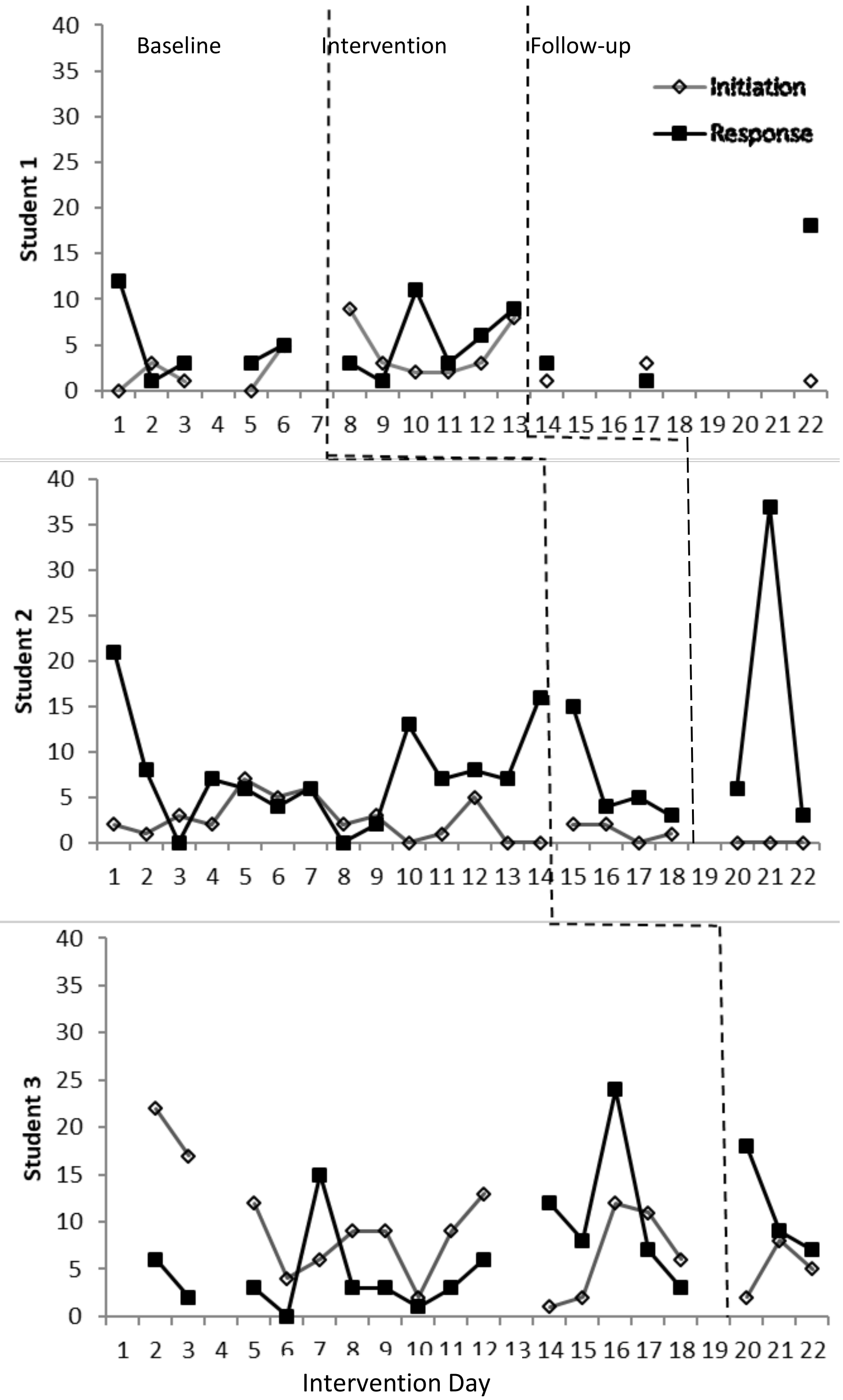
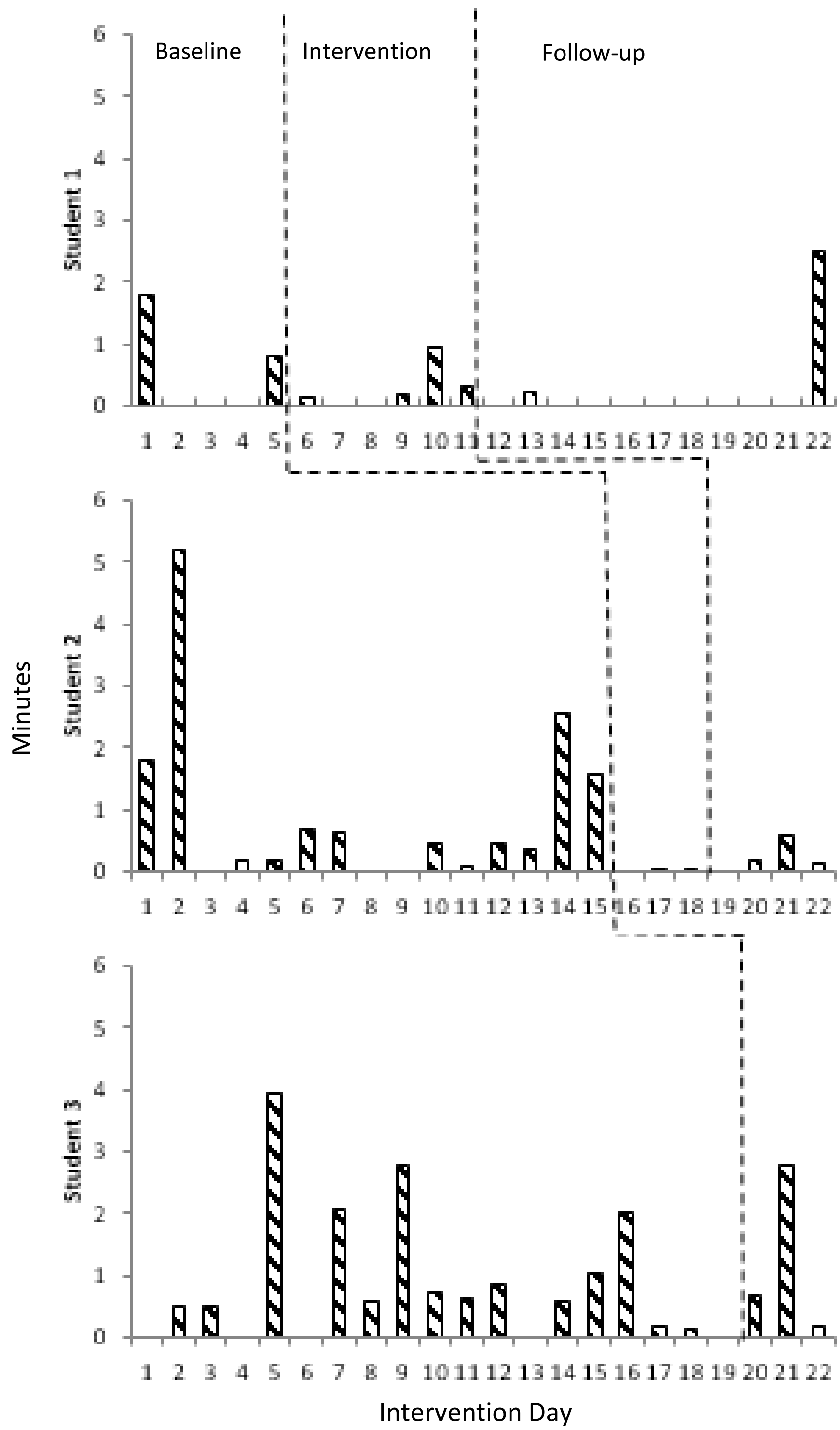


Figure 2

BEST Duration Data for Interactions



Appendix A

Inclusion Criteria Checklist for Participants with ASD

1	Principal gives permission to do study in school
2	Classroom teacher signs consent.
3	Paraprofessional or staff member signs consent
4	Child provides oral assent
5	Parent signs consent
6	Uses single words or word combinations to label or to regulate the behavior of others
7	Rarely or never uses words or word combinations in social communications with peers
8	From homes in which the primary language spoken is English or Spanish
9	Can watch a video for at least 3 minutes
10	Resident of [City name]
11	Is from an African-American or Hispanic background.
12	Documentation from a physician or clinical psychologist for a diagnosis of an ASD
13	Age 5 to 7
14	Diagnosis confirmed by the CARS2-ST
16	Demonstrates recognition of and pleasure in seeing themselves in a 1-minute video
17	Completes the EOWPVT (Spanish Bilingual Ed)
18	Achieves a standard score of 70 or higher on the PTONI
19	Included in a general education class and/or has daily opportunities to interact freely with typically developing peers for at least 30 m
20	Pre-baseline video 1
21	Pre-baseline video 2

Appendix B

Treatment Fidelity Checklist for Intervention Sessions

Write the date for the treatment session, and in the column below it, write "1" if the treatment step was completed and "0" if not. Complete the items below the checklist for each session.	
1	Did the student researcher only inform the participant that they will be viewing a short video, and then returning to their classroom without providing them with any other treatment information?
2	Was the video shown to the participant in a private space to permit uninterrupted, quiet viewing?
3	Was the treatment video shown according randomized schedule provided for each participant in its entirety?
4	Was the participant directed to watch the video?
5	Did the researcher avoid conversation and not provide additional information during the viewing?
6	If the participant was inattentive, did the researcher repeat the directive to watch the movie and count the redirectives?
7	Did the researcher escort the participant back to their classroom without any additional discussion of the video?
8	Was a 48-hour break allowed between this viewing of the video and the previous one?
9	Did the researcher complete the items below
	Total number of steps completed
	Percentage of steps completed

Complete items below for each session	
1	Number of video version shown
2	Number of redirectives needed
3	Rate the participant's attention to the video with a number from 1 to 3 with 1 indicating that the participant was mostly inattentive to the video during the session and 3 indicating that the child was mostly attentive.
4	Brief explanation of any equipment failure
5	Note if participant was absent or unable to be seen
6	Note if anything unusual happened that may be related to any behavioral differences

Appendix C

Procedural Fidelity Checklist for Videotaped Observation Sessions

	Write the date for the video observation session, and in the column below it, write "1" if the procedural step was completed and "0" if not.
1	The equipment was checked (e.g., batteries charged, flash card formatted) so that it was ready to be used.
2	If intervention phase, was treatment completed immediately prior to observation? (For all other phases, write "1").
3	The wireless microphone, connected to the bodypack, and the bodypack was clipped on the participant.
4	The audio equipment was turned on and each microphone was synchronized with the receiver.
5	The tripod and audio equipment were placed so that it did not interfere with the activity but was close enough to record behavior.
6	The video camera was set to record.
7	The participant was kept in the video frame as much as possible.
8	No one (i.e., peers or adults) prompted the participant.
9	The participant was videotaped for at least 10 minutes.
10	When videotaping was completed, the material was saved.
11	At the end of the session, all equipment including microphone/s were turned off and stored.
12	The researcher checked availability for videotaping the next observation session with the teacher prior to leaving.
13	Complete all the items below.
	Total number of steps completed
	Percentage of steps completed

	Complete items below for each session
1	Time observation started (00:00 in 24 hr. notation).
2	Time observation ended (00:00 in 24 hr. notation).
3	Length of observation.
4	If observation was not conducted immediately after the treatment session, note time in hours and minutes between sessions.

Appendix D

Procedural Fidelity Checklist for Coding Videos with BEST Recorder

Write the date for the coding session, and in the column below it, write "1" if the coding step was completed and "0" if not.	
1	Download video on to laptop and save in Windows Media File format.
2	Open the BEST program and set up a new data file in format [participant's ID code] Month-Day
3	Associate it with [participant's ID code] video for that date
4	Associate it with the configuration file
5	Click on record data button
6	Under options, open the data and statistics window
7	Open the video window.
8	Check the notes for that date along with the start & stop times
9	Start recording data at the start time
10	Pause the video at the stop time
11	Go through the steps on the screen to save the data file
12	Close the file before starting next file
13	Complete all the items below.
	Total number of steps completed
	Percentage of steps completed

Complete items below for each session	
1	Mark if session is for IOA
2	Brief explanation of any equipment failure

Appendix E

Procedural Fidelity Checklist for Transcription Sessions

	Write the date for the transcription session, and in the column below it, write "1" if the transcription step was completed and "0" if not.
1	Download video on to laptop and save in Windows Media File format.
2	Associate the video to a f4_2012 file
3	Record all the times associated with the file
4	Use the commands in the data window to control the media while transcribing.
5	Use the letter associated with participant and P for P at beginning of each utterance.
6	Convert the f4_2012 file to SALT format
7	Export file to SALT
8	Analyze the transcription
9	Complete all the items below.
	Total number of steps completed
	Percentage of steps completed

	Complete items below for each session
1	Mark if this session is for IOA
2	Brief explanation of any equipment failure

Appendix F

Adapted Usage Rating Profile-Intervention (URP-I) for Classroom Teacher

1	The amount of time required to use this intervention is reasonable (i.e., intervention = the student views the approximately 2-minute video self-modeling tape 2 to 3 times a week for a total of 6 viewings).
2	I would allow the implementation of this intervention with lots of enthusiasm.
3	The intervention could be implemented for the duration of time as prescribed.
4	The amount of time required for record keeping with this intervention is reasonable (i.e., teachers are not required to keep any records).
5	I am motivated to allow this intervention to be tried with my student.
6	I would need consultative support to allow the implementation of this intervention.
7	All pieces of this intervention could be implemented precisely.
8	The intervention could be implemented with the intensity as prescribed (see above).
9	I would have positive attitudes about allowing the implementation of this intervention.
10	I understand the procedures to allow the implementation of this intervention.
11	I would know what to do if I was asked to allow this intervention to be implemented.
12	Overall, the intervention is beneficial for my student.
13	Allowing the implementation of this intervention would require support from my co-workers.
14	Parental collaboration is required in order to use this intervention.
15	The requirements for allowing the implementation of this intervention are unclear. *
16	I would not be interested in allowing the implementation this intervention with my student.*
17	The intervention could be implemented exactly as described.
18	This intervention is a good way to improve the child's communication and social interaction skills.
19	I could only allow the implementation this intervention with assistance from other adults.
20	The intervention is a fair way to improve the child's communication and social interaction skills.
21	This intervention is reasonable for improving the communication and social interaction skills described.
22	I could use this intervention with my student by myself.
23	I would need support from my administrator to allow a school psychologist to use this intervention with my student.
24	I would be resistant to allowing a school psychologist to use this intervention with my student.*
25	This intervention could be implemented as frequently as described.
26	This is an acceptable intervention strategy for improving the child’s communication and social interaction skills.
27	I am knowledgeable about my role in implementing this intervention (i.e., provide a school psychologist with the times when the student can view the video).
28	This intervention is an effective choice for addressing a variety of problems.
29	This intervention would not be disruptive to other students.
30	I have the skills needed to allow the implementation this intervention.
31	Use of this intervention would save time spent on teaching communication and social interaction skills.
32	I understand how to allow this intervention to be used with my student.
33	I liked the procedures used in this intervention.
34	I would have no idea how to allow the school psychologist to implement this intervention.*
35	The directions for allowing the school psychologist to use this intervention are clear to me.

* Reverse coded items

Appendix G

Modified Usage Rating Profile-Intervention (URP-I) for Parents

1	The amount of time required to use this intervention is reasonable (i.e., intervention = the child views the approximately 2-minute video self-modeling tape 2 to 3 times a week for a total of 6 viewings).
2	I would allow the implementation of this intervention with lots of enthusiasm.
3	The intervention could be implemented for the duration of time as prescribed.
4	The amount of time required for record keeping with this intervention is reasonable (i.e., teachers and parents are not required to keep any records).
5	I am motivated to allow this intervention to be tried with my child.
6	This intervention could be used exactly as it is described above.
7	I understand what my child will be asked to do.
8	Overall, the intervention is beneficial for my child.
9	Collaboration of parents and teachers is required to use this intervention.
10	I am unclear on what my child will be required to do for this intervention. *
11	I would not be interested in allowing my child to receive this intervention.*
12	The intervention could be implemented exactly as described.
13	This intervention is a good way to teach the child communication and social interaction skills.
14	This intervention is a fair way to improve the child communication and social interaction skills.
15	This intervention is reasonable for improving the communication and social interaction skills described.
16	I could use this intervention with my child by myself.
17	I would be resistant to allowing a school psychologist to use this intervention with my child.*
18	This intervention could be implemented as frequently as described.
19	This is an acceptable intervention strategy for improving the child's communication and social interaction skills.
20	I am knowledgeable about my role in implementing this intervention (i.e., return the signed parent permission form and complete this interview).
21	This intervention is an effective choice for addressing a variety of problems.
22	This intervention would not be disruptive to family life.
23	I have the skills needed for my role in this intervention (i.e., return the signed parent permission form and complete this interview).
24	Use of this intervention would save time spent on teaching communication and social interaction skills.
25	I understand how this intervention will be used with my child.
26	I liked the procedures used (i.e., what my child will be asked to do) in this intervention.
27	I have no idea how to complete my role in this intervention (i.e., return the signed parent permission form and complete this interview).*
28	The directions for completing my role in this intervention are clear to me.

* Reverse coded items

Appendix H

Modified Usage Rating Profile-Intervention (URP-I) for Parents in Spanish

1	La cantidad de tiempo requerido para utilizar esta intervención es razonable (es decir, la intervención = el niño ve el vídeo auto-modelado de aproximadamente 2 minutos 2 a 3 veces por semana para un total de 6 visionados).
2	Que permita llevar a cabo esta intervención con mucho entusiasmo.
3	La intervención podría ser implementado por la duración del tiempo en la forma prescrita.
4	La cantidad de tiempo requerido para el mantenimiento de registros con esta intervención es razonable (es decir, los maestros y los padres no están obligados a mantener cualquier registro).
5	Estoy motivado para permitir que esta intervención se intentó con mi hijo.
6	Esta intervención podría ser utilizado tal y como se ha descrito anteriormente.
7	Entiendo lo que mi hijo tendrá que hacer.
8	En general, la intervención es beneficiosa para mi hijo.
9	La colaboración de los padres y maestros es necesario para utilizar esta intervención.
10	No sé lo que mi hijo tendrá que hacer por esta intervención.*
11	No permitiría que mi hijo reciba esta intervención.*
12	La intervención podría ser implementado exactamente como se ha descrito.
13	Esta intervención es una buena manera de mejorar las destrezas de comunicación e interacción social de mi hijo.
14	Esta intervención utiliza una forma justa para mejorar las destrezas de comunicación e interacción social de mi hijo.
15	Esta intervención es razonable para la mejora de las competencias descritas de comunicación e interacción social.
16	Podría usar esta intervención con mi hijo por mí mismo.
17	Sería resistente a permitir que un psicólogo escolar use esta intervención con mi hijo.*
18	Esta intervención podría ser implementado tan frecuentemente como se describe.
19	Esta es una estrategia de intervención aceptable para la mejora de las destrezas de comunicación e interacción social de los niños.
20	Estoy bien informado sobre mi papel en la implementación de esta intervención (es decir, devolver el permiso de los padres firmado, y completar esta entrevista).
21	Esta intervención es una opción eficaz para tratar diversos problemas.
22	Esta intervención no sería disruptiva para la vida familiar.
23	Tengo las habilidades necesarias para mi papel en esta intervención (es decir, devolver el permiso de los padres firmado, y completar esta entrevista).
24	El uso de esta intervención se ahorraría el tiempo dedicado a enseñar las destrezas de comunicación e interacción social.
25	Entiendo cómo esta intervención será utilizada con mi hijo.
26	Me gusta los procedimientos utilizados (es decir, lo que mi hijo tendrá que hacer) en esta intervención.
27	No tengo idea de cómo llevar a cabo mi papel en esta intervención (es decir, devolver el permiso de los padres firmado, y completar esta entrevista).*
28	Las indicaciones para realizar mi papel en esta intervención son claras para mí.

* Reverse coded ítems

Appendix I

Child Consumer Satisfaction Questionnaire

Name: ____ **Date**: ____________________

Please listen to me while I read you these sentences and then point to the smiley face for "yes" or the mad face for "no".

1. It was fun to make my movies.

2. I like watching my movies.

3. I want to make some more movies like this again.