A COMPARISON OF VIDEO MODELING WITH VERSUS WITHOUT PLAY NARRATIONS ON TOY PLAY FOR CHILDREN WITH AUTISM SPECTRUM DISORDER WHO DEMONSTRATE DELAYED ECHOLALIA

By

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Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Special Education

August, 2015

Nashville, Tennessee

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To my darling wife, who deserves an honorary degree for her unending love, care, and support from the beginning to the end of this entire process.

ACKNOWLEDGEMENTS

I am deeply grateful for my advisors, Drs. Mark Wolery and Donald Compton. I would also like to thank the members of my committee—Drs. Erin Barton, Vicki Harris, Joseph Lambert, and Joseph Wehby—for their time, thought, and service to this dissertation. I would like to thank Dr. Jeff Gabrielson, president, and Emily Puskar, clinic director, of Aptitude Habilitation Services, Inc. for their full support of this project. And thanks to Corinne Jones and Sara Sheffler for their diligence and hard work in coding my data.

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CHAPTER I

INTRODUCTION

The effectiveness of video modeling interventions for teaching children with autism spectrum disorders (ASD) skills across a variety of domains in which deficits are commonly present (see American Psychiatric Association, 2013) has been thoroughly researched and reviewed. Multiple independent research reviews have concluded that video modeling is an evidence-based practice for children with ASD (e.g., Bellini & Akullian, 2007; Reichow & Volkmar, 2010; Wang & Spillane, 2009; Wong et al., 2015). Most recently, a comprehensive review with the aim of identifying all evidence-based practices for individuals with ASD found studies supporting the efficacy of video modeling for teaching skills in 11 different domain areas including: (a) social, (b) communication, (c) behavior, (d) joint attention, (e) play, (f) cognitive, (g) school readiness, (h) academic, (i) motor, (j) adaptive, and (k) vocational domains (Wong et al., 2015). In addition to a wide range of domains, Wong and colleagues found studies supporting the efficacy of video modeling across a wide range of ages as well. Support was found for at least two of three age groups (i.e., birth to five-years-old, six- to 14-years-old, and 15- to 22-years-old) within eight of these 11 domains.

As the evidence base grows to the extent that there is general consensus about the effectiveness of an intervention, it is appropriate for the focus of some study efforts to shift from direct replications designed to demonstrate an effect to systematic replications designed to analyze relative effects. Likewise, it is appropriate for the focus of some literature review and synthesis efforts to shift from evaluations of the overall effect or evidence-base of an intervention to analyses of study variations and their associations with the relative effect of the intervention (Wolery, Gast, & Ledford, 2014).

Review of Video Modeling by Busick (2010)

Busick (2010) conducted a systematic review of the video modeling literature for children with ASD—restricted to social, communication, and play skill outcomes—with the specific aims of evaluating the literature in terms of: (a) reporting and assessment of participant characteristics, (b) internal and external validity measures, (c) variations in participant characteristics, (d) variations of the video modeling interventions, and (e) variations in procedural adherence to the principles of observational learning (Bandura, 1977). To be included in the review, studies had to: (a) be published in an English-language, peer-reviewed journal, (b) include a valid single case experimental design (see Gast & Ledford, 2014), (c) include at least one participant with an ASD diagnosis, and (d) measure dependent variables in the social, communication, and play skill domains. Based on these criteria, 20 studies were identified and included in this review (see Appendix A for a reference list of included studies). While (a) reporting and assessment of participant characteristics and (b) internal and external validity measures were of interest for reviewing the overall descriptive and methodological characteristics of the reviewed studies, (c) variations in participant characteristics, (d) variations of the video modeling interventions and (e) variations in procedural adherence to the principles of observational learning were of greater interest because these variations were analyzed for their associations with the relative effects of the video modeling interventions employed.

A summary of findings from Busick (2010) of variations analyzed and their associated relative effects is provided in Table 1. To make an overall determination of whether the relative effect of a variation should be categorized as a “positive effect”, a “potentially positive effect,” “no clear effect,” a “potentially negative effect,” or “too few studies to assess an effect,” the following procedural steps were taken: (a) studies were coded for descriptive characteristics and variations of interest, (b) studies were coded for methodological rigor, (c) experimental designs were visually analyzed for evidence of an effect (i.e., functional relation), (d) groups of all studies with versus without a characteristic/variation of interest were compared in terms of their within-group effect consistency (i.e., percentage of experimental designs within each group for which a functional relation was present), and (e) in some comparisons, groups of only the most rigorous studies (i.e., the five most rigorous from each group) with versus without a characteristic/variation of interest were compared in terms of their within-group effect consistency.

Table 1
Associations between Study Variations and Relative Effects of Video Modeling

Category Variation Variation Sub-category	Positive Effect	Potential Positive Effect	No Clear Effect	Potential Negative Effect	Too Few Studies to Assess Effect
Participant Characteristics:					
Learner has imitation skills*		X			
Learner is capable of deferred imitation*					X
Learner has delayed echolalia					X
Intervention Variations:					
Video Model Perspective Type:					
Other-adult			X		
Other-peer			X		
Self					X
Point-of-view					X
Number of Different Video Models Used:					
1 (vs. 2-4)			X		
5+ (vs. 1-4)				X	
Length of delay between viewing and measurement			X		
Length of video			X		
Consecutive viewings of video model	X				
Number of Modeled Behaviors Targeted:					
Single behavior (vs. 2+)					X
Sets of 6+ (vs. of <6)		X			
Procedural Adherence to Observational Learning Principles:					
Procedures to promote child attention to the video model		X			
Procedures to promote child motivation			X		

Note: *These participant characteristics are also related to principles of observational learning.

A coding scheme was developed to gather information about study characteristics and variations of interest. The coded information was divided into eight major categories: (a) participant characteristics—examples of information gathered included ASD category, gender, ethnicity, standardized test scores, functional characteristics, and prerequisite skills; (b) characteristics of the dependent variable—examples of which included domain category, the operational definition of the behavior, and the system of measurement used; (c) characteristics of the baseline phase—examples included length of baseline phase, number of measurement sessions, length of measurement session, setting, and whether additional components were added to the baseline phase; (d) characteristics of the independent variable—examples included the number of videos used to teach, what type of model was used, length of the video, number of behaviors demonstrated by the model, whether additional features were added to the video, and whether components in addition to video modeling were part of the intervention; (e) characteristics of the intervention phase—in addition to the same information gathered for characteristics of the baseline phase, other examples included the number of times the video was viewed before each measurement session, the setting in which the video was viewed, whether procedures were used to ensure the learner's attention to the video, and the delay between viewing the video and the measurement session; (f) methodological characteristics—examples included experimental design, interobserver agreement (IOA), procedural fidelity (alternatively, procedural reliability or treatment integrity), and whether any probable threats to internal validity existed; (g) results of the study—examples included stability in baseline, characteristics of the data shift across phases, and whether evidence of a functional relation was present; and (h) external validity—whether maintenance, generalization, and/or social validity were assessed and how they were assessed.

In addition to the coding scheme for study characteristics described above, an additional coding scheme was used to assess the methodological rigor of studies in the review to better qualify the overall judgments of relative effects that were made. Judgments based on comparisons of groups of studies with a high levels of methodological rigor were considered more reliable than judgments based on comparisons of groups of studies with mixed or poor levels of rigor. The methodological rigor coding scheme was based largely on quality indicators for single case research identified by Horner and colleagues (2005). Rigor was coded across five categories: (a) description of participants, (b) dependent variable, (c) independent variable, (d) experimental control/internal validity, and (e) external validity. Items within categories included items recommended by Horner and colleagues and additional items deemed appropriate for a review of video modeling. For example, within the "description of participants" category, items recommended by Horner and colleagues included whether the study reported participant characteristics such as age, gender, and diagnosis, whereas added items included whether the study reported participant characteristics such as imitation ability and echolalia. For each of the five methodological rigor categories, each study's level of rigor was ranked against all other studies included in the review (i.e., from 1 – 20). Each study's overall rigor rank was determined by calculating the rank average across all five rigor categories.

The researcher then used visual analysis (see Gast & Spriggs, 2014) to evaluate each experimental design for the presence of a functional relation between the video modeling intervention and primary dependent variable. Evidence of a functional relation was considered present if there was a consistent change in level, trend, or variability in a therapeutic direction across *all* demonstrations/replications within the design.

To conduct between-group study analyses, all studies that included a variation of interest (e.g., learners with imitation skills, consecutive viewings of the video model) were compared to all studies that did not include that variation of interest in terms of each group's consistency of effect—defined as the percentage of experimental designs in which there was evidence of a functional relation. If either group had fewer than three studies in it, between-group analyses were not conducted. For a variation to be categorized as having a "positive effect," the following criteria had to be met: (a) at least a 20% difference between groups in consistency of effect, (b) at least five studies in each group, and (c) the overall methodological rigors of the groups were comparable (i.e., the average rigor rank of each group was within one-half of a standard deviation of each other). For a variation to be categorized as having a "potentially positive (or negative) effect," one of two sets of criteria had to be met: set one—(a) at least a 20% difference between groups in consistency of effect, (b) between three to four studies in one or both groups, and (c) the overall methodological rigors of the groups were comparable or set two—(a) at least a 20% difference between groups in consistency of effect with all studies in each group compared, (b) the overall methodological rigors of the groups were not comparable with all studies in each group compared, and (c) at least a 20% difference between groups in consistency of effect with only the five most rigorous studies from each group compared. For a variation to be categorized as having "no clear effect," one of two sets of criteria had to be met: set one—(a) less than a 20% difference between groups in consistency of effect with all studies in each group compared or set two—(a) more than a 20% difference between groups in consistency of effect with all studies compared in each group, (b) the overall methodological rigors of the groups were not comparable with all studies in each group compared, and (c) less than a 20% difference between groups in consistency of effect with only the five most rigorous studies from each group compared. A variation was categorized as having "too few studies to assess an effect" if either group had fewer than three studies.

Using this method, four variations were identified as being associated with a positive or potentially positive effect: (a) the learner has imitation skills, (b) consecutive viewings (at least two) of the video model before each session, (c) targeting behavior sets with least six different behaviors per set (as compared to targeting behavior sets with less than six different behaviors per set), and (d) incorporating procedures to promote child attention to the video model. The current study was guided in part by these findings as well as findings related to: (a) principles of observational learning and (b) delayed echolalia as a learner characteristic.

Analysis of study variations related to principles of observational learning. Video modeling interventions are rooted in the principles of observational learning (Bandura, 1977). Through his series of studies, Bandura identified four conditions that must be present for a child to learn observationally. The child must: (a) pay attention to the person demonstrating the behavior (also known as the model), (b) retain the behavior demonstrated by the model until s/he is given the opportunity to reproduce it, (c) have the requisite skills and ability to imitate the behavior, and (d) be motivated enough to reproduce the behavior. Traditionally, modeling is conducted in a live-action format (also referred to as *in vivo* modeling). With in vivo modeling, the model demonstrates the behavior in its context, the learner observes the model, and then the learner is given the opportunity to imitate the modeled behavior. With video modeling, first a video recording of the model demonstrating the behavior is created, the learner observes the video recording of the model, and then the learner is given the opportunity to imitate the modeled behavior. Whether live or via video, the conditions of child (a) attention, (b) retention, (c) imitation ability, and (d) motivation are necessary for modeling to be effective.

Five studies reported using procedures to promote child attention to the video model when viewed. The procedures used included: (a) response prompting strategies when children diverted their attention away from the video model, (b) embedding attention cues and features into the video model to promote attention, and (c) providing contingent verbal praise for child attention. Studies that reported the use of attention-promoting procedures were associated with video modeling interventions that were potentially more effective relative to video modeling interventions in studies that did not report the use of any attention-promoting procedures.

Between the time in which the video model is viewed and the opportunity is given to imitate the modeled behavior, the child must retain what s/he has observed. This ability to retain the model is highly related to the concept of delayed, or deferred, imitation. Deferred imitation in children was first studied, observed, and defined by Piaget in *Play, Dreams, and Imitation in Childhood* (1962). Piaget found that most typically developing children are capable of deferred imitation—the ability to observe a modeled behavior, retain what was seen, and then imitate it at some point later—by 24 months of age. Delayed imitation is a crucial ability for a learner to benefit from video modeling. Since Piaget's seminal work on deferred imitation, other studies have found that typically developing children are capable of deferred imitation at even earlier ages. Meltzoff (1985) assessed the object imitation skills of children at 14- and 24-months of age under immediate and deferred (24-hour delay) conditions. The modeled behavior was a simple toy play action. He found that 75% (15 of 20) of children at 14-months and 80% (eight of 10) of children at 24-months were capable of immediate imitation and 45% (nine of 20) of children at 14-months and 70% (7 of 10) of children at 24-months were capable of deferred imitation after a 24-hour delay. Based on these findings, Busick (2010) used 24-months as the developmental age criterion for comparing the relative effects of video modeling with children who were likely capable of deferred imitation versus those who were not. However, there were not enough participants with IQ or developmental assessment scores reported to allow for this comparison to be made.

The finding that video modeling is potentially more effective when used with learners who have imitation skills was based almost entirely on a group of studies that simply reported descriptively that their children had imitation skills compared to the group of studies that did not report their children as having imitation skills. This was the only comparison that could be conducted because there was only one study in the review that included a direct assessment of imitation skills as part of its procedures (i.e., Hine & Wolery, 2006). But this finding is limited by the lack of studies that directly assessed imitation skills and because these studies were compared to a group that simply did not report on imitation skills (i.e., non-reporting is not necessarily equivalent to confirming that imitation skills were not present).

Eight studies incorporated features to promote the child's motivation to imitate the video models. Antecedent-based motivational features included using preferred toys, materials, and interaction partners. Consequent-based motivational features included the use of reinforcement contingent upon child imitation as a component of the intervention. The most common reinforcer used was specific verbal praise delivered to the child when s/he imitated a modeled behavior. No clear association was found between incorporating motivational features and the relative effect of video modeling. However, this finding was limited and obscured by large differences between the average methodological rigors of the two groups that were compared.

Analysis of delayed echolalia as a learner characteristic. One of the major diagnostic criteria for ASD is the presence of repetitive patterns of behavior. Echolalia—the repetition of words or phrases heard from other sources—is the most common form of verbal repetitive behaviors among children with ASD (American Psychiatric Association, 2013). Echolalia is categorized into two types—immediate and delayed (Tager-Flusberg, Paul, & Lord, 2005). Delayed echolalia (commonly referred to as "scripting") is the repetition of words or phrases heard from other sources at an earlier point in time, that is, there is a latency between when the source is first heard and when the child repeats it. Children with ASD may continue to demonstrate delayed echolalia with a particular word or phrase days, weeks, months, or years after the original source was first heard.

One of the most commonly reported sources of verbal stimuli for delayed echolalia is television (Prizant, 1983). Delayed echolalia with television and other forms of screen media is analogous to verbal imitation of an unsystematic, unplanned video model. To demonstrate delayed echolalia with screen media, a child must attend to the verbal information provided, retain the verbal information, and be willing and able to imitate the verbal information at a later time. Delayed echolalia is based on the same principles of observational learning—attention, retention, imitation, and motivation—as video modeling. Hence, video modeling might be more effective for children with ASD who demonstrate delayed echolalia than for those who do not. In fact, studies of other interventions have specifically targeted children with ASD who demonstrate delayed echolalia as participants and have found that their echolalic tendencies might have enhanced the effects of the interventions employed (e.g., Charlop, 1983; Leung & Wu, 1997).

Based on the hypothesized relation between delayed echolalia and video modeling, Busick (2010) set out to analyze the relative effect of video modeling for children with ASD who demonstrate delayed echolalia; however, across all 20 studies included in the review, there was only one valid experimental design with a participant who was specifically reported to have this characteristic.

Recommendations and conclusions of the Busick (2010) review. In conducting this review, perhaps the greatest and most consistent obstacle to planned analyses of variations of interest was the non-reporting by studies of certain information. This resulted in two major problems. First, for some planned analyses, non-reporting resulted in too few studies/participants/valid experimental designs to make comparisons (e.g., as with the analysis of delayed echolalia as a learner characteristic). Second, for other planned analyses, non-reporting resulted in the comparison of a group that reported the presence of a variation versus a group that did not report the presence of a variation (e.g., as with the analysis of learner imitation skills). Findings from these analyses must be qualified and interpreted with caution because the comparison made was not the presence of a variation versus the absence of it, but rather the presence of a variation versus the non-reporting of that variation. It is possible that the non-reporting group used to make a comparison included studies/participants for which the feature was in fact present. If any analyses were contaminated by this problem, the relative effect of the variations analyzed might have been diminished or completely masked. Thus, it was recommended that future studies explicitly report information on (a) participant characteristics such as echolalia, imitation ability, and developmental levels; (b) adherence to Bandura's (1977) criteria such as procedures that promote learner attention to the video model, and (c) other variations of the intervention such as the number of times the video models were viewed before each session, the length of the video model, and the length of delay between the viewing and the session.

While several reviews have concluded that overall, video modeling is an effective and evidence-based practice for children with ASD (e.g., Bellini & Akullian, 2007; Reichow & Volkmar, 2010; Wang & Spillane, 2009; Wong et al., 2015), video modeling is not always effective. In this review, nearly one in five (18%) valid experimental designs did not demonstrate evidence of a functional relation. There must be explanations as to why video modeling is not effective in all cases. This review investigated the relative effect of video modeling in terms of variations such as (a) participant characteristics, (b) adherence to Bandura's (1977) criteria for observational learning and (c) other variations of the intervention. Analyses revealed some potential explanations of the relative effects of video modeling (see Table 1).

With one exception (Sherer et al., 2001), the identified studies were designed primarily to demonstrate the main effect of video modeling rather than to compare the relative effect of video modeling under differing conditions. While this review incorporated an analysis strategy that attempted to control methodological rigor as a potential confound, there was still a large degree of between-study and between-group variation in rigor for the comparisons that were made. Many findings had to be qualified as a result of methodological inconsistencies. Alternatively, a within-study comparison that maintains a relatively consistent (and preferably high) degree of rigor would be a much stronger control for rigor as a confound.

A single within-study comparison might have the advantage of reducing confounds, but it has limited generalizability because the findings must be qualified by the other conditions that were held constant under the study. Extending the previous example, if high-complexity social skills were targeted using video self-modeling, it is unknown if the effect (or lack thereof) of delay between viewing and measurement would be similar when targeting low-complexity toy play skills using point-of-view modeling. To enhance the generalizability of findings, planned systematic replications should be conducted in which potentially confounding variables are held constant within a single study and intentionally varied across other studies.

While the relative effects of many variations remained unclear due the limitations of the Busick (2010) review, many recommendations can be made for potentially enhancing the effect of video modeling interventions for children with ASD. Based on the results related to Bandura's (1977) criteria for observational learning, first it is recommended that a procedure to ensure the learner's attention to the video model be included as part of the intervention. It is also recommended that child attention to the video model is measured so that the association between attention to the video model and the effect of video modeling can be analyzed. Second, although there were not enough studies to analyze child developmental level, it is still recommended that video modeling should only be used for children for whom it is developmentally appropriate (i.e., at least at a developmental age equivalent of 24 months; Meltzoff, 1985; Piaget, 1962). Third, while this review did not find any clear associated effect of incorporating features to promote child motivation, incorporating child preference, contingent reinforcement, and verbal praise are well-established and recommended instructional practices that promote learning (e.g., Cooper, Heron, & Heward, 2007; Sandall, Hemmeter, Smith, & McClean, 2005).

There were not enough cases to analyze the association between delayed echolalia and the relative effect of video modeling. Future studies should investigate the relative effects of video modeling for children with ASD who demonstrate delayed echolalia, especially with video models that include verbal stimuli or verbal target behaviors for children who demonstrate delayed echolalia specifically with various sources of screen media (e.g., television shows, movies, commercials).

As for other variations of the intervention, first, it is recommended that consecutive viewings of the video are presented before the learner is given the opportunity to imitate what s/he has seen. Second, using too many different video models to teach (i.e., five or more) might reduce the relative effect of video modeling. Third, when teaching a behavior class, or set of behaviors, the findings suggest that it might be best for the video model to demonstrate at least six unique behaviors within the class.

Other Recent Reviews of Variations and Relative Effects of Video Modeling

Since the Busick (2010) review, several research reviews on video modeling have been published. Many of these reviews have had similar aims of going beyond the question of the overall effectiveness of video modeling to analyzing questions of relative effects. There have been at least six systematic or meta-analytic reviews published since 2010 with a primary focus of analyzing the association between different variations and the relative effects of video modeling for children with ASD (see Appendix B for a reference list of these reviews). A summary of these reviews and key study findings is provided in Table 2.

Three of these six reviews were conducted by the same lead author using similar analysis techniques (i.e., Mason, Davis, Boles, & Goodwyn, 2013; Mason, Ganz, et al., 2013; Mason, Ganz, Parker, Burke, & Camargo, 2012). These three reviews were all meta-analyses using non-overlap methods with the improvement rate difference (IRD) as the effect size metric. The primary difference between the three reviews were study inclusion restrictions based on the perspective type of the video model. Two of the other reviews were also meta-analyses, one of which also used non-overlap methods, but with different effect size metrics—the percentage of non-overlapping data (PND and the percentage of data exceeding the median (PEM)—and another review used hierarchical linear modeling (HLM) with Cohen's *d* as the effect size metric (i.e., Sng, Carter, & Stephenson, 2014; Wang, Cui, & Parrila, 2011). The sixth review was a systematic review that did not use a meta-analytic technique (i.e., Shukla-Mehta, Miller, & Callahan, 2010).

Table 2

Systematic and Meta-Analytic Reviews of Variations and Relative Effects of Video Modeling Published Since 2010

Review	Type of review	# of Studies	Outcomes	Restrictions	Key Study Findings
Shukla-Mehta et al. (2010)	Systematic	26	S, C	ASD only	• Imitation should be assessed prior to VM **(+)** • Relative effect of consecutive viewings over single viewing prior to session **(+)** • No clear effect of VM perspective type **(+)** • VM+prompting/reinforcement might be necessary when VM alone is not effective **(E)** • Potential relative effect of VM for children who can attend to a video for at least 1 min **(E)** • Attending should be assessed prior to VM **(E)** • Video should not be longer than 3-5 min **(E)** • Visual processing, matching to sample, and spatial ability should be assessed prior to VM **(A)**
Wang et al. (2011)	Meta-analysis HLM (Cohen's *d)*	5	S	ASD only	• No relative effect of VM vs. peer-mediated interventions **(A)** • Potential relative effect of VM for children < 10 yrs over children > 10 yrs **(A)**
Mason et al. (2012)	Meta-analysis Non-overlap (IRD)	42	S, C, P, AC, AD, DFI	Any DD VMO only	• Relative effect of VMO+reinforcement over VMO alone or VMO packages **(E)** • Relative effect of VMO for teaching P skills over S+C skills **(A)** • No relative effect of VMO for gender **(A)** • Potential relative effect of VMO for elementary ages over preschool, secondary, and postsecondary ages **(A)** • Relative effect of VMO for children with ASD over children with other DDs **(A)**

Table 2, cont.

Review	Type of review	# of Studies	Outcomes	Restrictions	Key Study Findings
Mason, Davis, et al. (2013)	Meta-analysis Non-overlap (IRD)	14	S, C, P, DFI	Any DD POV only	• Relative effect of POV VM alone over POV VM+reinforcement and POV VM packages **(E)** • Relative effect of POV VM prompting over POV VM priming **(A)** • Relative effect of POV VM for children with ASD over children with other DDs **(A)** • Relative effect of POV VM for secondary and postsecondary ages over preschool and elementary ages **(A)** • Relative effect of POV VM for teaching DFI skills over S+C skills **(A)**
Mason, Ganz, et al. (2013)	Meta-analysis Non-overlap (IRD)	56	S, C, P, AC, AD, DFI	Any DD VMO and VSM only	• No relative effect of familiar vs. unfamiliar actors in VM **(+)** • Relative effect for VMO-Adult over VMO-Peer and VSM **(E)** • Relative effect for VMO+reinforcement over VMO alone and VMO packages **(E)** • Relative effect for VSM alone and VSM packages over VSM+reinforcement **(E)** • Relative effect for VMO alone over VMO packages **(A)**
Sng et al. (2014)	Meta-analysis Non-overlap (PND / PEM)	25	S, C	ASD only	• Relative effect for VMO-adult, VMO-peer, and VSM over POV VM **(E)** • No relative effect of VM vs. audio-script interventions **(A)**

Note: Type of Review codes—HLM = Hierarchical Linear Modeling, IRD = Improvement Rate Difference, PND = Percentage of Non-overlapping Data, PEM = Percentage of Data Exceeding the Median. Outcomes codes—S = Social, C = Communication, P = Play, AC = Academics, AD = Adaptive, DFI = Daily/Functional/Independent Living. Restrictions codes—DD = Developmental Disability, VMO = Video Modeling Other (adult or peer) perspective, POV = Point-of-View perspective, VSM = Video Self-Modeling perspective. Key Study Findings codes—**(+)** = Finding agrees with Busick (2010) findings, **(E)** = Finding extends Busick (2010) findings of no clear effect or too few studies, **(A)** = Additional finding unrelated to Busick (2010) findings.

Findings from reviews that agree with findings from Busick (2010). Across these six reviews, four findings were in agreement with the findings of Busick (2010) and no conclusions were incongruent with the findings of Busick. Three of the four agreements came from the systematic review conducted by Shukla-Mehta and colleagues (2010). First, these authors recommended that imitation ability should be directly assessed as a prerequisite skill prior to the implementation of a video modeling intervention. Second, they found that the relative effect of video modeling might be improved if the video model is shown consecutively before each session, as opposed to a single viewing. Third, Shukla-Mehta and colleagues did not find any clear association between the video model perspective type and the relative effect of video modeling. Fourth, Busick did not find any clear association between antecedent-based procedures that promote child motivation—such as using preferred toys, materials, and actors—and the relative effect of video modeling. Likewise, Mason, Ganz, and colleagues (2013) found no clear effect associated with the use of familiar versus unfamiliar actors in the video models.

Findings from reviews that extend findings from Busick (2010). In Busick (2010), there were several variations for which the overall judgment was that there was no clear relative effect (frequently, because of inconsistencies in methodological rigors of studies compared) or for which there were too few studies to conduct a meaningful analysis. Reviews since Busick's have come to more definitive conclusions about some of these variations.

First, Busick (2010) did not find any clear association between consequent-based procedures that promote child motivation—such as such as including reinforcement as a component—and the relative effect of video modeling. However, Shukla-Mehta and colleagues (2010) concluded that when video modeling without any additional components is first tried and has little or no effect, it might be necessary to add prompting or reinforcement to improve the target skills. In her three meta-analyses (i.e., Mason et al., 2012; Mason, Davis, et al., 2013; Mason, Ganz, et al., 2013), Mason and her research teams analyzed the relative effects of video modeling with reinforcement as a component versus video modeling alone and video modeling as part of a packaged intervention. Their findings were mixed depending on the perspective type of the video model. For video modeling with other (adult or peer) as model, they found that video modeling plus reinforcement was more effective than video modeling alone and video modeling packages (Mason et al., 2012; Mason, Ganz, et al., 2013). For point-of-view video modeling, they found that video modeling alone was more effective than video modeling plus reinforcement and video modeling packages. For video self-modeling, they found that video self-modeling alone and video-self modeling packages were both more effective than video modeling plus reinforcement.

Second, Busick (2010) did not find any clear effects associated with perspective type when adult-acted video models were compared to peer-acted video models and the relative effects of self-acted and point-of-view video models could not be analyzed because there were not enough studies. Sng and colleagues (2014), however, found that adult-acted, peer-acted, and self-acted video models were all more effective than point-of-view video models when social-communication skills were targeted.

Third, while Busick (2010) found that incorporating procedures that promote attention when watching the video model might improve the effect of video modeling, he did not analyze any variations or make any recommendations about prerequisite attending skills. However, Shukla-Mehta and colleagues (2010), found that video modeling might be more effective for children who could attend to a video for at least 1 min prior to the intervention and they recommended that attention skills should be assessed as a prerequisite.

Fourth, Busick (2010) found no clear relative effect associated with the length of the video model, but Shukla-Mehta and colleagues (2010) recommended that videos should be no longer than 3-5 min.

Additional findings. Child prerequisite skills and characteristics considered by Busick (2010) included imitation skills, retention skills (deferred imitation), and delayed echolalia. Shukla-Mehta and colleagues (2010) recommended that other skills be assessed as prerequisites before implementing video modeling including visual processing, matching-to-sample, and spatial ability.

Busick (2010) did not analyze any relative effects associated with age or gender. Three subsequent reviews had age-specific findings. First, Wang and colleagues (2011) found that video modeling might be more effective for children younger than 10 years old than for children older than 10. Second, Mason and colleagues (2012) found that other-modeled video models might be more effective for elementary-aged participants than preschool-, secondary-, and postsecondary-aged participants. Third, Mason, Davis, and colleagues (2013) found that point-of-view video modeling might be more effective for secondary and postsecondary ages than for preschool and elementary ages. One review (i.e., Mason et al., 2012) analyzed the association between gender and video modeling and did not find any differences in the effect of other-acted video modeling for boys versus girls.

Busick (2010) did not analyze any relative effects related to outcome or skill domain. Mason and her research teams analyzed effects associated with outcomes in two of her meta-analyses (i.e., Mason et al., 2012, Mason, Davis, et al., 2013). They found that other-acted video modeling might be more effective for teaching play skills than social-communication skills and that point-of-view video modeling might be more effective for teaching task-analyzed daily/functional/independent living skills than social-communication skills.

Busick (2010) limited his review to children with ASD only. All three reviews by Mason and colleagues, however, included participants with any kind of developmental disability in their analyses and found that both other-acted video models and point-of-view video models might be more effective for children with ASD than children with other types of developmental disabilities (i.e., Mason et al., 2012; Mason, Davis, et al., 2013).

The primary focus of two reviews (i.e., Wang et al., 2011; Sng et al., 2014) was to compare the relative effect of video modeling to other interventions. Wang et al. found no difference in effect between video modeling and peer-mediated interventions for teaching social skills to children with ASD. Sng and colleagues found no difference in effect between video modeling and audio-script interventions for teaching social-communication skills to children with ASD.

Current Trends in Video Modeling Research

Since the Busick (2010) review, dozens of studies on video modeling have been published. To compare the landscape of the video modeling literature as it stood at the time of this review to now, the researcher selected a sample of video modeling studies from a larger population of studies that have been published from 2010 to 2015. To select this sample for comparison, six steps were conducted. First, the researcher performed an electronic search on the *PsycInfo* database using a combination of the search terms “video,” “model*,” and “autism,” and limited to publications in English-language, peer-reviewed, scholarly journals between the years 2010 – 2015. Second, electronically-available articles found from this search strategy were saved. Third, each saved article was reviewed to determine whether it included (a) a valid experimental design, (b) at least one participant with ASD, and (c) video modeling as part of the intervention. Fourth, articles that met these inclusion criteria constituted the population from which a sample was taken. Fifth, to make the sample more representative of publication rates per year, a weighted average for each publication year was calculated based on the population distribution. Sixth, a sample of 20 studies were randomly selected from the population, with the number of studies selected from each year determined by the weighted average.

Using the first four steps described above, a population of 64 studies was generated. Twelve studies from this population were published in 2010, five were published in 2011, eight were published in 2012, 19 were published in 2013, 16 were published in 2014, and four were published in 2015. Using weighted averages (and rounding to the nearest whole number), the sample included four studies published in 2010, two studies published in 2011, two studies published in 2012, six studies published in 2013, five studies published in 2014, and one study published in 2015 (see Appendix B for a reference list of studies included in the sample).

The sampled studies were then coded for a variety of study characteristics so that comparisons to the studies included in the Busick (2010) review could be made. A summary of the study characteristics of these two groups of studies is provided in Table 3.

Table 3

Study Characteristics of Busick (2010) Review and Sample of Studies Published between 2010-2015

Category Characteristic	Busick (2010) Studies (*n* = 20)	2010-2015 Sample (*n* = 20)
Study Design:		
Demonstration	95% (19/20)	65% (13/20)
Comparison	5% (1/20)	35% (7/20)
Reported / Assessed Participant Characteristics:		
Age	100% (20/20)	100% (20/20)
Gender	100% (20/20)	100% (20/20)
Ethnicity	5% (1/20)	5% (1/20)
ASD diagnostic assessment scores / levels	15% (3/20)	50% (10/20)
Adaptive behavior assessment scores	10% (2/20)	40% (8/20)
Intelligence / developmental assessment scores	35% (7/20)	60% (12/20)
Internal / External Validity:		
IOA	100% (20/20)	100% (20/20)
Procedural fidelity / reliability / integrity	50% (10/20)	80% (16/20)
Maintenance	75% (15/20)	80% (16/20)
Generalization	55% (11/20)	70% (14/20)
Social Validity	35% (7/20)	80% (16/20)
Video Model Perspective Type*:		
Other-adult	40% (8/20)	25% (5/20)
Other-peer	40% (8/20)	20% (4/20)
Self	30% (6/20)	25% (5/20)
Point-of-view	5% (1/20)	50% (10/20)
Animated	0% (0/20)	5% (1/20)
Procedures Related to Observational Learning Principles:		
Measured child attention to video	0% (0/20)	20% (4/20)
Included procedures to promote child attention to video	20% (4/20)	30% (6/20)
Directly assessed pre-study imitation skills	5% (1/20)	20% (4/20)
Incorporated motivational features	40% (8/20)	50% (10/20)
Other Procedures:		
Consecutive viewings of video model before session	30% (6/20)	15% (3/20)

Note: *Sums are greater than 100% because some studies used video models with more than one perspective type.

Busick (2010) recommended that because the general effect of video modeling for children with ASD had been relatively well-established and agreed upon by independent researchers and reviewers, it would be appropriate for experimenters to conduct more investigations of relative effects and comparisons. This trend appears to be reflected by the 2010 – 2015 sample. Whereas the Busick review included only one study designed as a comparison, seven of the 20 (35%) studies in the sample were comparison designs.

Busick (2010) recommended a need for improvement in study reporting and assessment of various participant characteristics. The reporting of descriptive characteristics such as age and gender were reported in 100% of studies in both sets and the reporting of ethnicity remained equally low in the sampled set compared to the set in Busick's review (one study in each set reported ethnicity). However, the frequency of reporting and assessment of more functional characteristics such as levels of ASD severity, adaptive behavior, and IQ/development has increased according to the 2010 – 2015 sample.

Methodological rigor was an issue with many of the studies in the Busick (2010) review. While the complete methodological rigors of the sampled studies were not coded, they were coded for quality indicators of internal and external validity. Aside from IOA, which was measured in 100% of both samples, measurement of all other types of internal and external validity were higher in the 2010 – 2015 sample than the studies included in the Busick review. This might indicate that the overall methodological rigor of video modeling studies has improved.

At the time of the Busick (2010) review, the perspective type used in the video models was relatively evenly distributed among other-acted, peer-acted, and self-acted. Only one study included in the Busick review used point-of-view modeling. However, in the sample of more recent studies, point-of-view modeling was the most commonly used perspective type, used in half of all studies sampled. Although used less frequently, the usage was still relatively evenly distributed among the remaining three types. Furthermore, a new perspective type category that was not included in the studies reviewed by Busick had to be added, as one study in the more recent sample used animated video models (i.e., animated characters from a video game).

Several procedural recommendations were made by the Busick (2010) review. Because video modeling is rooted in the principles of observational learning (see Bandura, 1977), it was recommended that video modeling studies should include procedures that adhere to these principles. Specific procedural recommendations related to observational learning principles were: (a) measuring child attention to the video model, (b) using procedures that promote child attention to the video model, (c) directly assessing imitation skills as a prerequisite prior to introduction of video modeling, and (d) incorporating procedures that promote child motivation. The use of all four of these recommended procedures was higher in the 2010 – 2015 sample than in the studies in the Busick review. Busick also found that the relative effect of video modeling might be enhanced by showing the video model consecutively before each session as opposed to a single viewing before each session. However, the frequency of this procedure decreased from 30% (six of 20 studies) in Busick's review to 15% (three of 20) in the 2010 – 2015 sample.

Other Closely Related Publications

Two recently published studies and one narrative review are closely related to the Busick (2010) review and the current study that follows. First, MacDonald, Dickson, Martineau, and Ahearn (2015) investigated associations between prerequisite skills and success with video modeling interventions for a sample of 29 children with ASD (age range: 3.6 to 12.1 years). The authors directly assessed each child's performance on an imitation-of-actions-with-objects task and two matching-to-sample tasks (one picture-based and one computer-based). Each task was tested under both immediate (no latency between trial presentation and opportunity to demonstrate the skill) and delayed (3 s latency between trial presentation and opportunity to demonstrate the skill) constraints. After assessment of these skills, each child's video modeling performance was assessed in three different sessions. For each session, a different video model demonstrating an 8-step play sequence with a different set of toys was shown. Children who imitated at least 18 of the 24 (75%) total play steps were grouped into the high video modeling performance group (n = 11) and children who imitated less than 18 of the 24 total play steps were grouped into the low video modeling performance group (n = 18). The high performers outscored the low performers on all immediate and delayed tasks assessed, indicating that imitating with objects and matching images to samples might be important prerequisite skills that predict a child's success with video modeling.

Second, Smith, Ayers, Mechling, and Smith (2013) compared the relative effects of video modeling with narrations versus video modeling without narrations for teaching functional living skills to four teenagers with ASD (age range: 14 – 16 years old). For each participant, each video modeling intervention targeted a different sequenced, task-analyzed functional skill, and their relative effects were compared using an adapted alternating treatments design (see Wolery et al., 2014). For two of the four participants, video modeling with narrations was more efficient (i.e., fewer errors to criterion) than video modeling without narrations and for the other two participants, there was no differentiation between the two types. Two of the participants were described as demonstrating high frequencies of scripting behaviors (i.e., delayed echolalia), but these were also the same two participants who showed no differentiation between the two video modeling types. When surveyed after the experiment, all four participants indicated a preference for video modeling with narrations over video modeling without narrations. Key differences between the study by Smith and colleagues and the current study are: (a) age of participants (teenagers versus preschool to elementary-aged), (b) participant selection criteria (delayed echolalia/scripting was an inclusion criteria for the current study), (c) target skills (functional living skills versus toy play skills), and (d) the presentation and function of narrations. In the study by Smith and colleagues, each narration was provided *before* the demonstration of corresponding modeled functional skill and was meant to serve the function of a verbal cue/instruction, not as a language target to be imitated. In the current study, each narration was provided *concurrently* as the modeled toy play action was being demonstrated and was meant to serve the function of an appropriate play-based language target to be imitated.

Third, despite the connections between imitation ability and video modeling, a review by Lindsay, Moore, Anderson, and Dillenburger (2013) identified only six studies that included direct assessments of imitation as part of their procedures. Although they only had these six studies from which to draw conclusions, the authors concluded that these studies provide evidence that the relative effect of video modeling might be enhanced when child imitation is directly assessed and treated as a prerequisite skill for video modeling, which is consistent with the findings of the Busick (2010) review.

Rationale and Research Questions for the Current Study

The first major aim of the current study was to incorporate procedures based on Busick's (2010) recommendations and findings into one cohesive unit. The second major aim was to investigate the hypothesized alignment between delayed echolalia as a learner characteristic and video modeling as an intervention. One aspect of this hypothesis included investigating the overall effect of video modeling for children with ASD who demonstrate delayed echolalia with screen media. But the aspect of greater interest was investigating whether the relative effect of video modeling is enhanced for children with ASD who demonstrate delayed echolalia with screen media by incorporating verbal stimuli into video models. A comparison of video modeling with narrations versus video modeling without narrations was conducted to investigate this relative effect. With these aims in mind, the research questions under investigation in this study were:

1. Can identified recommended practices, practices based on the principles of observational learning, and practices for which more research is needed for video modeling interventions be incorporated into the study procedures?
2. Is video modeling effective for teaching toy play actions to children with ASD who demonstrate delayed echolalia?
3. Is video modeling effective for teaching corresponding toy play narrations to children with ASD who demonstrate delayed echolalia?
4. What are the relative effects of video modeling with versus without modeled toy play narrations on modeled and unmodeled toy play actions and what are the relative changes in unmodeled toy play actions from baseline to intervention?
5. What are the relative effects of video modeling with versus without modeled toy play narrations on narration of modeled and unmodeled toy play actions and what are the relative changes in usage of modeled and unmodeled toy play narrations?
6. What are the relative associations between child attention to video models with versus without modeled toy play narrations and frequencies of modeled toy play actions?
7. What are the relative maintenance effects of video modeling with versus without modeled toy play narrations upon withdrawal of the video modeling interventions?

CHAPTER II

METHOD

Participants

Recruitment of participants. Participant recruitment procedures followed the protocol that was pre-approved by the researcher's university-based institutional review board. The researcher recruited participants through a private company that specializes in the provision of applied behavior analysis (ABA)-based therapy services to children with ASD. Prior to and throughout the duration of the study, the researcher independently contracted with this company as an ABA therapy supervisor and direct therapist. After obtaining written approval of all study procedures by the president of the company, the researcher met with the local clinic director to identify child clients within the company who might qualify as potential participants based on the pre-specified inclusion and exclusion criteria. Through this method, the researcher and clinic director identified three children as potential participants, all of whom were recruited by the researcher, qualified for the study based on the inclusion and exclusion criteria, and included as the participants in the study.

Inclusion and exclusion criteria. For each participant, a total of 10 criteria (six inclusion and four exclusion) were assessed. The six inclusion criteria assessed were: (a) presence of delayed echolalia with screen media (i.e., movies, television shows, and/or commercials), (b) chronological age between 24 and 96 months, (c) developmental age of at least 24 months, (d) diagnosis of ASD, (e) motor imitation with objects, and (f) verbal imitation. The four exclusion criteria assessed were: (a) prior exposure to video modeling interventions, (b) diagnosis of severe intellectual disability, (c) nonverbal (no functional language or communication), and (d) documented hearing or visual impairment. Table 4 provides a description of the dimensions, methods of assessment, and requirements for these criteria.

Table 4
Inclusion and Exclusion Criteria

Type Dimension	Assessment Method	Criterion
Inclusion Criteria:		
Presence of delayed echolalia with screen media	Echolalia and imitation questionnaire	Parent must: (a) report child demonstrates delayed echolalia with screen media at least 1x/day and (b) give at least one example of a phrase child imitates
Chronological age	Parent report	24 – 96 months (2 – 9 years)
Developmental age	Previous record of developmental assessment (< 1 year old) or researcher-administered Mullen	At least 24 months
ASD Diagnosis	Parent report	Parent must provide official ASD diagnosis information (date and diagnostician)
Motor imitation with objects	Object imitation subscale of MIS	Child scores at least a 12 (out of 16) on the object imitation subscale
Verbal imitation	Play-based assessment	Child must imitate at least 70% of all modeled play narrations
Exclusion Criteria:		
Exposure to video modeling interventions	Parent report	Prior experience with video modeling interventions
Diagnosis of severe intellectual disabilities	Parent report	Presence of severe intellectual disabilities
Nonverbal	Parent report	No functional language / communication
Hearing / visual impairment	Parent report	Documented hearing / visual impairments

Note: Mullen = *Mullen Scales of Early Learning* (Mullen, 1995); MIS = *Motor Imitation Scale* (Stone, Ousley, & Littleford, 1997).

Assessment of inclusion and exclusion criteria. Presence of delayed echolalia with screen media was assessed using a researcher-developed questionnaire administered to parents (Appendix D). The inclusion requirements determined by this questionnaire was that the parent (a) reported that the child imitated phrases heard on movies, television shows, or commercials an average of at least one to two times per day with a delay of at least 1 min after hearing them and (b) was able to give at least one specific example of a phrase the child imitated from one of these sources of screen media.

If a recent record (administered within the previous year) of a standardized developmental measure was available, this record was accepted and used to determine the developmental age of the child at the study start. If no such record was available, the researcher administered the *Mullen Scales of Early Learning* (Mullen; Mullen, 1995) to make this determination. The Mullen is a standardized, norm-referenced assessment designed to measure developmental level from birth to 68 months. It consists of five scales, each measuring a specific developmental domain, including (a) gross motor skills, (b) visual reception, (c) fine motor skills, (d) receptive language, and (e) expressive language (each scale score is standardized with M = 50, *SD* = 10). Scores on the visual reception, fine motor skills, receptive language, and expressive language scales can be combined to yield a standardized composite score (M = 100, *SD* = 15), which represents an estimate of overall developmental level and can be translated into a developmental age equivalent. For inclusion in this study, children were required to be at a developmental age equivalent of at least 24 months. The criterion level was set at 24 months because that is the upper bound of the age range at which deferred imitation is predictably present (Meltzoff, 1985; Piaget, 1962); thus, children at this developmental age should be able to retain modeled behaviors from the time they are shown to the time they are given the opportunity to demonstrate them.

Motor imitation with objects was assessed using the object imitation subscale of the *Motor Imitation Scale* (MIS; Stone, Ousley, & Littleford, 1997; Appendix E). There are eight assessment items on the object imitation subscale, with three possible scores per item: (a) no imitation equals 0 points, (b) partial imitation equals 1 point, and complete imitation equals 2 points. Thus, the aggregate score on the object imitation subscale can range between 0 to 16 points. To be included in the study, the child was required to have an aggregate score of at least 12 points on the object imitation subscale.

Verbal imitation was assessed directly during a 20-min toy-play-based session with the researcher and the child (Appendix F). For this play session, a preferred toy set (as reported by the parent) was used. During the session, the researcher contingently imitated each toy play action—defined as the child intentionally putting one figure or part of the toy set in contact with any other figure or part of the toy set. The researcher selected 10 toy play actions demonstrated by the child and modeled a related toy play narration paired with his contingent imitation of the toy play action, thus creating a trial or opportunity for the child to imitate the toy play narration that was modeled. If the child did not imitate the verbal model (first prompt) within 3 s, the researcher provided a verbal instruction prompt (second prompt) using the format, "Say, '(toy play narration)'." The grammatical components of each toy play narration provided included a subject, an action verb, and a prepositional phrase with an object (e.g., "Driving car up the ramp," "Baby sleep in bed," "The plane lands on the roof"). To be counted as a correct imitation, the child was required to imitate all three grammatical components of the modeled toy play narration provided. Errors in verb tense, word order, pluralization, articles, or other morphological endings were disregarded. To be included in the study, the child was required to correctly imitate at least 70% (7 of 10) of toy play narrations provided (responding to either the verbal model or verbal instruction prompt).

Description of child participants. Three participants were included in the study. These three participants are referred to as Charlie, Lucas, and Eli for the remainder of this manuscript.

Charlie was an 8-year, 1-month old Caucasian boy diagnosed with autism. His mother reported that he demonstrated delayed echolalia with screen media more than 10 times per day, on average, using phrases he has heard the same day and more than 10 times per day, on average, using phrases he has heard from previous days. She also reported that Charlie will continue to demonstrate delayed echolalia with phrases he has heard many months later after first hearing them. The researcher assessed Charlie's developmental age using the Mullen (Mullen, 1995). Charlie scored at the testing ceiling level on all four domain scales; therefore, scale and composite scores could not be calculated, but his developmental age equivalent can be estimated to be greater than the developmental ceiling of the test (i.e., 68 months), which is well above the study criterion of 24 months. Charlie scored an aggregate of 16 (out of 16) on the object imitation subscale of the MIS (Stone, Ousley, & Littleford, 1997), demonstrating complete imitation on all eight object imitation tasks assessed. Charlie correctly imitated 100% (10 of 10) of toy play narrations provided during the toy-play-based verbal imitation assessment. His mean length of utterance (MLU) for correctly imitated toy play narrations was 7.2.

Lucas was a 4-year, 1-month old Caucasian boy diagnosed with autism. His mother reported that he typically did not demonstrate same-day delayed echolalia (i.e., repeating a phrase more than one minute after first hearing it, but on the same day after first hearing it) with screen media, but demonstrated delayed echolalia three to five times per day, on average, using phrases he has heard from previous days. She also reported that Lucas will continue to demonstrate delayed echolalia with phrases he has heard many months later after first hearing them. The researcher assessed Lucas's developmental age using the Mullen (Mullen, 1995). Lucas's standardized scores on the visual reception, fine motor, receptive language, and expressive language scales were 53, 39, 45, and 40, respectively. His standardized composite score was 89, which translates to a developmental age equivalent of 43 months (3.6 years) at the start of the study. Lucas scored an aggregate of 16 (out of 16) on the object imitation subscale of the MIS (Stone, Ousley, & Littleford, 1997), demonstrating complete imitation on all eight object imitation tasks assessed. Lucas correctly imitated 90% (9 of 10) of toy play narrations provided during the toy-play-based verbal imitation assessment. His mean length of utterance (MLU) for correctly imitated toy play narrations was 6.7.

Eli was a 4-year, 3-month old Caucasian boy diagnosed with autism. His mother reported that he demonstrated delayed echolalia with screen media more than 10 times per day, on average, using phrases he has heard the same day and five to 10 times per day, on average, using phrases he has heard from previous days. She also reported that Eli will continue to demonstrate delayed echolalia with phrases he has heard many months later after first hearing them. Eli's mother had records of a Mullen (Mullen, 1995) that was conducted by a clinical psychologist at a child development center 11 months prior to the study start, so the results of this assessment were used in lieu of a researcher-administered Mullen. Eli's standardized scores on the visual reception, fine motor, receptive language, and expressive language scales were 31, 20, 35, and 20, respectively. His standardized composite score was 58, which translates to a developmental age equivalent of 30 months (2.5 years) at the start of the study. Eli scored an aggregate of 16 (out of 16) on the object imitation subscale of the MIS (Stone, Ousley, & Littleford, 1997), demonstrating complete imitation on all eight object imitation tasks assessed. Eli correctly imitated 90% (9 of 10) of toy play narrations provided during the toy-play-based verbal imitation assessment. His mean length of utterance (MLU) for correctly imitated toy play narrations was 4.3. Table 5 summarizes the descriptive information and assessment results for each child.

Description of interventionist. The researcher administered all assessments and conducted all measurement sessions. He was a board certified behavior analyst, certified for eight years, with 12 years of experience providing ABA therapy to children with ASD. He had prior experience developing and implementing video modeling interventions for children with ASD as a component of ABA therapy services provided. At the time of the study, he had provided direct ABA therapy services to Lucas for 1.5 years. The researcher did not have any prior contact or relationship with Charlie or Eli before the study.

Table 5

Participant Characteristics

Characteristic	Charlie	Lucas	Eli
Age at start of study (years)	8.1	4.1	4.3
Diagnosis	Autism	Autism	Autism
Delayed Echolalia (DE) with Screen Media:			
Average # of same-day DE / day	10+	0	10+
Average # of >1-day DE / day	10+	3 - 5	5 - 10
DE sometimes includes word substitutions	No	Yes	No
Uses DE to communicate with others	Yes	Yes	Yes
Uses same DE phrases how long after first hearing	Many months later	Many months later	Many months later
Imitates other types of actions from screen media	No	Yes	Yes
Mullen:			
Visual Reception ($M^{SS} = 50$, $SD^{SS} = 10$)	AE > 5.5^{C} (SS = n/c)	AE = 4.3 (SS = 53)	AE = 2.5 (SS = 31)
Fine Motor ($M^{SS} = 50$, $SD^{SS} = 10$)	AE > 5.7^{C} (SS = n/c)	AE = 3.7 (SS = 39)	AE = 2.3 (SS = 20)
Receptive Language ($M^{SS} = 50$, $SD^{SS} = 10$)	AE > 5.8^{C} (SS = n/c)	AE = 3.8 (SS = 45)	AE = 2.6 (SS = 35)
Expressive Language ($M^{SS} = 50$, $SD^{SS} = 10$)	AE > 5.8^{C} (SS = n/c)	AE = 3.5 (SS = 40)	AE = 2.0 (SS = 20)
Composite ($M = 100$, $SD = 15$)	n/c	89	58
Developmental AE (years)	>5.7^{C}	3.6	2.5
Object Imitation (MIS)	100% (16/16)	100% (16/16)	100% (16/16)
Verbal Imitation:			
% correctly imitated play narrations	100% (10/10)	90% (9/10)	90% (9/10)
MLU of correctly imitated play narrations	7.2	6.7	4.3

Notes: Delayed echolalia information was parent-reported using echolalia and imitation questionnaire. Mullen = *Mullen Scales of Early Learning* (Mullen, 1995); AE = Age Equivalent (in years); SS = Standard Score; ^{C} = Testing Ceiling; n/c = not calculable (because at testing ceiling). MIS = *Motor Imitation Scale* (Stone, Ousley, & Littleford, 1997). MLU = Mean length of utterance.

Settings and Materials

All measurement sessions occurred in each child's home setting. The researcher and parent selected an agreed-upon area within the home with minimal distractions where the researcher could set up study materials and conduct all session procedures. The toy set materials were arranged on top of a table, with chairs for the researcher and children to sit while sessions were conducted.

Toy sets. For each child, the researcher and parent selected an agreed-upon novel, age-appropriate toy set to use in all measurement sessions. Each toy set had 12 different toy figures that could be grasped and moved by hand (e.g., vehicles, people figures, animal figures) and a base structure with moving parts (i.e., campground set, playground set, and space station) that the child could use the figures to act upon. For each toy set, the researcher had 12 toy figures that were identical to the 12 toy figures given to the child to play with, so that he could contingently imitate toy play actions demonstrated by the child during measurement sessions.

Additional equipment. For the purposes of data collection, all instructional procedures and measurement sessions were videotaped using a digital camcorder. During the video modeling comparison phase of the study, video models were shown to the children on a laptop computer with the child sitting in a chair in same area as the measurement sessions that immediately followed the video model viewings. The laptop had an embedded webcam centered in the casing directly above the screen. This webcam was used to record the child while watching the video models so that the child's attention to the video models could be measured.

Primary Dependent Measures

The two primary dependent measures were toy play actions and toy play narrations. For each of these, modeled and unmodeled variations were measured. Table 6 summarizes how toy play actions and narrations were defined and classified for measurement.

Definitions and examples of toy play actions. The defining feature of a toy play action (hereafter referred to as play action or PA) was intentionally putting a toy figure in contact with any part of the base structure. PAs were classified into two different types: The first type of PAs was *contact only* (CO). A CO-PA occurred when (a) a toy figure held in the hand was intentionally put in contact with any part of the base structure, (b) a toy figure was intentionally dropped from the hand, resulting in contact between the toy figure and a part of the base structure, or (c) a toy figure held in the hand was put in "contact" with an opening or hole that was part of the design of the base structure (e.g., through an open doorway, in the hole of a tunnel, inside a window opening). Examples of CO-PAs include: (a) putting a squirrel (toy figure) on top of a tree (part of the base structure), (b) dropping an acorn (toy figure) onto a see saw (part of the base structure), and (c) putting an army man (toy figure) through a window opening (part of the base structure) and pulling the army man back out. The second type of PAs was *contact plus manipulation* (CM). CM-PAs include a *contact only* behavior as a component, but in addition, also include some type of manipulation of a related moving part of the base structure, that is, manipulating a moving part of the base structure so that the toy figure and the base structure were not only in contact, but also interacting in some way. Examples of CM-PAs include: (a) putting a food item (toy figure) inside of a trash can (part of the base structure) and closing the trash can lid (manipulating a related moving part), (b) putting a tiger (toy figure) on an elevator platform (part of the base structure) and turning the knob that makes the elevator platform go up and down (manipulating a related moving part), and (c) putting an alien (toy figure) in a swivel chair (part of the base structure) and spinning the chair around (manipulating a related moving part).

Closely related, “near miss,” non-examples of PAs included: (a) retrieving a toy figure that was left in contact with a part of the base structure after the toy figure is released by the hand, (b) incidental, unintentional contact between a toy figure and a part of the base structure when moving the toy figure from one place to another, (c) manipulating a moving part of the base structure that does not involve any interaction between the structure and a toy figure, and (d) placing a toy figure in contact with another toy figure or making two toy figures interact with each other without any contact made between the toy figures and any part of the base structure. Exclusion of these non-examples from measurement is not meant to imply that these types of behaviors are "inappropriate” forms of toy play; rather, they were excluded because they were sufficiently different in form and function from the types of PAs that were targeted by the video modeling interventions.

Coding system for play actions. Two dimensions of PAs were measured: (a) frequency (number of occurrences per session) and (d) duration. These two dimensions were measured by applying a systematic set of coding rules used to determine the onset and offset of each separate PA. The onset and offset of each PA were time-stamped according to the 1-s interval in which they occurred on the recorded video of the session. When a toy figure was intentionally put in contact with a part of the base structure, the time at which contact was made marked the onset of the occurrence of a PA behavior. The duration of each CO-PA behavior continued until: (a) contact between the hand and the toy figure was broken for more than three consecutive seconds (unless this was followed by a related structure manipulation, in which case the duration of the behavior was continued, making it a CM-PA behavior), (b) contact between the toy figure and the part of the base structure was broken for more than three consecutive seconds, (c) contact between the same toy figure with a different part of the base structure was made (thus initiating the occurrence/onset of a separate PA), or (d) contact between the hand and the toy figure was broken in order to demonstrate a separate PA with a different toy figure. The duration of each CM-PA behavior continued until: (a) contact between the hand and the toy figure or the hand and the related moving part of the base structure was broken for more than three consecutive seconds, (b) contact between the toy figure and the part of the base structure was broken for more than three consecutive seconds, (c) contact between the same toy figure with a different part of the base structure was made (thus initiating the occurrence/onset of a separate PA), or (d) contact between the hand and the toy figure or the hand and the related moving part of the base structure was broken in order to demonstrate a separate PA with a different toy figure. In each of these coding scenarios, the time at which the relevant contact (i.e., hand:figure, figure:structure, or hand:moving part of structure) was broken marked the offset of the occurrence of a coded PA behavior.

Modeled versus unmodeled play actions. A modeled PA was defined as a complete imitation of a PA demonstrated in a video model. To be counted as a complete imitation, the child had to put the same toy figure in contact with the same part of the base structure (for modeled CO-PAs), and manipulate the same moving part of the structure (for modeled CM-PAs) as was demonstrated in the video model. If any of these components differed, the PA demonstrated by the child was recorded as an unmodeled PA.

Unique versus repeat play actions. A running record was kept, which described each PA in terms of three action components: (a) the toy figure used, (b) the part of the base structure with which it was put in contact, (c) and the structure manipulation performed (if applicable). This running record tracked unique versus repeat demonstrations of PAs within each session and across all sessions, which allowed for cumulative frequencies to be measured. A within-session unique PA was defined as a PA that did not share at least one of those three components in common with all other PAs demonstrated within the same session. A cumulative unique PA was defined as a PA that did not share at least one of those three components in common with all other PAs demonstrated across all sessions.

Definitions and examples of toy play narrations. A toy play narration (hereafter referred to as play narration or PN) was defined as any verbalization that was concurrent with a PA and included one of two grammatical components: (a) a related action verb or (b) a related preposition. These grammatical components were selected as defining features of a PN because they describe the PA relation between the toy figure and structure part. To be considered concurrent, the onset of the verbalization had to occur no sooner than 3 s before the onset of a PA or no later than 3 s after the offset of a PA. Errors in verb tense, word order, pluralization, articles, or other morphological endings were disregarded.

Coding system for play narrations. The number of occurrences of PNs per session was measured. The onset of the narration was time-stamped according to the 1-s interval in which it occurred on the recorded video of the session. The time at which the first word was verbalized marked the onset of the occurrence of a PN (given that it was also concurrent with a PA, as defined above).

Modeled versus unmodeled play narrations. A modeled PN was defined as an imitation of a PN demonstrated in a video model. To be counted as a partial imitation, the PN had to include over 50% (and less than 100%) of the same words as a modeled PN and had to include at least two of the three following grammatical components: (a) the same action verb, (b) the same preposition, and/or (c) the same object of the preposition. Errors in verb tense, word order, pluralization, articles, or other morphological endings were disregarded. To be counted as a complete imitation, the PN had to include 100% of the same words as a modeled PN, disregarding errors in verb tense, word order, pluralization, articles, or other morphological endings. All other PNs were recorded as unmodeled.

Modeled PNs were further classified in terms of word substitutions and with which types of PAs they concurred. A partially imitated modeled PN was classified as with or without word substitutions. A partially imitated PN with word substitutions included over 50% of the same words as the video model PN, the required grammatical components, and also at least one unmodeled word added to it. A partially imitated PN without word substitutions did not include any unmodeled words added to it. All modeled PNs were classified as either corresponding or transferred. A corresponding modeled PN was used concurrently with the same PA with which it concurred in the video model. A transferred modeled PN was used concurrently with any PN other than the same PA with which it concurred in the video model; thus, a transferred modeled PN could concur with an unmodeled PA, a modeled PA from the alternate video model, or a different modeled PA from the same video model in which it was demonstrated.

Delayed echolalia. Providing children with modeled PNs also provided them with verbal stimuli that they could potentially use as forms of delayed echolalia. Therefore, the occurrence of delayed echolalia was measured and was defined as any complete or partial imitation of a modeled PN that was not concurrent with a PA or with any other type of ongoing toy play (e.g., structure-only or figure-only play). In other words, these were modeled play narration imitations that occurred in the absence of any kind of appropriate toy play.

Secondary Measures

Attention to video models. During the video modeling comparison phase of the study, as the child viewed a video model on the laptop, the embedded webcam was used to video record the child to measure his attention to the video model. Attention was defined as head and eye gaze oriented toward the laptop monitor. Total duration attending to the video model was measured using a duration recording system in which each onset and offset of attending was time-stamped according to the 1-s interval in which they occurred on the recorded video of the viewing.

Table 6
Definitions and Classifications of Dependent Measures

Behavior Class Sub-class	Definition
Play Action	Intentionally putting a toy figure in contact with base structure
Contact only	(A) Figure in hand intentionally put in contact with base structure, (B) Figure intentionally dropped, making contact with base structure, or (C) Figure intentionally put in "contact" with an opening / hole in base structure
Contact + manipulation	Contact only plus manipulating a related moving part of the base structure
Modeled	Complete imitation of a play action demonstrated in a video model
Unmodeled	Any play action that was not a complete imitation of a modeled play action
Play Narration	Any verbalization that was concurrent with a play and included a related (a) action verb or (b) preposition
Unmodeled	Any play narration that did not meet the criteria for a modeled play narration
Modeled	An imitation of a play narration demonstrated in a video model; must include >50% of words imitated and 2 of these 3: (a) action verb, (b) preposition, (c) object of the preposition.
Complete imitation	A modeled play narration with 100% of words imitated
Partial imitation w/ substitutions	A modeled play narration with >50% (and <100%) of words imitated plus at least one unmodeled word added
Partial imitation w/o substitutions	A modeled play narration with >50% (and <100%) of words imitated with no additional words included
Corresponding	Used with the same play action with which it concurred in the video model
Transferred	Used with any play action other than the same play action with which it concurred in the video model
Delayed echolalia	Any imitation (complete or partial) of a modeled play narration that occurred in the absence of any kind of toy play

Design and Procedures

For each child, an adapted alternating treatments design (AATD) was used to analyze the effects of the video modeling interventions (see Wolery et al., 2014). AATDs are specifically designed to compare the relative effects of two or more interventions or conditions. For this study, the AATD was used to compare the relative effects of two video modeling conditions: (a) video models demonstrating modeled PAs only versus (b) video models demonstrating modeled PAs combined with corresponding modeled PNs. For ease of notation, the PA-only video model is referred to as Video Model A and the PA plus PN video model is referred to as Video Model B for the remainder of this manuscript.

Criteria for phase changes. Baseline data was collected for a minimum of five measurement sessions until a stable pattern was established, then the video modeling comparison phase was initiated. The video modeling comparison phase was continued until: (a) the mastery criteria (100% of target modeled PAs were demonstrated within the target session for three consecutive target sessions) was met for both Video Model A and Video Model B conditions, (b) the mastery criteria was met for either the Video Model A or Video Model B condition plus an additional 50% of the number of target sessions required for the first condition to reach criterion were conducted (e.g., if 10 sessions were needed for one of the conditions to reach criterion first, an additional 5 target sessions for each condition would be conducted), or (c) stable patterns for both conditions were established. Following the video modeling comparison phase, the maintenance phase was initiated.

Frequency and sequencing of measurement sessions. For each child during the baseline phase, one measurement session per day was conducted at least three days per week. During the video modeling comparison phase, two measurement sessions (one session for each condition) per day were conducted at least three days per week. To counterbalance against potential sequence effects (Wolery et al., 2014) during the comparison phase, the order in which the conditions were conducted for a given day (i.e., A then B, or B then A) was sequenced using a blocked randomization method (Kratochwill & Levin, 2014), such that the same blocked order was not retained for more than two consecutive days in which measurement occurred. The first maintenance session was conducted one week after the conclusion of the video modeling comparison phrase and three subsequent maintenance sessions (a total of four) were conducted at one-week intervals (with the exception of Lucas, whose final maintenance session was conducted two weeks after the third [i.e., five weeks after the conclusion of the comparison phase] due to scheduling conflicts).

Baseline phase procedures. During baseline, the interventionist guided the child to the toy set with the toy figures and base structure arranged at a table with chairs. Once the child was sitting in a chair in front of the toy set, the interventionist verbally instructed the child to play with the toy set. Delivery of this verbal instruction cued the start of the 5-min measurement. No instructions on how to play with the toys were provided. The interventionist contingently imitated PAs demonstrated by the child within 5 s of the offset of each PA. If the child verbalized a PN, the investigator responded with a brief general verbal acknowledgement (e.g., "Me too," "That's fun," "I like that," "I see") within 5 s of the offset of the PN. To encourage engagement and compliance, the investigator provided four to six general verbal praise statements (i.e., not specific to the target behaviors) during each measurement session (e.g., "Nice job sitting," "Thank you for staying and playing," "Good sitting and playing"). If the child left his seat during the measurement session, the interventionist physically redirected the child back to his seat within 5 s and redelivered the verbal instruction to play with the toys. If any toy figures fell off the table or became out of reach of the child, the interventionist retrieved them and put them back in reach of the child within 5 s (unless the child retrieved it himself).

Video model production. For each child in the study, two unique video models—one per condition in the video modeling comparison phase—were created. The researcher acted as the model in each video. Most television shows, commercials, movies or other screen media with which children demonstrate delayed echolalia are likely presented in third person perspective. Hence, video models created for this study were also filmed from a third person perspective to match familiar screen media. The materials (toy set, tables, and chairs) were spatially arranged in a similar fashion to their arrangement in measurement sessions, with the researcher sitting in a similar spatial position as the child sat in measurement sessions.

Each video model was approximately 1.5 min in length (range: 1.4 – 1.7 min). Each video model included six different modeled PAs demonstrated. Each demonstration of a modeled PA lasted approximately 3 – 5 s and each modeled PA was demonstrated twice consecutively with a 1-s pause between consecutive demonstrations of the same modeled PA. After two consecutive demonstrations of the same modeled PA, a 3 – 5 s pause was taken, followed by two consecutive demonstrations of the next modeled PA, repeated until all six modeled PAs per video model were demonstrated. For Video Model B, corresponding PNs were verbalized concurrently with each modeled PA as the modeled PA was being demonstrated.

Determining modeled play action behavior sets. Two behavior sets, each consisting of six novel PAs were selected for the video models. That is, a set of six novel PAs was selected for and targeted by Video Model A (PA-only video model) and a different set of six novel PAs was selected for and targeted by Video Model B (PA plus PN video model). For ease of notation, the six novel PAs assigned to Video Model A are referred to as the A-set and the six novel PAs assigned to Video Model B are referred to as the B-set for the remainder of this manuscript. To determine novel PAs, a running record was kept of all unmodeled PAs demonstrated by the child during the baseline phase. Based on this record, a novel PA was defined as any PA that was not demonstrated by the child during the baseline phase. Using this method, a total of 12 novel PAs that were never demonstrated by the child during baseline sessions were selected as the modeled PAs that comprised the A- and B-sets.

Establishing equivalence of behavior sets. To ensure experimental control within an AATD, it is crucial to establish equivalent behavior sets for each condition (Wolery et al., 2014). Several steps were taken to promote equivalence between the A- and B-sets. First, the running record of unmodeled PAs demonstrated in the baseline phase was used to identify the three most frequently-played-with toy figures, measured in terms of total frequencies of unmodeled PAs demonstrated with each toy figure across all baseline sessions. The rationale behind this step was to ensure that child motivation was present to play with the toy figures selected for modeled PAs. Second, for each of the three toy figures selected, a total of four modeled PAs were selected, which were divided into two pairs that were matched for equivalence in terms of form, function, and response requirements. Matching pairs of PAs in terms of response requirements was based on the definitions of CO-PAs and CM-PAs (see Table 6). That is, for each selected toy figure, a matched pair of two CO-PAs and a matched pair of two CM-PAs were selected. These matched pairs were also made equivalent in terms of form and function to the greatest extent possible. Third, each PA in a matched pair was then randomly assigned to the A- or B-set. Table 7 provides an example of establishing equivalence between the two sets of modeled PAs used for Lucas.

Determining modeled toy play narrations. For modeled PAs assigned to the B-set, corresponding modeled PNs were selected. The PNs selected were also novel, according to the running record of unmodeled PNs demonstrated in the baseline phase. The length of utterance of each modeled PN did not exceed the PN with the longest length of utterance correctly imitated by the child in the play-based verbal imitation assessment conducted prior to the start of study The MLU of all modeled PNs selected was kept as close as possible to the MLU of all PNs correctly imitated by the child in the verbal imitation assessment.

Table 7

Example of Establishing Equivalence of Behavior Sets for Lucas

Toy Structure Used: Treehouse Playground

3 Most-Frequently-Played-With Toy Figures in Baseline: 1. Acorn; 2. Farmer; 3. Tractor

Toy Figure	Matched Pair #	Description of Modeled Play Action	RR Type	Video Model	Corresponding Play Narration
Acorn	1	1. Hang acorn in leaf hanger hole	CO	A	---
		2. Hang acorn in hammock hanger hole	CO	B	"Hang the acorn in the hammock"
	2	1. Put acorn in tire swing and turn tire swing knob to spin tire swing	CM	A	---
		2. Put acorn in hamster wheel and turn hamster wheel knob to spin hamster wheel	CM	B	"The acorn spins in the hamster wheel"
Farmer	1	1. Put farmer in front of telescope	CO	A	---
		2. Put farmer in swing	CO	B	"The farmer lays down in the swing"
	2	1. Put farmer on elevator and turn elevator wheel to make elevator go up/down	CM	A	---
		2. Put farmer on see saw and turn see saw knob to make see saw go up/down	CM	B	"The farmer goes up and down the see saw"
Tractor	1	1. Put tractor on slide	CO	A	---
		2. Put tractor on ladder	CO	B	"The tractor drives up the ladder"
	2	1. Open gate and put tractor inside tree trunk hole	CM	A	---
		2. Open hatch and put tractor down hatch	CM	B	"Put the tractor down the tree hatch"
MLU of Modeled Play Narrations					6.8

Notes: Once modeled PAs were selected and matched, each PA within a matched pair was randomly assigned to Video Model A or B. RR = Response requirements; CO = Contact only; CM = Contact + Structure Manipulation. MLU = Mean length of utterance.

Video modeling comparison phase procedures. Video modeling comparison procedures were identical to baseline procedures, except that the child first viewed either Video Model A or B prior to each measurement session. For ease of notation, measurement sessions immediately following the Video Model A intervention are referred to as A-sessions and measurement sessions immediately following the Video Model B intervention are referred to as B-sessions for the remainder of this manuscript. To view a video model, the child was seated at a table in front of a laptop computer and out of reach of the toy set. Before playing the video model, the interventionist started recording the child's face with the embedded webcam on the laptop to measure the child's attention to the video as it was viewed. Then, the investigator pointed at the laptop computer screen and verbally instructed the child to watch how to play with toys and began playing the target video model. After the video model finished playing, the interventionist pointed at the laptop computer screen and verbally instructed the child to watch how to play with toys again and then replayed the video model one more time. As the video model was playing, the interventionist sat next to the child and monitored his attention to the video model. If the child appeared to divert his attention away from the video model for more than three consecutive seconds, the interventionist redirected the child's attention back to the video model within 3 s (unless the child self-redirected within that interval) by pointing at the computer screen and/or verbal instructing the child to watch the video. After the second viewing of the video model, the interventionist removed the laptop and moved the child in front of the prearranged toy set. Following the first intervention measurement session for the day, the child was given a short break (1 – 3 min) to allow for the interventionist to rearrange the toy set and prepare for the viewing of the second video model. Then, the second video model was shown using the same procedures as described for the first video model, followed by another measurement session.

Maintenance phase procedures. Maintenance procedures were identical to baseline procedures, except that the frequency of maintenance sessions occurred once a week for four weeks (with the exception of Lucas, as noted previously), beginning one week after the conclusion of the video modeling comparison phase.

Data Collection

All instructional procedures and measurement sessions were video recorded and video records were reviewed to collect four types of data: (a) primary dependent measures, (b) child attention to the video model, (c) procedural fidelity, and (d) IOA.

Analysis of Data

The AATD provides experimental control that allows for the comparison of the interventions under investigation (in this case, Video Model A versus Video Model B) in terms of their relative effects on the target dependent variables (in this case, A-set PAs versus B-set PAs). The most internally valid analysis of an experimental effect within an AATD is the direct comparison of paired intervention sessions (i.e., A-1 versus B-1, A-2 versus B-2, etc.) within the comparison phase (Wolery et al., 2014).

Target sessions for A-set PAs were measurement sessions conducted immediately following the viewing of Video Model A (i.e., A-sessions). Target sessions for B-set PAs were measurement sessions conducted immediately following the viewing of Video Model B (i.e., B-sessions). Following the first target session conducted in the comparison phase, each subsequent A-set target session also served as a non-target session for the B-set, and vice versa. In other words, modeled PAs from either set could occur in either A- or B-sessions. As designed for this study, the experimental effect of primary interest was in terms of the relative comparison of Video Model A versus Video Model B on target PAs in target intervention sessions (i.e., A-set PAs in A-sessions versus B-set PAs in B-sessions. However, other experimental effects of interest were also analyzed such as the relative comparison of Video Model A versus Video Model B on (a) target PAs in non-target intervention sessions (i.e., A-set PAs in B-sessions versus B-set PAs in A-sessions, (b) unmodeled PAs in A-versus B-sessions, (c) use of PNs in A-versus B-sessions, and (d) maintenance of effects upon withdrawal of the interventions.

Where the design of the study did not allow for the experimental analysis of other measured variables, associations between the introduction of the video modeling interventions and these variables were analyzed in descriptive terms, without making experimental inferences. Descriptive analyses included: (a) changes in unmodeled PAs between phases, (b) usage of modeled PNs, and (c) associations between attention to the video models and frequencies of modeled PAs.

The primary method for analyzing the data was visual analysis of the graphed data (see Gast & Spriggs, 2014), with emphasis on comparison of paired sessions in the intervention phase. Additionally, descriptive statistics were used in conjunction with visual analysis to report and discuss data patterns within phases, changes across phases, and comparisons within the intervention phase.

Procedural Fidelity

Collection and calculation method. Procedural fidelity data were collected for at least 20% of all measurement sessions across all phases, all conditions within the comparison phase, and all participants. For each participant, one of five baseline and one of four maintenance sessions were selected at random for procedural fidelity. For Charlie, one of five sessions from the Video Model A condition and one of five sessions from the Video Model B condition were selected at random. For each Lucas and Eli, three of 15 sessions from the Video Model A condition and three of 15 sessions from the Video Model B condition were selected in a blocked randomized fashion to ensure a more even distribution of sessions across time (i.e., within each condition, one session from sessions 1 – 5, one session from sessions 6 – 10, and one session from sessions 11 – 15 were selected at random).

Procedural fidelity was measured according to the procedural protocol developed prior to the start of the study. Procedural steps that were opportunity-based—that is, a specific child behavior or other preceding event had to occur first in order to create an opportunity for the interventionist to respond—were recorded on a trial-by-trial basis. Procedural steps that were independent of child behaviors or other preceding events were recorded using a behavior checklist.

Procedural fidelity results. Tables 8 and 9 present procedural fidelity results for measurement session procedures and video modeling instructional procedures, respectively. Across all children, the average correct implementation of each measurement session procedural step ranged from 86% to 100%. There were no procedural errors made for four of nine measurement session procedural steps (i.e., 100% correct implementation across all children and all phases/conditions). For one measurement session procedural step—physically redirecting the child back to his seat within 5 s of child leaving his seat—there were no opportunities to implement this procedural step because there were no instances of children leaving their seats in any of the observed sessions. One procedural error was made in providing four to six general praise statements per session. This error occurred with Lucas in a B-session, and in the session in which this error occurred, the interventionist only provided three general praise statements. For the procedural step of retrieving a toy within 5 s if it fell of the table, correct implementation across all children averaged 86%. Per child and per phase/condition, correct implementation of this procedural step ranged from 67% to 100%. No more than one procedural error was made within any phase/condition per child. For the procedural step of contingently imitating each play action within 5 s of its offset, correct implementation across all children averaged 88%. For Charlie per phase/condition, correct implementation of this procedural step ranged from 84% to 100%. For Lucas per phase/condition, correct implementation of this procedural step ranged from 85% to 94%. For Eli per phase/condition, correct implementation of this procedural step ranged from 73% to 87%. The most procedural errors in contingently imitating play actions were made with Eli. These errors were due in large part to Eli's play style compared to the other children. Eli played more repetitively and generally more rapidly (i.e., play actions with shorter durations and shorter latencies between play actions) than the other two children, resulting in some play actions going unnoticed by the interventionist during live sessions. For the procedural step of verbally acknowledging each play narration within 5 s of its offset, correct implementation across all children averaged 87%. For Lucas, there were no opportunities to implement this procedural step because he did not demonstrate any play narrations in observed sessions. For each Charlie and Eli, per phase/condition, correct implementation of this procedural step ranged from 67% to 100%. Overall procedural fidelity across all steps was lower for Eli (87%) than for Charlie (94%) and Lucas (90%). The lower procedural fidelity for Eli was almost entirely due to errors made with the play imitation procedural step as described above, which accounted for 82% (31 of 38) of all procedural errors made for Eli.

There were no procedural errors made for the video modeling instructional procedures (i.e., 100% correct implementation for all steps across all children and across both conditions).

Furthermore, none of video modeling procedural steps occurred in the maintenance and baseline phases, that is, the video modeling interventions were correctly withheld/withdrawn in these phases.

Table 8

Procedural Fidelity Results for Measurement Session Procedures

Measurement Session Procedural Steps	Charlie				Lucas				Eli				Avg. across children
	BL	VM-A	VM-B	M	BL	VM-A	VM-B	M	BL	VM-A	VM-B	M	
Sits child at table in front of toy set	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (20/20)
Verbally instructs child to play with toys	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (20/20)
Does not provide any instruction on how to play with toys	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (20/20)
Does not provide any specific verbal praise for playing with toys	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	100% (20/20)
Provides 4 - 6 general praise statements	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (1/1)	100% (3/3)	67% (2/3)	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (1/1)	95% (19/20)
If toy falls off table, retrieves toy within 5 s	n/o	n/o	100% (1/1)	n/o	100% (1/1)	75% (3/4)	100% (3/3)	n/o	100% (2/2)	67% (2/3)	83% (5/6)	100% (2/2)	86% (19/22)
If child leaves seat, physically redirects child back to seat within 5 s	n/o	n/o	n/o	n/o	n/o	n/o	n/o	n/o	n/o	n/o	n/o	n/o	---
Contingently imitates PA within 5 secs of offset	90% (18/20)	84% (16/19)	96% (22/23)	100% (18/18)	92% (12/13)	94% (48/51)	85% (66/78)	89% (24/27)	73% (16/22)	85% (67/79)	87% (66/76)	87% (20/23)	88% (393/449)
Verbally acknowledges PN within 5 secs of offset	67% (2/3)	n/o	100% (5/5)	n/o	n/o	n/o	n/o	n/o	n/o	67% (8/12)	96% (27/28)	100% (3/3)	87% (45/52)
Average across all behaviors within phase / condition	89% (25/28)	88% (21/24)	97% (33/34)	100% (23/23)	95% (18/19)	93% (66/71)	86% (83/96)	91% (29/32)	79% (23/29)	84% (92/109)	90% (113/125)	91% (30/33)	---
Average across all behaviors and all phases / conditions	94% (102/109)				90% (196/218)				87% (258/296)				89% (556/623)

Note: BL = Baseline, VM-A = Video Model A condition, VM-B = Video Model B condition, M = Maintenance, n/o = no opportunities.

Table 9

Procedural Fidelity Results for Video Modeling Instructional Procedures

Video Modeling Instruction Procedural Steps	Charlie		Lucas		Eli		Avg. across children
	VM-A	VM-B	VM-A	VM-B	VM-A	VM-B	
Sits child at table in front of computer	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (3/3)	100% (3/3)	100% (14/14)
Points at laptop and delivers verbally instructs child to watch how to play	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (3/3)	100% (3/3)	100% (14/14)
Plays correct video model	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (3/3)	100% (3/3)	100% (14/14)
Points at laptop and delivers verbal instructs child to watch how to play again	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (3/3)	100% (3/3)	100% (14/14)
Plays correct video model again	100% (1/1)	100% (1/1)	100% (3/3)	100% (3/3)	100% (3/3)	100% (3/3)	100% (14/14)
If child diverts attention from video for 3 consecutive secs, redirects (points or verbally) child's attention back to laptop within 3 secs (if chid does not self-redirect)	n/o	n/o	n/o	n/o	100% (1/1)	n/o	100% (1/1)
Average across all behaviors within condition	100% (5/5)	100% (5/5)	100% (15/15)	100% (15/15)	100% (16/16)	100% (15/15)	---
Average across all behaviors and all conditions	100% (10/10)		100% (30/30)		100% (31/31)		100% (71/71)

Note: VM-A = Video Modeling A condition, VM-B = Video Modeling B condition, n/o = no opportunities. Data for baseline and maintenance phases are not shown because there were no occurrences of and no opportunities for these behaviors in these phases (i.e., the video modeling interventions were correctly withheld / withdrawn in all baseline and maintenance sessions).

Interobserver Agreement

Collection and calculation method. The researcher was the primary observer. Two master's level graduate students were the secondary observers. To measure IOA, the secondary observers independently collected data on the primary dependent measures using the same definitions and coding system for at least 20% of all measurement sessions across all phases, all conditions within the comparison phase, and all participants (one secondary observer collected data on Charlie and Lucas and the other secondary observer collected data on Eli). For each participant, one of five baseline and one of four maintenance sessions were selected at random for procedural fidelity. For Charlie, one of five sessions from the Video Model A condition and one of five sessions from the Video Model B condition were selected at random. For each Lucas and Eli, three of 15 sessions from the Video Model A condition and three of 15 sessions from the Video Model B condition were selected in a block randomized fashion to ensure a more even distribution of sessions across time (i.e., for each condition, one session from sessions 1 – 5, one session from sessions 6 – 10, and one session from sessions 11 – 15 were selected at random). One to two sessions per child that were not selected for IOA were used to train the secondary observers on the use of the coding system. After training, each observer coded IOA sessions independently of one another.

For IOA purposes, each toy figure and each part of the toy structure was labeled with a unique code identification number (ID). For each recorded unmodeled PA, the onset, offset, code ID of the toy figure used, and code ID of the structure part used were coded. For each occurrence of an unmodeled PA, three criteria had to be met to be scored as an agreement: (a) the times at which the observers denoted the onset of the PA was within 3 s of each other, (b) the toy figure code IDs matched, and (c) the structure part code IDs either matched, or if they differed, the two coded structure parts had to be located nearest to each other on the toy structure. Each modeled PA was given a unique ID code (i.e., A1 – A6 and B1 – B6). For each recorded modeled PA, the onset, offset, and modeled PA code was coded. For each occurrence of a modeled PA, two criteria had to be met to be scored as an agreement: (a) the times at which the observers denoted the onset of the PA were within 3 s of each other and (b) the modeled PA code IDs matched. For each PA occurrence that was recorded by either observer, IOA was calculated using the point-by-point method of agreement (number of agreements divided by number of agreements plus disagreements, multiplied by 100; Ayres & Ledford, 2014) for unique and total occurrences of modeled and unmodeled PAs.

For each recorded unmodeled PN, the onset was coded. For each occurrence of an unmodeled PN, two criteria had to be met to be scored as an agreement: (a) the times at which the observers denoted the onset of the PN were within 3 s of each other and (b) each coder's recorded onset had to be concurrent with a coded PA (i.e., the recorded onset of the PN was no sooner than 3 s before the onset of a coded PA or no later than 3 s after the offset of a coded PA). Each modeled PN was given an ID code that corresponded to the ID code of the modeled PA with which it was paired (i.e., B1 – B6). For each recorded modeled PN, the onset and the modeled PN ID code were recorded. For each occurrence of a modeled PN, three criteria had to be met to be scored as an agreement: (a) the times at which the observers denoted the onset of the PN were within 3 s of each other, (b) each coder's recorded onset had to be concurrent with a coded PA, and (c) the modeled PN code IDs matched. For each recorded instance of delayed echolalia, the onset and the ID code DE (delayed echolalia) were recorded. For each recorded occurrence of delayed echolalia, three criteria had to be met to be scored as an agreement: (a) the times at which the observers denoted the onset of delayed echolalia were within 3 s of each other, (b) each coder's recorded onset had to be *non-concurrent* with all other coded PAs, and (c) code IDs indicating DE matched. For each PN occurrence that was recorded by either observer, IOA was calculated using the point-by-point method of agreement (number of agreements divided by number of agreements plus disagreements, multiplied by 100; Ayers & Ledford, 2014) for occurrences of modeled PNs, unmodeled PNs, and delayed echolalia.

Three types of duration-based IOA were measured. First, duration IOA was measured for all agreed-upon occurrences of PAs (modeled and unmodeled). For each agreed-upon occurrence of a PA, the recorded total durations of the PA—according to each observer's recorded onset and offset—had to be within 5 s of each other. For agreed-upon occurrences of PAs, duration IOA was calculated using the point-by-point method of agreement (number of agreements divided by number of agreements plus disagreements, multiplied by 100; Ayers & Ledford, 2014). Second, the average difference in duration per agreed-upon PA occurrence was calculated. To calculate this average difference, first the duration difference (i.e., the longer-recorded duration minus the shorter-recorded duration) for each agreed-upon PA occurrence was calculated. Then, all duration differences were summed and divided by the total number of agreed-upon PA occurrences. Third, IOA for the total duration of the session engaged in PAs was measured. To calculate IOA for total duration of PA engagement, the durations of all PAs recorded by each observer (whether agreed-upon or not) were summed. Then, the shorter duration sum total was divided by the longer duration sum total and multiplied by 100 (Cooper, et al., 2007).

Interobserver agreement results. IOA results for each child are presented in Table 10. In addition, the secondary observer's data is graphed alongside the primary observer's data in Appendices G, H, I, J, K, and L so that discrepancies between the two observers can be visually analyzed (Ayers & Ledford, 2014). These appendices are identical to Figures 7, 8, 10, 11, 13, and 14 in the *Results* section, except that only the primary observer's data is graphed on the figures in the *Results* section.

Before reporting and discussing IOA results for each child, it is worth noting that both observers agreed that there were no occurrences of any modeled PAs or modeled PNs in any baseline session for any child. This finding is confirmatory of the study procedures, because modeled PAs and modeled PNs were selected and targeted on the basis that they were behaviors that had never occurred in baseline.

Table 10

Interobserver Agreement Results

Behavior Dimension Measured Behavior / Dimension Sub-type	Charlie Baseline (*n* = 1)	 A-sessions (*n* = 1)	 B-sessions (*n* = 1)	 Maintenance (*n* = 1)	 TOTALS
Play Actions:					
Unique Occurrences	88% (14/16)	92% (11/12)	96% (22/23)	100% (17/17)	94% (64/68)
A-set	---	100% (6/6)	n/o	100% (6/6)	100% (12/12)
B-set	---	n/o	100% (6/6)	100% (6/6)	100% (12/12)
Unmodeled	88% (14/16)	83% (5/6)	94% (16/17)	100% (5/5)	91% (40/44)
Total Occurrences	90% (18/20)	75% (15/20)	90% (27/30)	95% (19/20)	88% (79/90)
A-set	---	70% (7/10)	n/o	100% (7/7)	82% (14/17)
B-set	---	n/o	89% (8/9)	100% (6/6)	93% (14/15)
Unmodeled	90% (18/20)	80% (8/10)	90% (19/21)	86% (6/7)	88% (51/58)
Duration of Occurrences	100% (18/18)	80% (12/15)	96% (26/27)	100% (19/19)	95% (75/79)
A-set	---	71% (5/7)	n/o	100% (7/7)	86% (12/14)
B-set	---	n/o	100% (8/8)	100% (6/6)	100% (14/14)
Unmodeled	100% (18/18)	88% (7/8)	95% (18/19)	100% (6/6)	96% (49/51)
Avg. difference per PA	0.5 s	2.6 s	0.9 s	0.5 s	1.1 s
Total duration engaged in PAs	100%	69%	90%	93%	88%
Play Narrations:					
Occurrences	60% (3/5)	n/o	81% (13/16)	86% (6/7)	79% (22/28)
Modeled	---	n/o	89% (8/9)	86% (6/7)	88% (14/16)
Unmodeled	60% (3/5)	n/o	83% (5/6)	n/o	73% (8/11)
Delayed Echolalia	---	n/o	0% (0/1)	n/o	0% (0/1)

Table 10, cont.

Behavior Dimension Measured Behavior / Dimension Sub-type	Lucas				
	Baseline (*n* = 1)	A-sessions (*n* = 3)	B-sessions (*n* = 3)	Maintenance (*n* = 1)	TOTALS
Play Actions:					
Unique Occurrences	85% (11/13)	87% (68/78)	91% (49/54)	86% (18/21)	88% (146/166)
A-set	---	100% (12/12)	100% (9/9)	100% (3/3)	100% (24/24)
B-set	---	100% (5/5)	100% (8/8)	100% (4/4)	100% (17/17)
Unmodeled	85% (11/13)	84% (51/61)	86% (32/37)	79% (11/14)	84% (105/125)
Total Occurrences	75% (18/24)	88% (92/105)	86% (70/81)	81% (22/27)	85% (202/237)
A-set	---	96% (24/25)	84% (16/19)	86% (6/7)	90% (46/51)
B-set	---	100% (6/6)	100% (11/11)	100% (4/4)	100% (21/21)
Unmodeled	75% (18/24)	84% (62/74)	84% (43/51)	75% (12/16)	82% (135/165)
Duration of Occurrences	94% (17/18)	99% (91/92)	99% (69/70)	100% (22/22)	99% (199/202)
A-set	---	96% (23/24)	94% (15/16)	100% (6/6)	96% (44/46)
B-set	---	100% (6/6)	100% (11/11)	100% (4/4)	100% (21/21)
Unmodeled	94% (17/18)	100% (62/62)	100% (43/43)	100% (12/12)	99% (134/135)
Avg. difference per PA	1.1 s	0.8 s	0.7 s	1.0 s	0.8 s
Total duration engaged in PAs	90%	91%	92%	69%	89%
Play Narrations:					
Occurrences	0% (0/1)	n/o	n/o	n/o	0% (0/1)
Modeled	---	n/o	n/o	n/o	n/o
Unmodeled	0% (0/1)	n/o	n/o	n/o	0% (0/1)
Delayed Echolalia	---	n/o	n/o	n/o	n/o

Table 10, cont.

Behavior Dimension Measured Behavior / Dimension Sub-type	Eli Baseline (*n* = 1)	 VM-A (*n* = 3)	 VM-B (*n* = 3)	 Maintenance (*n* = 1)	 TOTALS
Play Actions:					
Unique Occurrences	44% (4/9)	90% (47/52)	85% (35/41)	100% (11/11)	86% (97/113)
A-set	---	100% (2/2)	n/o	100% (1/1)	100% (3/3)
B-set	---	100% (1/1)	100% (6/6)	100% (2/2)	100% (9/9)
Unmodeled	44% (4/9)	90% (44/49)	83% (29/35)	100% (8/8)	84% (85/101)
Total Occurrences	55% (6/11)	83% (70/84)	80% (69/86)	88% (23/26)	81% (168/207)
A-set	---	100% (2/2)	n/o	100% (2/2)	100% (4/4)
B-set	---	100% (1/1)	100% (10/10)	100% (2/2)	100% (13/13)
Unmodeled	55% (6/11)	83% (67/81)	78% (59/76)	86% (19/22)	79% (151/190)
Duration of Occurrences	83% (5/6)	97% (68/70)	96% (66/69)	100% (23/23)	96% (162/168)
A-set	---	100% (2/2)	n/o	100% (2/2)	100% (4/4)
B-set	---	100% (1/1)	100% (10/10)	100% (2/2)	100% (13/13)
Unmodeled	83% (5/6)	97% (65/67)	95% (56/59)	100% (19/19)	96% (145/151)
Avg. difference per PA	4.2 s	1.1 s	1.2 s	0.4 s	1.2 s
Total duration engaged in PAs	91%	85%	94%	81%	89%
Play Narrations:					
Occurrences	n/o	33% (1/3)	91% (20/22)	100% (5/5)	87% (26/30)
Modeled	---	100% (1/1)	100% (20/20)	100% (5/5)	100% (26/26)
Unmodeled	n/o	0% (0/2)	0% (0/2)	n/o	0% (0/4)
Delayed Echolalia	---	n/o	n/o	n/o	n/o

Note: VM-A = Video Model A condition, VM-B = Video Model B condition, "n/o" indicates that both observers agreed there were no occurrences of the behavior.

IOA results for Charlie. For Charlie, there were only four disagreements for unique occurrences of PAs of all types (M = 94%). All of these disagreements occurred with unmodeled PAs (range per phase/condition: 83 – 100%, M = 91%). Agreement for unique occurrences of modeled PAs was 100% for both A- and B-set PAs.

Average agreement for total occurrences of PAs of all types was 88% (range per phase/condition: 75 – 95%). Average agreement for total occurrences of A-set PAs was 82% (range per phase/condition: 70 – 100%). Average agreement for total occurrences of B-set PAs was 93% (range per phase/condition: 89 – 100%). Average agreement for total occurrences of unmodeled PAs was 88% (range per phase/condition: 80 – 90%). Of the 11 total disagreements for total occurrences of all PA types, seven (64%) were unmodeled PA disagreements. All but one of the 11 (91%) total disagreements occurred in the A-session that was coded for IOA. This was the first session that the secondary observer coded for IOA. Once disagreements from this session were discussed and misunderstandings about the coding system were resolved, IOA for the remaining coded sessions improved.

Average agreement for duration of agreed-upon occurrences of PAs of all types was 95% (range per phase/condition: 80 – 100%). Average agreement for duration of agreed-upon occurrences of A-set PAs was 86% (range per phase/condition: 71 – 100%). Agreement for duration of agreed-upon occurrences of B-set PAs was 100%. Average agreement for duration of agreed-upon unmodeled PAs was 96%, with only two disagreements total (range per phase/condition: 88 – 100%). The average difference in duration per PA was 1.1 s (range per phase/condition: 0.5 – 2.6 s). The average agreement for total duration of PA engagement was 88% (range per phase/condition: 69 – 100%). As with total occurrences IOA described above, the lowest agreement for all types of duration agreement was in the A-session that was coded for IOA.

The average agreement for occurrences of PNs was 79% (range per phase/condition: 60 – 86%). The average agreement for occurrences of modeled PNs was 88% (range per phase/condition: 86 – 89%). The average agreement for occurrences of unmodeled PNs was 73% (range per phase/condition: 60 – 83%). While the one instance in which an observer recorded the occurrence of delayed echolalia was not agreed upon, both observers agreed that delayed echolalia was a near-zero-frequency behavior that rarely occurred (i.e., both observers agreed that there were no occurrences of delayed echolalia in the other two sessions in which it could have occurred).

IOA results for Lucas. For Lucas, agreement for unique occurrences of PAs of all types was relatively consistent across all phases/conditions (range per phase/condition: 85 – 91%, *M* = 88%). All of these disagreements occurred with unmodeled PAs (range per phase/condition: 79 – 86%, *M* = 84%). Agreement for unique occurrences of modeled PAs was 100% for both A- and B-set PAs.

Average agreement for total occurrences of PAs of all types was 85% (range per phase/condition: 75 – 88%). Average agreement for total occurrences of A-set PAs was 90% (range per phase/condition: 84 – 96%). Agreement for total occurrences of B-set PAs was 100%. Average agreement for total occurrences of unmodeled PAs was 82% (range per phase/condition: 75 – 84%). Of the 35 total disagreements for total occurrences of all PA types, 30 (86%) were unmodeled PA disagreements.

Average agreement for duration of agreed-upon occurrences of PAs of all types was 99% (range per phase/condition: 94 – 100%). There were only three total disagreements for duration of agreed-upon occurrences of PAs of all types, two of which were for A-set PAs (range per phase/condition: 94 – 100%, *M* = 96%) and one of which was for unmodeled PAs (range per phase/condition: 94 – 100%, *M* = 99%). The average difference in duration per PA was 0.8 s (range per phase/condition: 0.7 – 1.1 s). The average agreement for total duration of PA engagement was 89% (range per phase/condition: 69 – 92%).

Across all sessions observed for IOA, there was only one recorded instance of a PN of any kind (an unmodeled PN recorded in baseline), which was not agreed upon. Therefore, the overall IOA for occurrences of PNs of all kinds was 0%. However, in the remaining seven sessions coded for IOA, both observers agreed that there were no occurrences of PNs of any kind (i.e., 88% session-level agreement on zero occurrences of PNs).

IOA results for Eli. As a reminder, there were two secondary observers. One secondary observer coded sessions for Charlie and Lucas and the other secondary observer coded sessions for Eli. Similarly to the secondary observer who coded sessions for Charlie and Lucas, the agreement among the primary observer and secondary observer who coded Eli's sessions was lowest for the first session that the secondary observer coded for IOA. In Eli's case, this was the baseline session. As with the secondary observer who coded sessions for Charlie and Lucas, once disagreements from this session were discussed and misunderstandings about the coding system were resolved, IOA for the remaining coded sessions improved.

For Eli, average agreement for unique occurrences of PAs of all types was 86% (range per phase/condition: 44 – 100%). All of these disagreements occurred with unmodeled PAs (range per phase/condition: 44 – 100%, *M* = 84%). Agreement for unique occurrences of modeled PAs was 100% for both A- and B-set PAs.

Average agreement for total occurrences of PAs of all types was 81% (range per phase/condition: 55 – 88%). As with unique occurrences of PAs, all disagreements for total occurrences of PAs of all types occurred with unmodeled PAs (range per phase/condition: 55 – 86%, *M* = 79%). Agreement for total occurrences of modeled PAs was 100% for both A- and B-set PAs.

Average agreement for duration of agreed-upon occurrences of PAs of all types was 96% (range per phase/condition: 83 – 100%). There were only six total disagreements for duration of agreed-upon occurrences of PAs of all types, all of which were for unmodeled PAs (range per phase/condition: 94 – 100%, *M* = 96%) and one of which was for unmodeled PAs (range per phase/condition: 83 – 100%, *M* = 96%). Agreement for duration of agreed-upon occurrences of modeled PAs was 100% for both A- and B-set PAs. The average difference in duration per PA was 1.2 s (range per phase/condition: 0.4 – 4.2 s). The average agreement for total duration of PA engagement was 89% (range per phase/condition: 81 – 94%).

Average agreement for occurrences of PNs of all types was 87% (range per phase/condition: 33 – 100%). Agreement for occurrences of modeled PNs was 100%. Across all sessions observed for IOA, there were only four recorded instances unmodeled PNs, none of which were agreed upon. Therefore, the overall IOA for occurrences of unmodeled PNs was 0%. These four instances were recorded in two different sessions, one A-session and one B-session. In the remaining six sessions coded for IOA, both observers agreed that there were no occurrences of any unmodeled PNs (i.e., 75% session-level agreement on zero occurrences of unmodeled PNs).

Summary of IOA results. For all three children, agreement on modeled behaviors (modeled PAs and modeled PNs) was consistently high for all types of IOA measured.

Agreement for unique occurrences of modeled PAs was 100% across all three children. Average agreement for total occurrences of modeled A-set PAs ranged from 82 – 100% across all three children. Average agreement for total occurrences of modeled B-set PAs ranged from 93 – 100% across all three children. Average agreement for occurrences of modeled PAs ranged from 88 – 100% across all three children (there were no recorded occurrences of modeled PAs for Lucas). Duration-based IOA was consistently high for all types of duration-based IOA measured, for PAs of all types, across all three children. Average agreement for duration of agreed-upon occurrences of PAs of all types ranged from 95 – 99% across all three children. Average difference in duration per PA ranged from 0.8 – 1.2 s across all three children. Average agreement for total duration engaged in PAs ranged from 88 – 89%.

Overall, IOA levels for unmodeled behaviors (PAs and PNs) were lower, on average, than for modeled behaviors, but in most cases, was still acceptably high. Average agreement for unique occurrences of unmodeled PAs ranged from 86 – 94% across all three children. Average agreement for total occurrences of unmodeled PAs ranged from 79 – 88%. Average agreement for occurrences of unmodeled PNs ranged from 0 – 73%.

While the lower IOA levels for unmodeled behaviors is a cause for concern, especially with regard to unmodeled PNs, there are three reasons why these low IOA levels are not threats to the overall validity of the entire study. First, for the two children (Lucas and Eli) in which 0% agreement for unmodeled PNs was obtained, both observers generally agreed that this was a low-frequency, near-zero-level behavior for both children, as evident by the session-level agreement that there were zero instances of unmodeled PNs for 81% (13 of 16) of all observed sessions across both children. Second, the research questions of greatest interest were concerning experimental effects related to modeled behaviors, for which there were acceptably high levels of

IOA. Third, and perhaps most importantly, when the secondary observer's data are visually analyzed in comparison to the primary observer's data (see Appendices G – L), there are no patterns in discrepancies between the two observers' graphed data that would have led the researcher to different overall findings than those reported and discussed, especially in the case of unmodeled PNs for Lucas and Eli, for which both observers agreed that frequencies remained at zero or near-zero levels throughout the study.

CHAPTER III

RESULTS

Modeled Play Actions in Target Sessions

Unique modeled play actions per target session. For each participant, the number of unique modeled PAs per target session within the video modeling comparison phase is shown in Figure 1. The maximum number of unique modeled PAs that could be demonstrated per target session was six for each set (A-set and B-set).

Charlie. The first time Charlie demonstrated all six A-set PAs in a single target session was in the third A-session. In comparison, the first time Charlie demonstrated all six B-set PAs in a single target session was in the second B-session. Charlie reached the mastery criteria (i.e., 100% of target modeled PAs demonstrated the target session for three consecutive target sessions) for the A-set in the fifth A-session and he reached the mastery criteria for the B-set in the fourth B-session. In the first two paired comparisons (i.e., A-1 versus B-1 and A-2 versus B-2), Charlie demonstrated more unique B- than A-set PAs. For the remaining three paired comparisons, there was no differentiation between the two interventions, as Charlie demonstrated all six modeled PAs for each set.

Lucas. Lucas never demonstrated all six modeled PAs in a single target session for either the A- or B-set. The most number of unique modeled PAs he demonstrated in a single target session was five for each set. The first time Lucas demonstrated five of six A-set PAs in a single target session was in the fourth A-session. In comparison, the first time Lucas demonstrated five of six B-set PAs in a single target session was in the fourteenth B-session. Lucas demonstrated five of six A-set PAs in a single target session in five different sessions (A-5, A-6, A-7, A-9, and A-10) and he demonstrated five of six B-set PAs in one target session (B-14). Across all 15 paired comparisons, Lucas demonstrated more unique A- than B-set PAs in 12 pairs (80%), more unique B- than A-set PAs in two pairs (13%), and an equal number of unique A- and B-set PAs in one pair (7%). On average, Lucas demonstrated 4.1 unique A-set PAs and 2.6 unique B-set PAs per target session.

Eli. Eli never demonstrated all six modeled PAs in a single target session for either the A- or B-set. The most number of unique modeled PAs he demonstrated in a single target session was three for the A-set (demonstrated once in session A-13) and five for the B-set (demonstrated once in session B-8). Across all 15 paired comparisons, Eli demonstrated more unique A- than B-set PAs in two pairs (13%), more unique B- than A-set PAs in 10 pairs (67%), and an equal number of A- and B-set PAs in three pairs (20%). On average, Eli demonstrated 0.6 unique A-set PAs and 1.9 unique B-set PAs per target session.

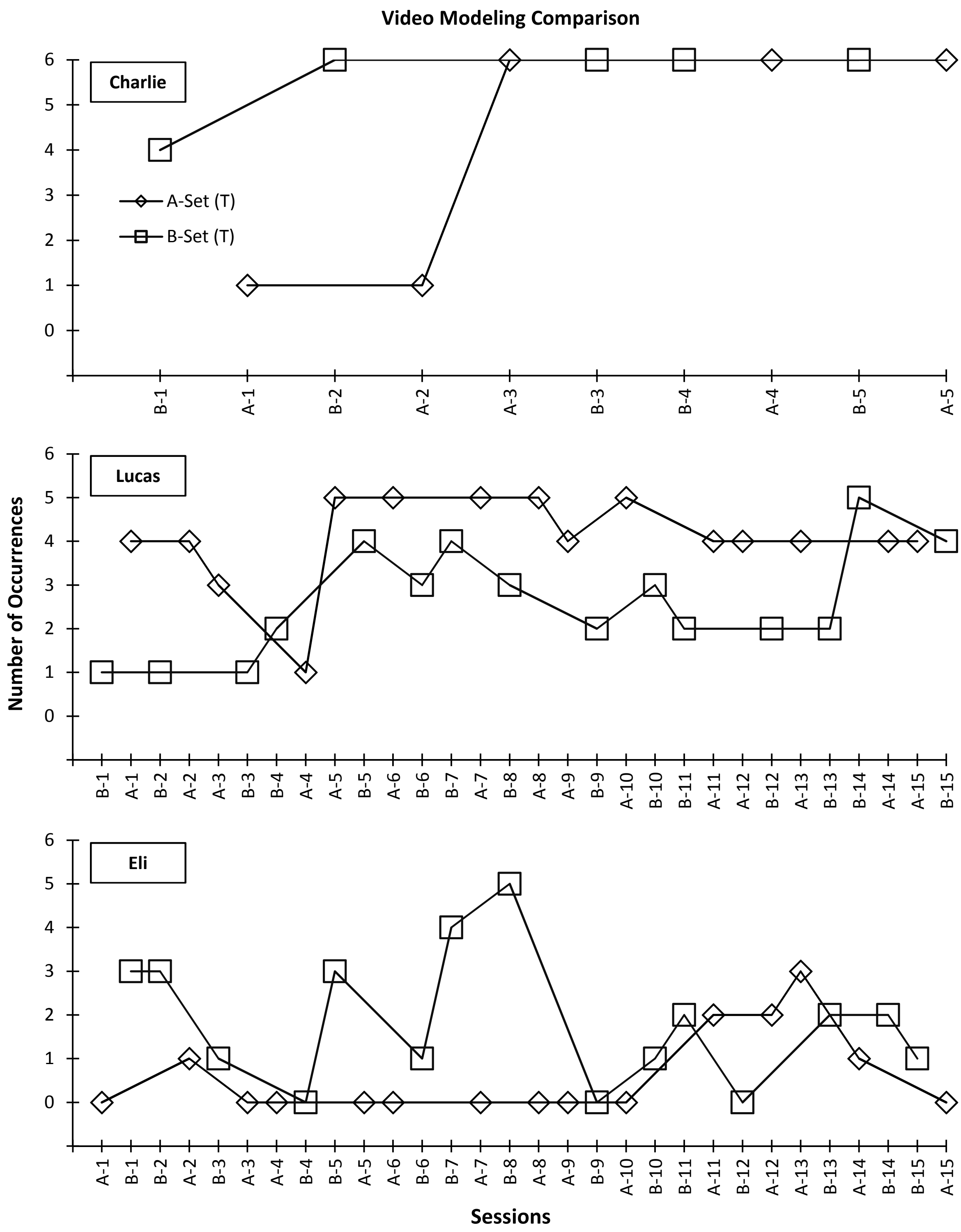

Figure 1. Number of unique modeled play actions per target (T) session within the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Total modeled play actions per target session. For each participant, the number of total (unique plus repeat) modeled PAs per target session within the video modeling comparison phase is shown in Figure 2. Because repeat demonstrations were included in the total, there is no defined ceiling for the maximum number of total modeled PAs that could be demonstrated per target session.

Charlie. Across all five paired target comparisons, Charlie demonstrated more total A- than B-set PAs in one pair (20%), more total B- than A-set PAs in two pairs (40%), and an equal number of total A- and B-set PAs in two pairs (40%). On average, Charlie demonstrated 6.2 total A-set PAs and 8.0 total B-set PAs per target session.

Lucas. Across all 15 paired target comparisons, Lucas demonstrated more total A- than B-set PAs in 12 pairs (80%), more total B- than A-set PAs in one pair (7%), and an equal number of total A- and B-set PAs in two pairs (13%). On average, Lucas demonstrated 6.9 total A-set PAs and 3.3 total B-set PAs per target session.

Eli. Across all 15 paired target comparisons, Eli demonstrated more total A- than B-set PAs in two pairs (13%), more total B- than A-set PAs in 10 pairs (67%), and an equal number of total A- and B-set PAs in three pairs (20%). On average, Eli demonstrated 0.6 total A-set PAs and 2.7 total B-set PAs per target session.

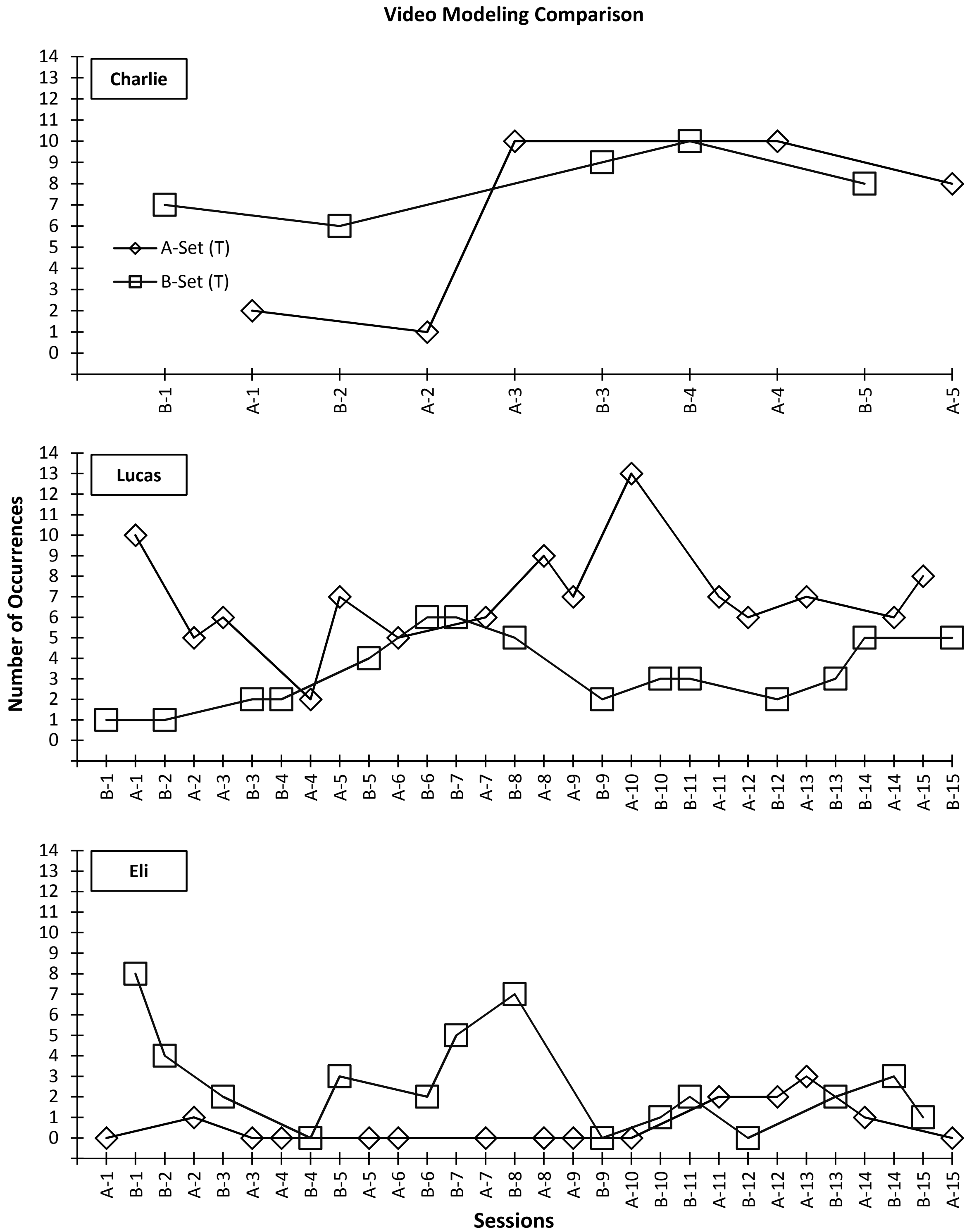

Figure 2. Number of total modeled play actions per target (T) session within the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Cumulative frequency of unique modeled play actions across target sessions. For each participant, the cumulative frequency of unique modeled PAs across target sessions within the video modeling comparison phase is shown in Figure 3. The maximum cumulative frequency of unique modeled PAs that could be demonstrated was six for each behavior set.

Charlie. Charlie attained the cumulative frequency maximum for the A-set in the third A-session and he attained the cumulative frequency maximum for the B-set in the second B-session. For Charlie, the cumulative frequency of the B-set in target sessions remained above that of the A-set for the entirety of the comparison phase, until they equalized at the maximum.

Lucas. Lucas attained the cumulative frequency maximum for the A-set in the second A-session and attained the cumulative frequency maximum for the B-set 11 sessions later, in the thirteenth B-session. For Lucas, the cumulative frequency of the A-set in target sessions remained above that of the B-set for the entirety of the comparison phase, until they equalized at the maximum.

Eli. Eli attained the cumulative frequency maximum for the B-set in the seventh B-session. Eli did not attain the cumulative frequency maximum for the A-set in target sessions. Across all target sessions, he demonstrated three of six modeled PAs in the A-set, which was first attained in the eleventh A-session. For Eli, the cumulative frequency of the B-set in target sessions remained above that of the A-set for the entirety of the comparison phase.

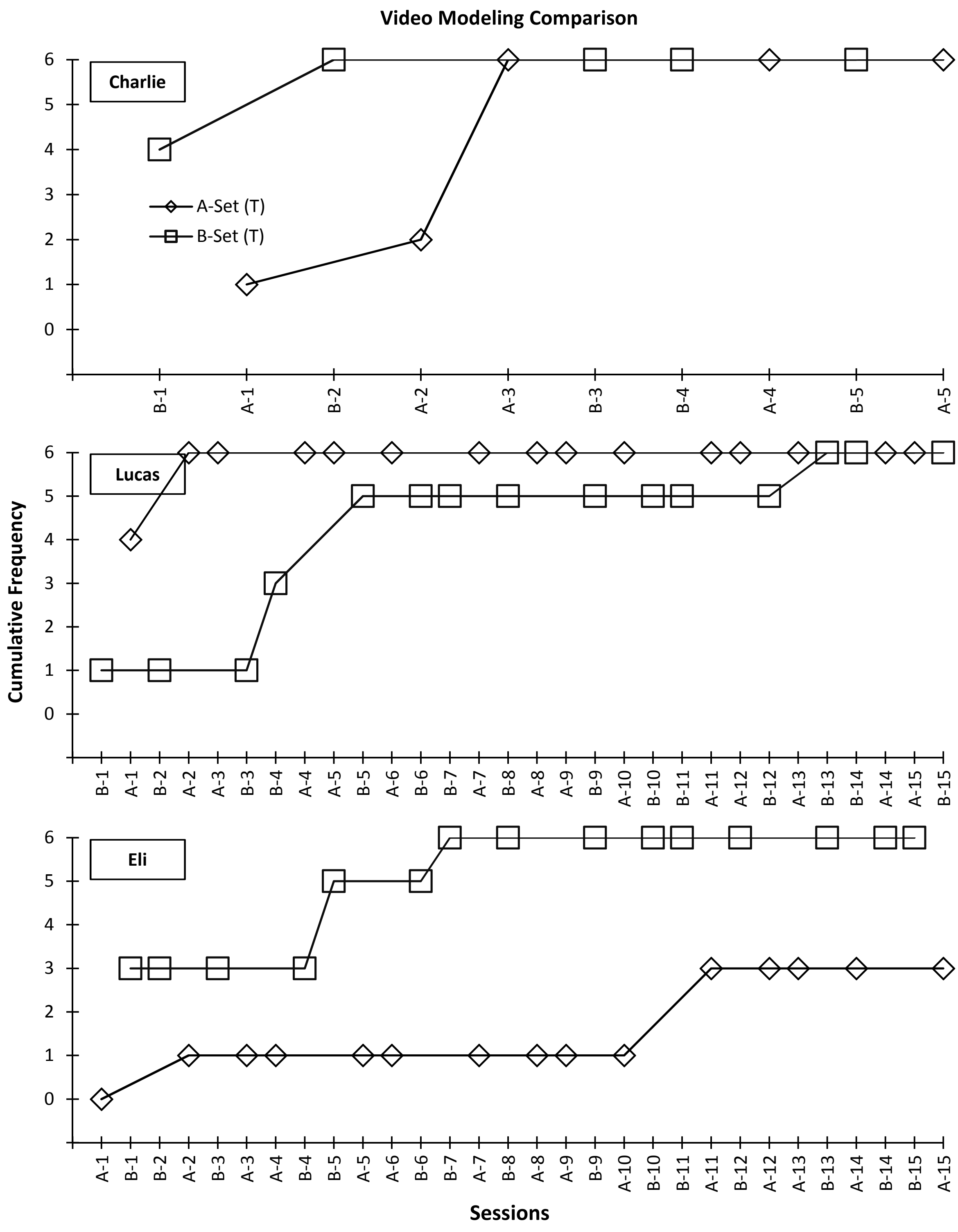

Figure 3. Cumulative frequency of unique modeled play actions across target (T) sessions within the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Modeled Play Actions in Non-Target Sessions

Please note that all analyses of modeled PAs in non-target sessions have one less paired comparison per child than target session analyses because the first non-target session for the video modeling intervention that was introduced second (selected at random for each child) did not occur until the following measurement day, when the A-2 and B-2 sessions were conducted. This also means that the video modeling intervention that was introduced first has one more non-target session than the video modeling intervention that was introduced second because its first non-target session occurred on the same day it was introduced.

Unique modeled play actions per non-target session. For each participant, the number of unique modeled PAs per non-target session within the video modeling comparison phase is shown in Figure 4. As with target sessions, the maximum number of unique modeled PAs that could be demonstrated per non-target session was six each for the A- and B-sets.

Charlie. Charlie did not demonstrate any modeled PAs from either set in any non-target sessions.

Lucas. Lucas never demonstrated all six modeled PAs in a single non-target session for either the A- or B-set. The most number of unique modeled PAs he demonstrated in a single non-target session was five for the A-set (first demonstrated in the fourth B-session) and three for the B-set (first demonstrated in the fifth A-session). Lucas demonstrated five of six A-set PAs in a single non-target session in five different sessions (B-4, B-10, B-14, and B-16) and he demonstrated three of six B-set PAs in three different sessions (A-5, A-9, and A-15). Across all 14 paired comparisons, Lucas demonstrated more unique A- than B-set PAs in 11 pairs (79%) and more unique B- than A-set PAs in three pairs (21%). On average, Lucas demonstrated 3.4 unique A-set PAs and 1.5 unique B-set PAs per non-target session.

Eli. Eli never demonstrated all six modeled PAs in a single non-target session for either the A- or B-set. The most number of unique modeled PAs he demonstrated in a single non-target session was two for the A-set (demonstrated once in the seventh B-session) and four for the B-set (demonstrated once in the tenth A-session). Across all 14 paired comparisons, Eli demonstrated more unique A- than B-set PAs in one pair (7%), more unique B- than A-set PAs in nine pairs (64%), and an equal number of A- and B-set PAs in four pairs (29%). On average, Eli demonstrated 0.2 unique A-set PAs and 1.4 unique B-set PAs per non-target session.

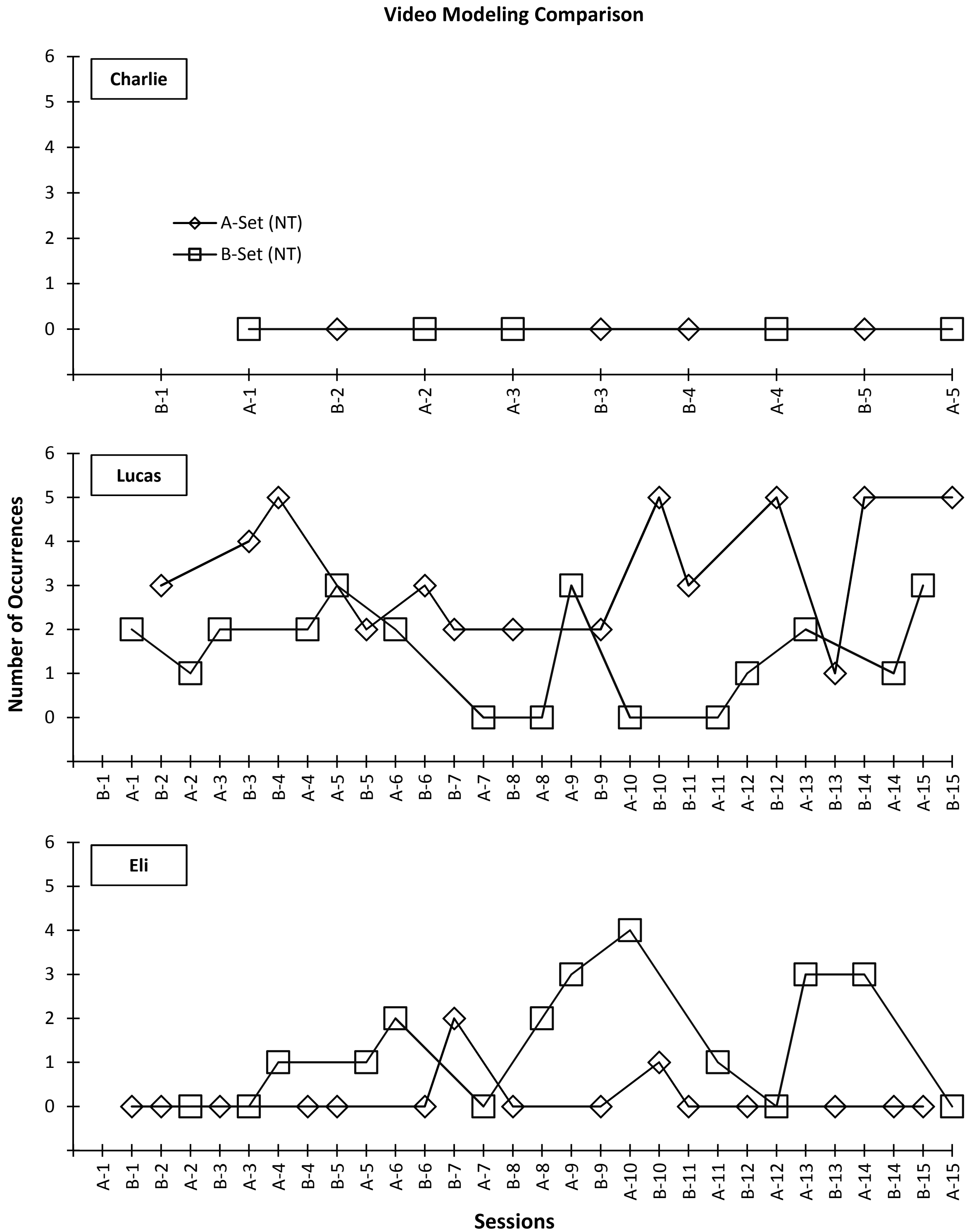

Figure 4. Number of unique modeled play actions per non-target (NT) session within the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Total modeled play actions per non-target session. For each participant, the number of total (unique plus repeat) modeled PAs per non-target session within the video modeling comparison phase is shown in Figure 5. Because repeat demonstrations were included in the total, there is no defined ceiling for the maximum number of total modeled PAs that could be demonstrated per non-target session.

Charlie. Charlie did not demonstrate any modeled PAs from either set in any non-target sessions.

Lucas. Across all 14 paired non-target comparisons, Lucas demonstrated more total A- than B-set PAs in 12 pairs (86%) and more total B- than A-set PAs in two pairs (14%). On average, Lucas demonstrated 5.6 total A-set PAs and 2.0 total B-set PAs per non-target session.

Eli. Across all 14 paired non-target comparisons, Eli demonstrated more total A- than B-set PAs in one pair (7%), more total B- than A-set PAs in nine pairs (64%), and an equal number of total A- and B-set PAs in four pairs (29%). On average, Eli demonstrated 0.2 total A-set PAs and 1.4 total B-set PAs per non-target session.

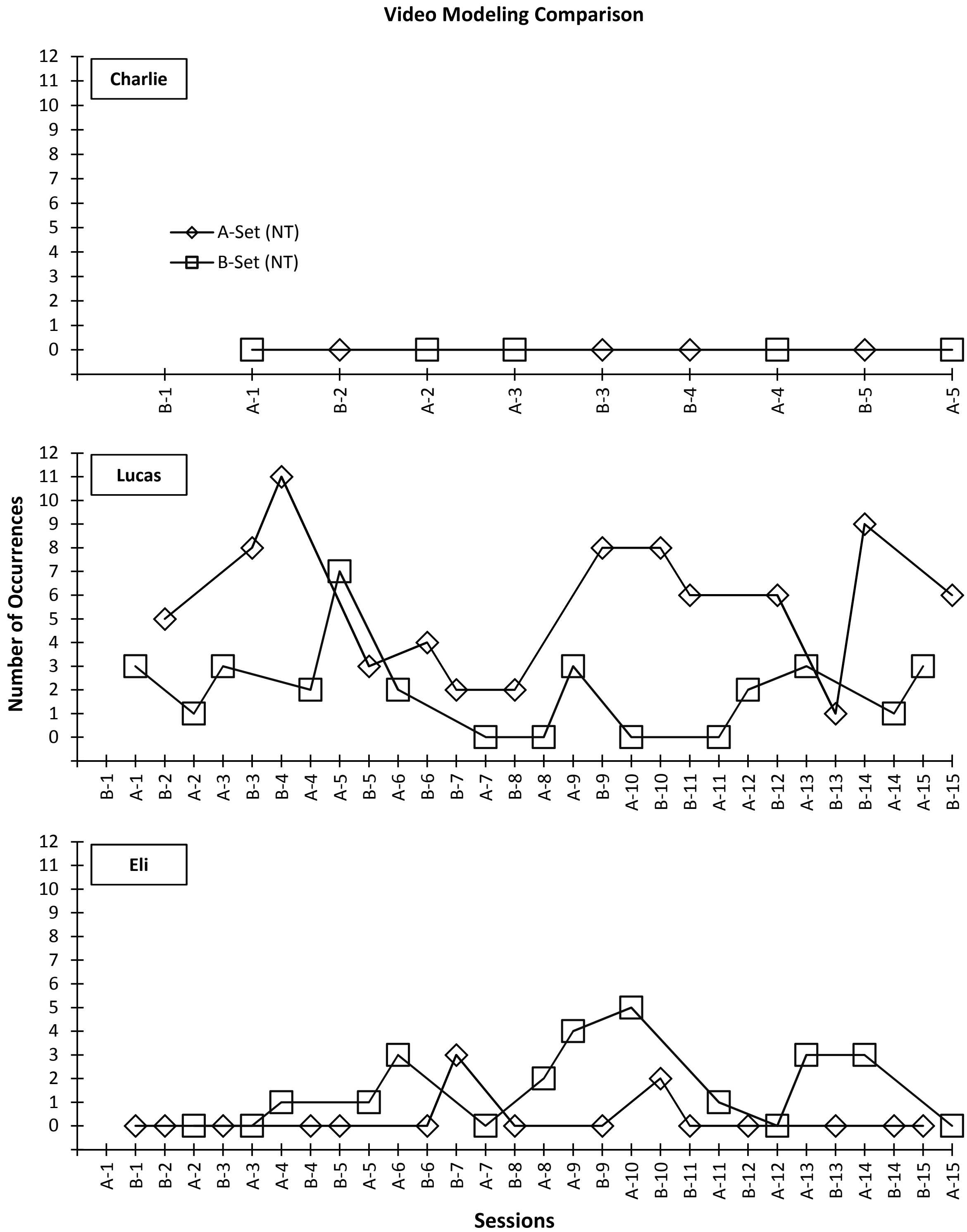

Figure 5. Number of total modeled play actions per non-target (NT) session within the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Cumulative frequency of unique modeled play actions across non-target sessions. For each participant, the cumulative frequency of unique modeled PAs across non-target sessions within the video modeling comparison phase is shown in Figure 6. As with target sessions, the maximum cumulative frequency of unique modeled PAs that could be demonstrated was six for each behavior set.

Charlie. Charlie did not demonstrate any modeled PAs from either set in any non-target sessions, therefore his cumulative frequency remained at zero for both sets across the entirety of the comparison phase.

Lucas. Lucas attained the cumulative frequency maximum for the A-set in the second non-target session (B-3), but never attained the cumulative frequency maximum for the B-set. Across all non-target session, he demonstrated four of six B-set PAs, which was attained in the final non-target session (A-15). For Lucas, the cumulative frequency of the A-set in non-target sessions remained above that of the B-set for the entirety of the comparison phase.

Eli. Eli did not attain the cumulative frequency maximum for the A-set in non-target sessions. Across all non-target sessions, he demonstrated two of six A-set PAs, which was first attained in the seventh non-target session (B-7). Eli also did not attain the cumulative frequency maximum for the B-set in non-target sessions. Across all non-target sessions, he demonstrated five of six B-set PAs, which was first attained in the ninth non-target session (A-10). For Eli, the cumulative frequency of the B-set remained above the cumulative frequency of the A-set for the entirety of the comparison phase, except for the first two comparison pairs in which each set remained at zero.

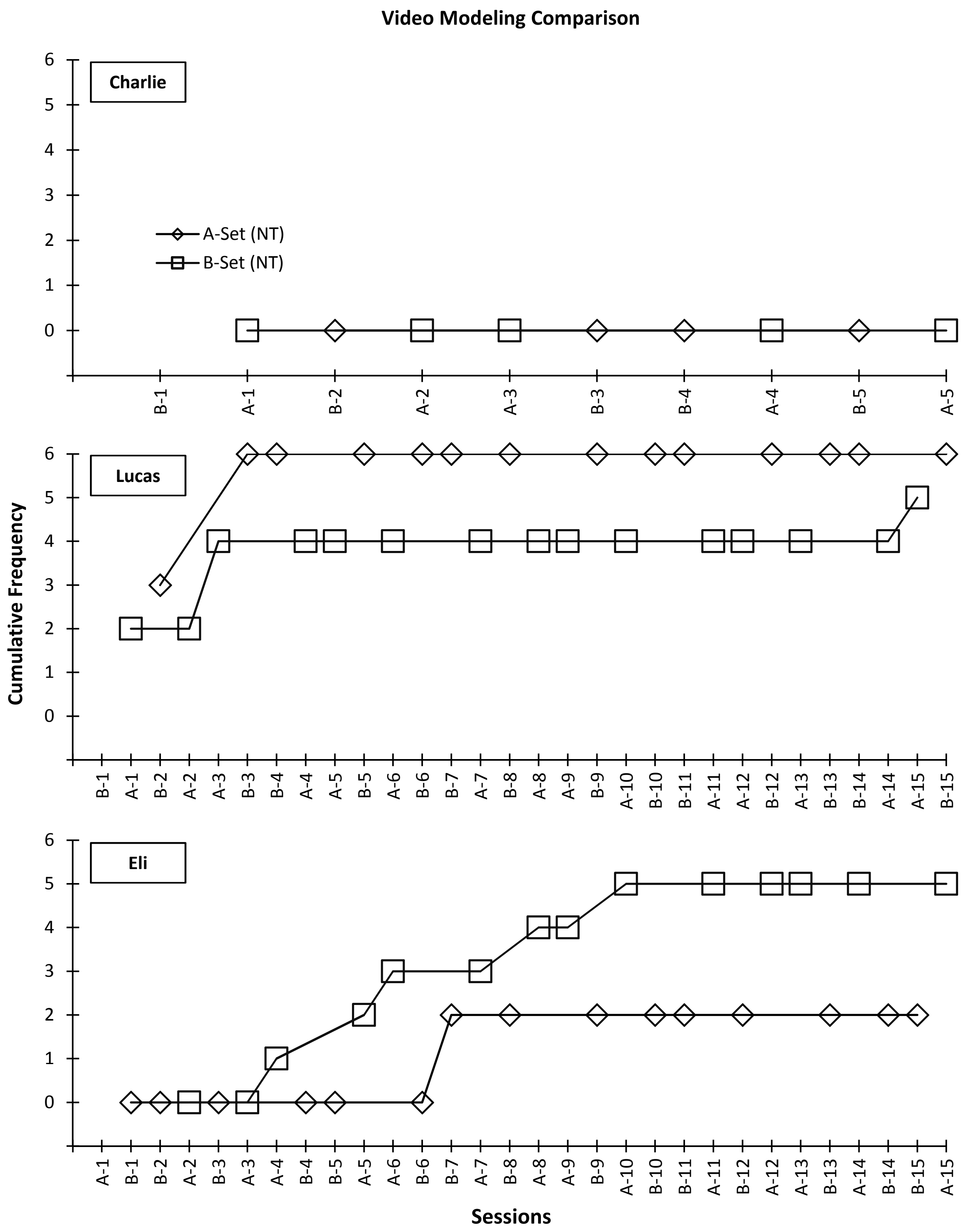

Figure 6. Cumulative frequency of unique modeled play actions across non-target (NT) sessions within the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Modeled Play Actions in Maintenance Sessions

Unique modeled play actions in maintenance sessions. For each participant, the number of unique modeled PAs per session within the comparison (target and non-target sessions graphed as one series) and maintenance phases is shown in Figure 7. The maximum number of unique modeled PAs that could be demonstrated per session was six each for the A- and B-sets.

Charlie. Charlie's maintenance data showed no differentiation between the A- and B-sets in the maintenance phase. For the first three maintenance sessions, he demonstrated all six modeled PAs for each set. For the final maintenance session, he demonstrated zero modeled PAs for each set. On average, Charlie demonstrated 4.5 unique modeled A-set PAs and 4.5 unique modeled B-set PAs in maintenance sessions. For the A-set, this average was an increase of 2.3 from the comparison phase average ($M = 2.2$) and for the B-set, this average was an increase of 1.4 from the comparison phase average ($M = 3.1$).

Lucas. Lucas's maintenance data showed a differentiation pattern in favor of the A-set, similar to the comparison phase data. For three of four (75%) maintenance sessions, Lucas demonstrated more unique A- than B-set PAs. For two of the four maintenance sessions (including the final one), he demonstrated five unique A-set PAs, which was equal to his highest level within comparison phase sessions. In the third maintenance session, Lucas demonstrated four unique B-set PAs, equal to his highest level within comparison phase sessions. On average, Lucas demonstrated 4.3 unique modeled A-set PAs and 3.0 unique modeled B-set PAs in maintenance sessions. For the A-set, this average was an increase of 0.5 from the comparison phase average ($M = 3.7$) and for the B-set, this average was an increase of 0.9 from the comparison phase average ($M = 2.1$).

Eli. Eli's maintenance data showed a slight differentiation between the A- and B-sets in favor of the A-set, which is the opposite of the differentiation pattern in the comparison phase. Eli demonstrated more unique A- than B-set PAs in two of four sessions, more unique B- than A-set PAs in one of four sessions, and an equal number of unique A- and B-set PAs in one session. Eli had one maintenance session in which he demonstrated zero modeled B-set PAs. In the final maintenance session, he demonstrated three unique A-set PAs, equal to his highest level within comparison phase sessions. In the first and fourth maintenance sessions, Eli demonstrated two unique B-set PAs, three less than his highest level within comparison phase sessions. On average, Eli demonstrated 2.0 unique modeled A-set PAs and 1.3 unique modeled B-set PAs in maintenance sessions. For the A-set, this average was an increase of 1.6 from the comparison phase average ($M = 0.4$) and for the B-set, this average was a decrease of 0.4 from the comparison phase average ($M = 1.7$).

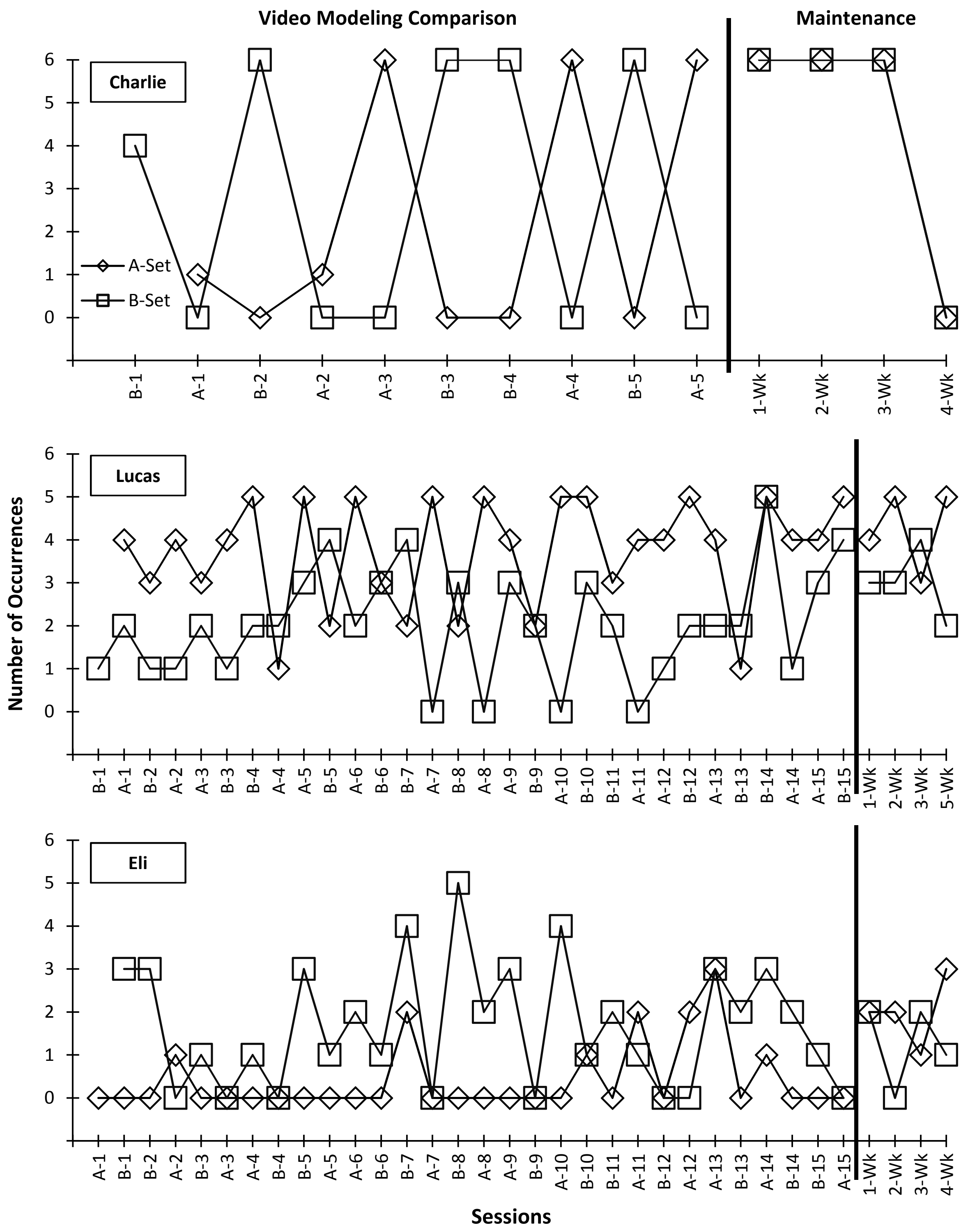

Figure 7. Number of unique modeled play actions per session in the comparison and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Total modeled play actions in maintenance sessions. For each participant, the number of total (unique plus repeat) modeled PAs per session within the comparison (target and non-target sessions graphed as one series) and maintenance phases is shown in Figure 8. Because repeat demonstrations were included in the total, there is no defined ceiling for the maximum number of total modeled PAs that could be demonstrated per session.

Charlie. Charlie did not show any clear differentiation between the A- and B-sets in the maintenance phase. He demonstrated more total A- than B-set PAs in one maintenance session, more B-set and A-set PAs in two maintenance sessions, and zero each in the final maintenance session. On average, Charlie demonstrated 5.0 total modeled A-set PAs and 5.8 total modeled B-set PAs in maintenance sessions. For the A-set, this average was an increase of 1.6 from the comparison phase average (M = 3.4) and for the B-set, this average was an increase of 1.8 from the comparison phase average (M = 4.0).

Lucas. Lucas showed a pattern in maintenance similar to the comparison phase. For three of four (75%) maintenance sessions, Lucas demonstrated more total A- than B-set PAs. On average, Lucas demonstrated 6.5 total modeled A-set PAs and 4.3 total modeled B-set PAs in maintenance sessions. For the A-set, this average was an increase of 0.2 from the comparison phase average (M = 6.3) and for the B-set, this average was an increase of 1.6 from the comparison phase average (M = 2.7).

Eli. Eli's maintenance data showed a slight differentiation between the A- and B-sets in favor of the A-set, which is the opposite of the differentiation pattern in the comparison phase. Eli demonstrated more total A- than B-set PAs in two of four sessions and an equal number of total A- and B-set PAs in two sessions. On average, Eli demonstrated 2.3 total modeled A-set PAs and 1.3 total modeled B-set PAs in maintenance sessions. For the A-set, this average was an increase of 1.6 from the comparison phase average (*M* = 0.7) and for the B-set, this average was a decrease of 0.4 from the comparison phase average (*M* = 1.7).

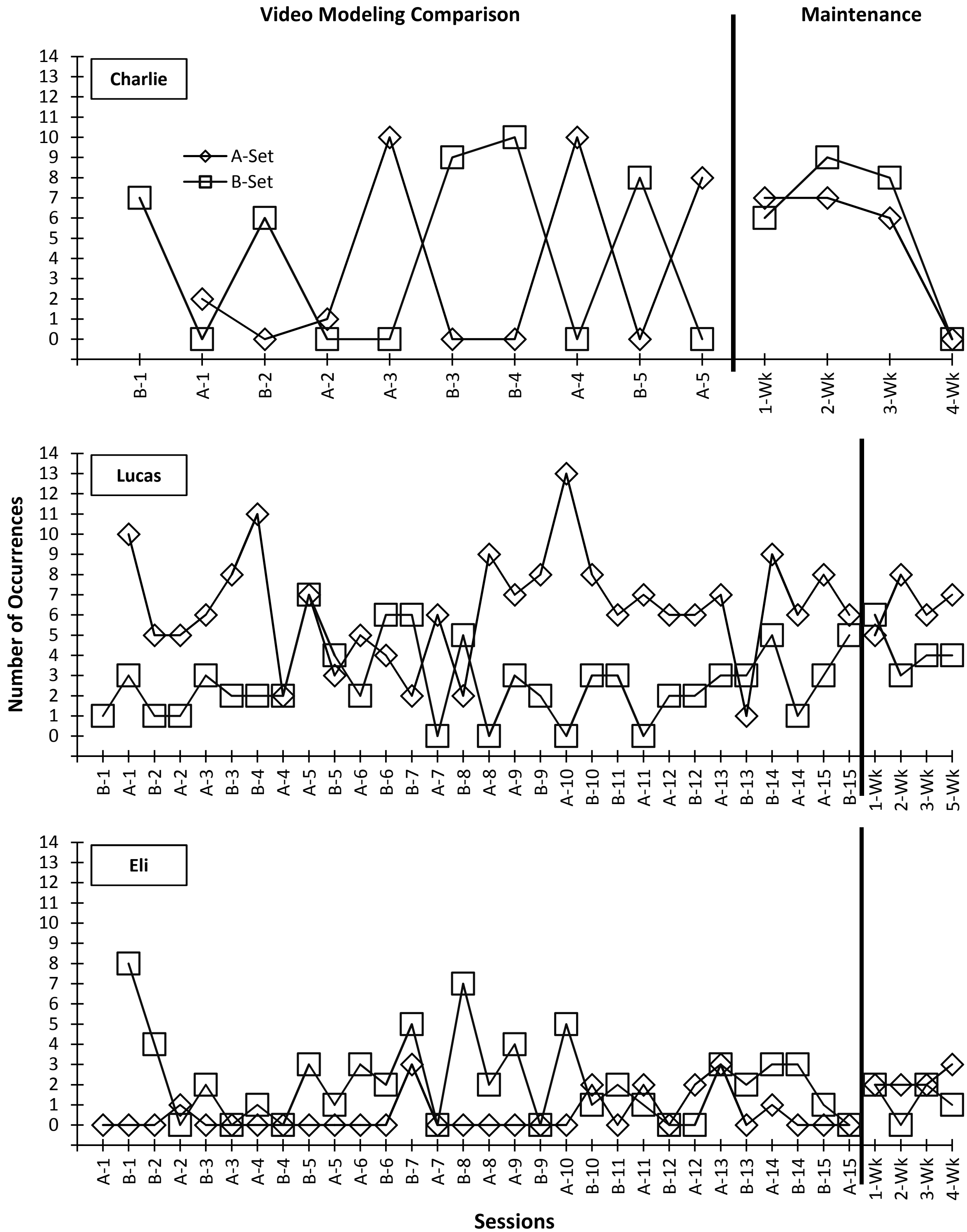

Figure 8. Number of total modeled play actions per session in the comparison and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Cumulative frequency of unique modeled play actions across maintenance sessions. For each participant, the cumulative frequency of unique modeled PAs across sessions in the video modeling comparison phase and maintenance phases is shown in Figure 9. The cumulative frequency count was "reset" to zero at the start of the maintenance phase so that within- and across-phase comparisons could be analyzed. Within each phase, the maximum cumulative frequency of unique modeled PAs that could be demonstrated was six for each behavior set.

Charlie. In the maintenance phase, Charlie attained the cumulative frequency maximum in the first maintenance session for both modeled PA sets; therefore, the cumulative frequencies of the two modeled PAs remained equal for the entirety of the maintenance phase.

Lucas. Lucas attained the cumulative frequency maximum for the A-set in the second maintenance session. He did not attain the cumulative frequency maximum for the B-set in the maintenance phase. Across all maintenance sessions, he demonstrated five of six modeled PAs in the B-set, which was first attained in the third maintenance session. The cumulative frequency of the A-set remained above that of the B-set for the entirety of the maintenance phase.

Eli. Eli did not attain the cumulative frequency maximum for either the A- or B-set in the maintenance phase. Across all maintenance sessions, he demonstrated three of six modeled PAs in the A-set (first attained in the second maintenance session) and four of six modeled PAs in the B-set (first attained in the third maintenance session). The cumulative frequency of the B-set was equal to the A-set in the first maintenance session, below the A-set in the second maintenance session, and above the A-set for the final two maintenance sessions.

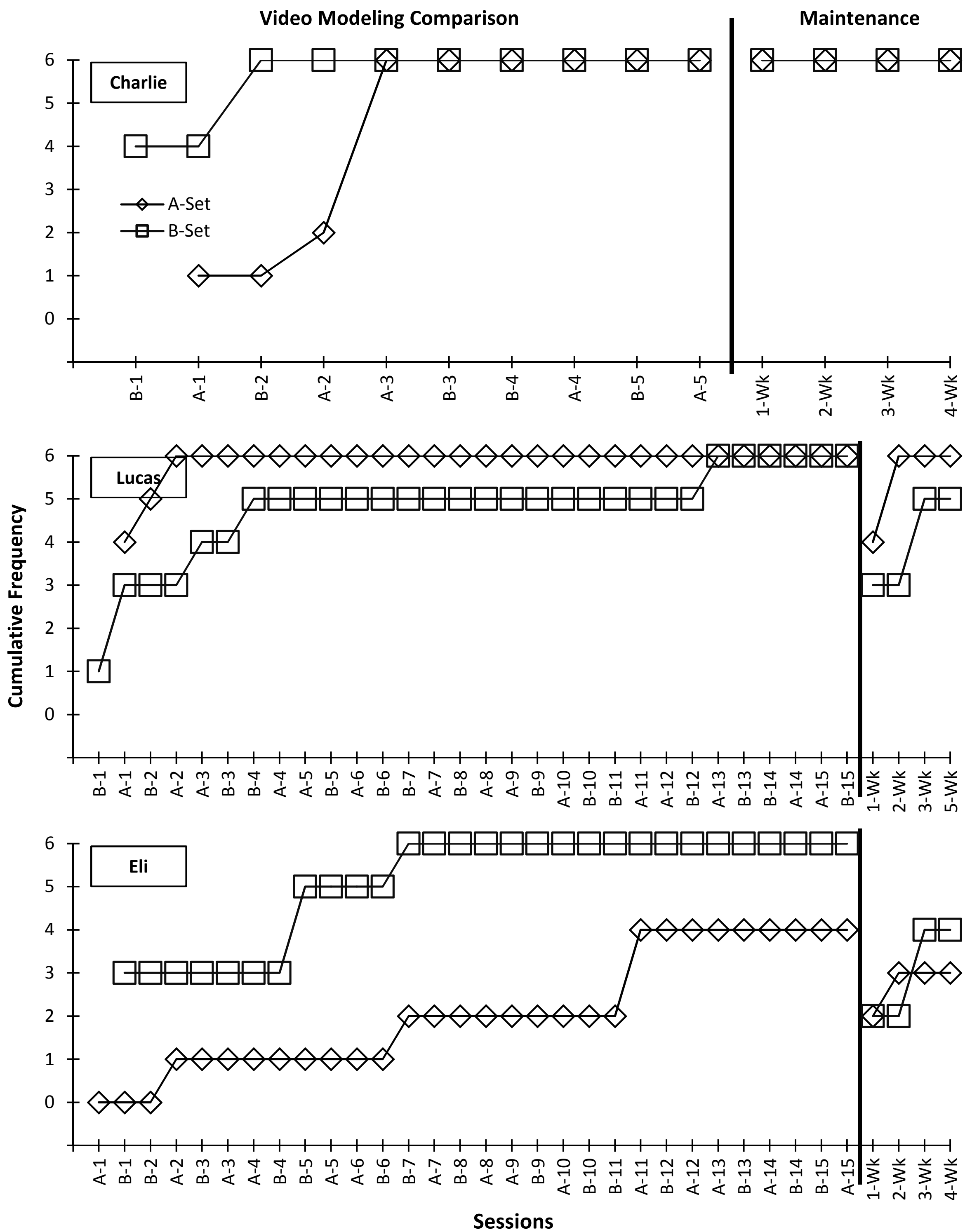

Figure 9. Cumulative frequency of unique modeled play actions across sessions in the comparison and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Unmodeled Play Actions

Unique unmodeled play actions per session. For each participant, the number of unique unmodeled PAs per session in the baseline, comparison (split between A- and B-sessions), and maintenance phases is shown in Figure 10. The series of unique unmodeled play actions is split in the video modeling comparison phase so that comparisons between Video Model A and B could be analyzed. There was no defined ceiling for the maximum number of unique unmodeled PAs that could be demonstrated per session.

Charlie. On average, Charlie demonstrated 13.6 unique unmodeled PAs per session in the baseline phase, with relative stability in the baseline data (*SD* = 2.9). In the video modeling comparison phase, this average decreased by 7.2 (*M* = 6.4, *SD* = 1.5) in A-sessions and 4.4 (*M* = 9.2, *SD* = 4.9) in B-sessions. Therefore, the introduction of the intervention was associated with a greater average decrease in unique unmodeled PAs per session for Video Model A than B. Using the median baseline session (BL-3 = 14) as a basis for comparison, all five (100%) A-sessions and four of five (80%) B-sessions were lower than the baseline median. In comparing Video Model A to B, there were fewer unmodeled PAs demonstrated in A- than B-sessions in three of five (60%) paired comparisons. In the maintenance phase, the average number of unique unmodeled PAs per session (*M* = 7.0, *SD* = 5.6) remained lower than was demonstrated in baseline by almost 50%. In the final maintenance session, in which Charlie did not demonstrate any modeled PAs (see Figure 1), the number of unique unmodeled PAs (15) was comparable to baseline levels. Three of four (75%) maintenance sessions were lower than the baseline median.

Lucas. On average, Lucas demonstrated 10.8 unique unmodeled PAs per session in the baseline phase, with relative stability in the baseline data (*SD* = 3.4). In the video modeling comparison phase, this average increased by 0.8 (*M* = 11.6, *SD* = 6.9) in A-sessions and 2.3 (*M* =

13.1, *SD* = 4.2) in B-sessions, but the variability in comparison phase data obscures the interpretability of these differences. Using the median baseline session (BL-5 = 10) as a basis for comparison, six of 15 (40%) A-sessions and 10 of 15 (67%) B-sessions were higher than the baseline median. In comparing Video Model A to B, there were more unique unmodeled PAs demonstrated in A- than B-sessions in five of 15 (33%) paired comparisons, more in B- than A-sessions in nine of 15 (60%) paired comparisons, and an equal number in one (7%) paired comparison. In the maintenance phase, the average number of unique unmodeled PAs per session (*M* = 11.5, *SD* = 1.9) was comparable to baseline. Two of four maintenance sessions were higher than the baseline median and the other two were equal to the baseline median.

Eli. On average, Eli demonstrated 13.0 unique unmodeled PAs per session in the baseline phase, with a higher amount of variability (*SD* = 6.5) compared to Charlie and Lucas. In the video modeling comparison phase, this average increased by 1.1 (*M* = 14.1, *SD* = 4.0) in A-sessions and decreased by 0.1 (*M* = 12.9, *SD* = 5.4) in B-sessions, but the variability in the baseline and comparison phase data obscures the interpretability of these differences. Using the median baseline session (BL-1 = 10) as a basis for comparison, 12 of 15 (80%) A-sessions and 10 of 15 (67%) B-sessions were higher than the baseline median. In comparing Video Model A to B, there were more unique unmodeled PAs demonstrated in A- than B-sessions in nine of 15 (60%) paired comparisons, more in B- than A-sessions in five of 15 (3%) paired comparisons, and an equal number in one (7%) paired comparison. In the maintenance phase, the average number of unique unmodeled PAs per session (*M* = 11.8, *SD* = 3.9) was 1.2 lower than baseline, but also more stable. Two of four maintenance sessions were higher than the baseline median and one of four was equal to the baseline median.

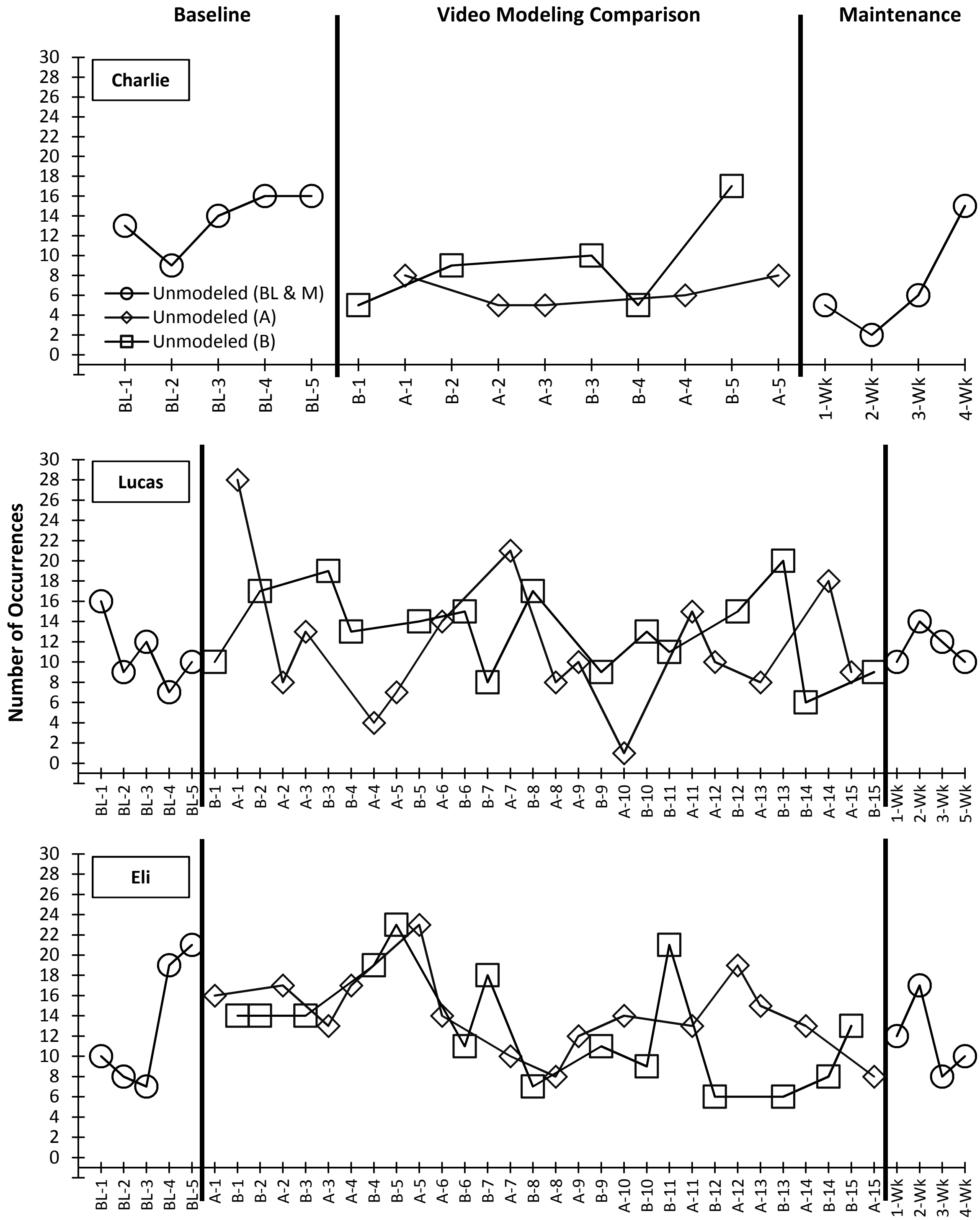

Figure 10. Number of unique unmodeled play actions per session in the baseline, comparison (split between A- and B-sessions), and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Total unmodeled play actions per session. For each participant, the number of total (unique plus repeat) unmodeled PAs per session in the baseline, comparison (split between A- and B-sessions), and maintenance phases is shown in Figure 11. The series of total unmodeled play actions is split in the video modeling comparison phase so that comparisons between Video Model A and B could be analyzed. There was no defined ceiling for the maximum number of total unmodeled PAs that could be demonstrated per session.

Charlie. On average, Charlie demonstrated 16.0 total unmodeled PAs per session in the baseline phase, with relative stability in the baseline data (*SD* = 5.1). In the video modeling comparison phase, this average decreased by 5.6 (*M* = 10.4, *SD* = 4.3) in A-sessions and 5.0 (*M* = 11.0, *SD* = 6.3) in B-sessions. Using the median baseline session (BL-1 = 15) as a basis for comparison, four of five (80%) A-sessions and four of five (80%) B-sessions were lower than the baseline median. In comparing Video Model A to B, there were fewer unmodeled PAs demonstrated in A- than B-sessions in three of five (60%) paired comparisons. In the maintenance phase, the average number of total unmodeled PAs per session (*M* = 8.0, *SD* = 6.9) was 50% lower than was demonstrated in baseline. In the final maintenance session, in which Charlie did not demonstrate any modeled PAs (see Figure 2), the number of total unmodeled PAs (18) was comparable to baseline levels. Three of four (75%) maintenance sessions were lower than the baseline median.

Lucas. On average, Lucas demonstrated 18.2 total unmodeled PAs per session in the baseline phase, with relative stability in the baseline data (*SD* = 4.4). In the video modeling comparison phase, this average decreased by 4.1 (*M* = 14.1, *SD* = 8.8) in A-sessions and 0.7 (*M* = 17.5, *SD* = 5.9) in B-sessions, but the variability in comparison phase data obscures the interpretability of these differences. Using the median baseline sessions (BL-2 & BL-5 = 17) as a basis for comparison, 10 of 15 (67%) A-sessions and six of 15 (40%) B-sessions were lower than the baseline median. In comparing Video Model A to B, there were fewer total unmodeled PAs demonstrated in A- than B-sessions in 10 of 15 (67%) paired comparisons and fewer in B- than A-sessions in 5 of 15 (33%) paired comparisons. In the maintenance phase, the average number of total unmodeled PAs per session (M = 13.0, SD = 2.4) was 5.2 lower than was demonstrated in baseline. All four (100%) maintenance sessions were lower than the baseline median.

Eli. On average, Eli demonstrated 17.6 total unmodeled PAs per session in the baseline phase, with a higher amount of variability (SD = 7.9) compared to Charlie and Lucas. In the video modeling comparison phase, this average increased by 7.1 (M = 24.7, SD = 9.3) in A-sessions and decreased by 9.1 (M = 26.7, SD = 10.6) in B-sessions, but the variability in the baseline and comparison phase data obscures the interpretability of these differences. Using the median baseline session (BL-1 = 15) as a basis for comparison, 14 of 15 (93%) A-sessions and 13 of 15 (87%) B-sessions were higher than the baseline median. In comparing Video Model A to B, there were more total unmodeled PAs demonstrated in A- than B-sessions in five of 15 (33%) paired comparisons and more in B- than A-sessions in 10 of 15 (67%) paired comparisons. In the maintenance phase, the average number of total unmodeled PAs per session (M = 23.0, SD = 7.4) was 5.4 higher than baseline. All four (100%) maintenance sessions were higher than the baseline median.

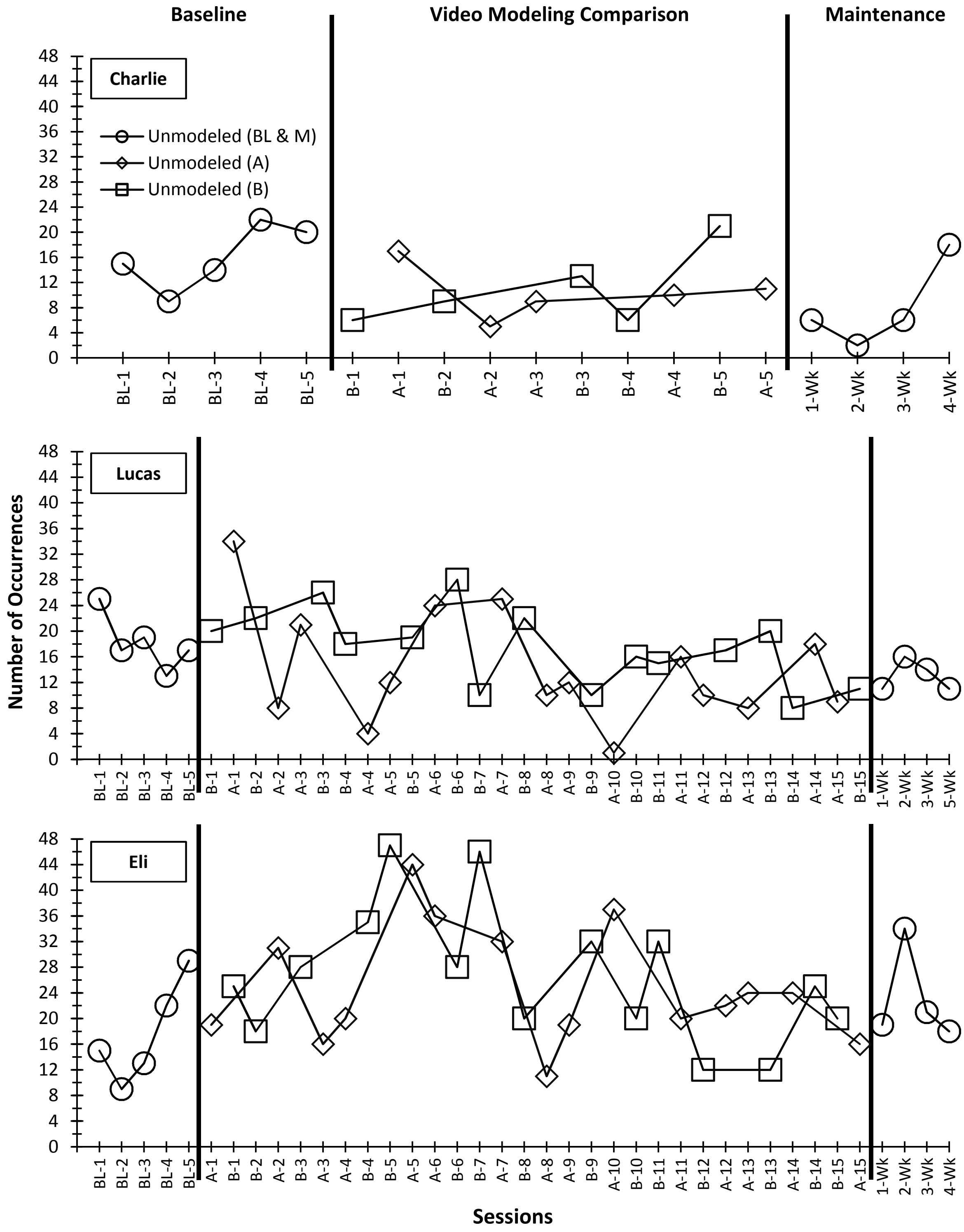

Figure 11. Number of total unmodeled play actions per session in the baseline, comparison (split between A- and B-sessions), and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Cumulative frequency of unique unmodeled play actions across sessions. For each participant, the cumulative frequency of unique unmodeled PAs across sessions in the baseline, video modeling comparison, and maintenance phases is shown in Figure 12. In the video modeling comparison phase, the cumulative frequency is graphed as one series with different data point symbols used to indicate A- versus B-sessions. The primary metric used for comparative analyses is the rate of increase in the cumulative frequency total from the previous session (i.e., cumulative frequency total for Session *"N"* minus the cumulative frequency total for Session *"N minus 1"* equals the rate of increase). Although there was no defined ceiling for the cumulative frequency maximum of unique unmodeled PAs, the rate of increase was expected to decrease over time as there became progressively fewer unique unmodeled PAs available from the entire set of "never-before-demonstrated" unique unmodeled PAs.

Charlie. Charlie demonstrated 112 total unique unmodeled PAs across the entire study. Across all baseline sessions, Charlie demonstrated 51 total unique unmodeled PAs, with an average rate of increase of 10.2 per baseline session. Across all video modeling comparison sessions, Charlie demonstrated 43 total unique unmodeled PAs. Across all A-sessions, he demonstrated 22 total unique unmodeled PAs, with an average rate of increase of 4.4 and across all B-sessions, he demonstrated 21 total unique unmodeled PAs with an average rate of increase of 4.2. In paired comparison sessions, Charlie demonstrated a higher rate of increase in A- than B-sessions in three of five (60%) sessions. Across all maintenance sessions, Charlie demonstrated 18 total unique unmodeled PAs, with an average rate of increase of 4.5 per maintenance session.

Lucas. Lucas demonstrated 128 total unique unmodeled PAs across the entire study. Across all baseline sessions, Lucas demonstrated 24 total unique unmodeled PAs, with an average rate of increase of 4.8 per baseline session. Across all video modeling comparison sessions, Lucas demonstrated 98 total unique unmodeled PAs. Across all A-sessions, he demonstrated 51 total unique unmodeled PAs, with an average rate of increase of 3.4 and across all B-sessions, he demonstrated 47 total unique unmodeled PAs with an average rate of increase of 3.1. In paired comparison sessions, Lucas demonstrated a higher rate of increase in A- than B-sessions in five of 15 (33%) sessions, a higher rate in B- than A-sessions in eight of 15 (53%) sessions, and an equal rate of increase in two of 15 (13%) of sessions. Across all maintenance sessions, Lucas demonstrated six total unique unmodeled PAs, with an average rate of increase of 1.5 per maintenance session.

Eli. Eli demonstrated 123 total unique unmodeled PAs across the entire study. Across all baseline sessions, Eli demonstrated 52 total unique unmodeled PAs, with an average rate of increase of 10.4 per baseline session. Across all video modeling comparison sessions, Eli demonstrated 67 total unique unmodeled PAs. Across all A-sessions, he demonstrated 36 total unique unmodeled PAs, with an average rate of increase of 2.4 and across all B-sessions, he demonstrated 31 total unique unmodeled PAs with an average rate of increase of 2.1. In paired comparison sessions, Eli demonstrated a higher rate of increase in A- than B-sessions in seven of 15 (47%) sessions, a higher rate in B- than A-sessions in six of 15 (40%) sessions, and an equal rate of increase in two of 15 (13%) of sessions. Across all maintenance sessions, Eli demonstrated four total unique unmodeled PAs, with an average rate of increase of 1.0 per maintenance session.

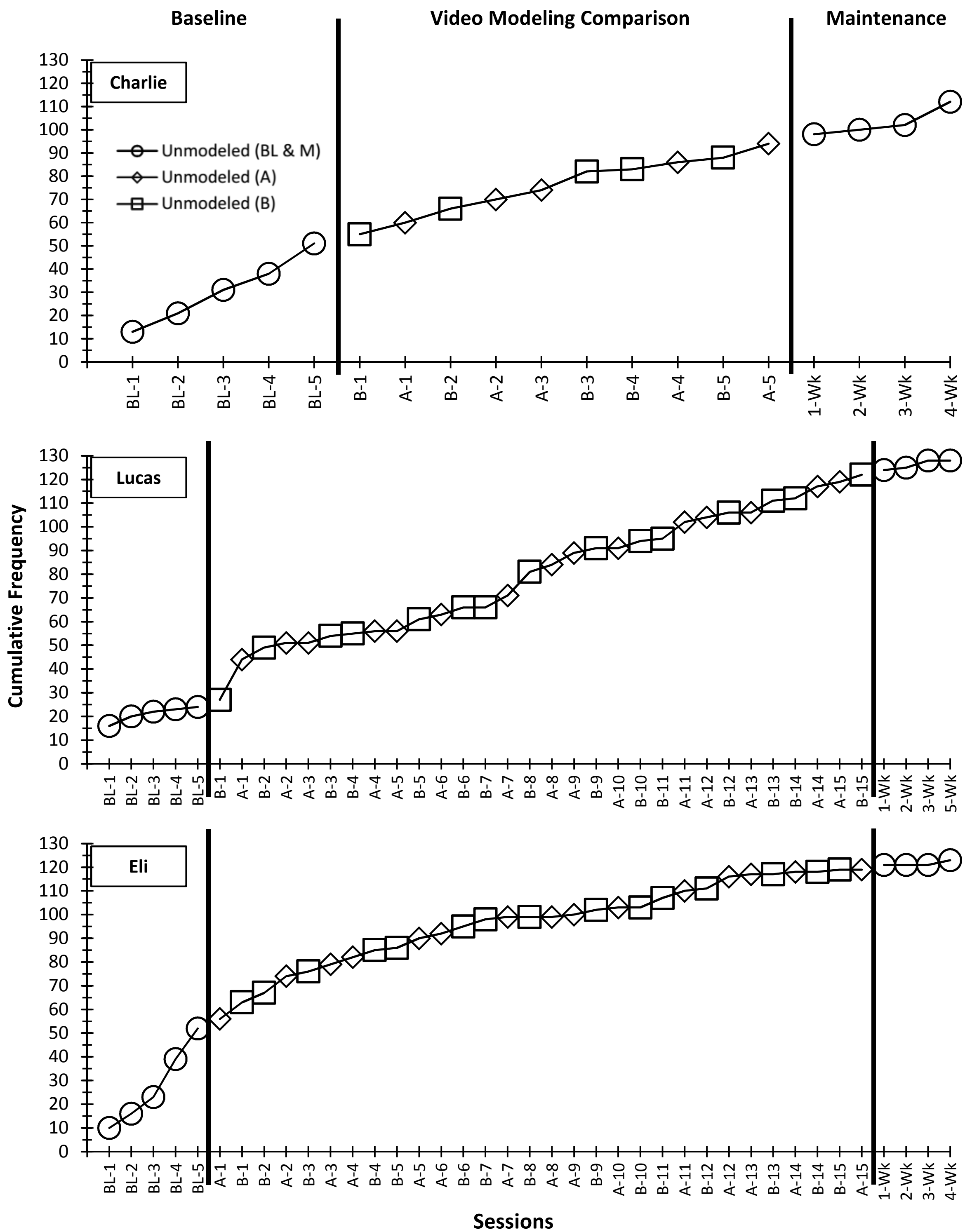

Figure 12. Cumulative frequency of unique unmodeled play actions across sessions in the baseline, comparison, and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Duration of Engagement in Play Actions

For each participant, the percentage of each session the child was engaged in PAs (modeled plus unmodeled) and the percentage of total PA engagement allocated to each type of PA (unmodeled, A-set, and B-set) in the baseline, video modeling comparison, and maintenance phases is shown in Figure 13. Percentage allocated to each type of PA was calculated by dividing the total duration the child was engaged in each type of PA by the total duration the child was engaged in PAs of all types and multiplying by 100. Therefore, the total percentage allocated to all three types equals 100% for each session. In the baseline phase, modeled play actions had not yet been introduced, so the percentage of total play action engagement allocated to unmodeled PAs equals 100% for all baseline sessions.

Charlie. In baseline, Charlie was engaged in PAs an average of 14% of the total duration of baseline sessions. In the video modeling comparison phase, he was engaged in PAs an average of 15% of the total duration of intervention sessions, a negligible increase of 1% from baseline. In comparing A- to B-sessions, Charlie's average total PA engagement in A-sessions was 13% and 17% in B-sessions, a slight difference of 4% in favor of Video Model B. In paired comparison sessions, Charlie's total engagement in PAs was higher in A- than B-sessions in one of five (20%) comparisons and higher in B- than A-sessions in four of five (80%) comparisons.

Across nine comparison phase sessions (excluding the first comparison phase session because the A-set was not introduced until the second comparison phase session), Charlie's average allocation of engagement in the comparison phase was 56%, 28%, and 16% for unmodeled, A-set, and, B-set PAs, respectively. Charlie engaged longer in unmodeled than A- or B-set PAs in five of nine (56%) comparison phase sessions, longer in A-set than unmodeled or B-set PAs in three of nine (33%) comparison phase sessions, and engaged equally in unmodeled and A-set PAs in one of nine (11%) comparison phase sessions. In paired comparisons of target sessions, Charlie allocated more of his total PA engagement to the A- than B-set in four of five (80%) paired target sessions and more to the B- than A-set in one of five (20%) paired target sessions. There was no differentiation between the A- and B-set in non-target sessions, because his engagement was 0% for each in all non-target sessions.

In the maintenance phase, Charlie was engaged in PAs an average of 22% of the total duration of maintenance sessions, an increase of 8% from baseline. His average allocation of engagement in the maintenance phase was 45%, 27%, and 28% for unmodeled, A-set, and B-set PAs, respectively. Charlie engaged longer in unmodeled than A- or B-set PAs in two of four (50%) maintenance sessions (one of which was the final maintenance session, in which his engagement in A- and B-set PAs was 0% for each), longer in A-set than unmodeled or B-set PAs in one of four (25%) of maintenance sessions, and longer in B-set than unmodeled or A-set PAs in one of four (25%) of maintenance sessions. Charlie allocated more of his total PA engagement to the A- than B-set in one of four (25%) maintenance sessions, more to the B- than A-set in two of four (50%) maintenance session, and the two sets were equal at 0% in the final maintenance session.

Lucas. In baseline, Lucas was engaged in PAs an average of 13% of the total duration of baseline sessions. In the video modeling comparison phase, he was engaged in PAs an average of 24% of the total duration of intervention sessions, an increase of 11% from baseline. In comparing A- to B-sessions, Lucas's average total PA engagement in A-sessions was 23% and 25% in B-sessions, a slight difference of 2% in favor of Video Model B. In paired comparison sessions, Lucas's total engagement in PAs was higher in A- than B-sessions in four of 15 (27%)

comparisons, higher in B- than A-sessions in eight of 15 (53%) comparisons, and equal in three of 15 (20%) comparisons.

Across 29 comparison phase sessions (excluding the first comparison phase session because the A-set was not introduced until the second comparison phase session), Lucas's average allocation of engagement in the comparison phase was 43%, 45%, and 12% for unmodeled, A-set, and, B-set PAs, respectively. Lucas engaged longer in unmodeled than A- or B-set PAs in 12 of 29 (41%) comparison phase sessions, longer in A-set than unmodeled or B-set PAs in 15 of 29 (52%) comparison phase sessions, longer in B-set than unmodeled or A-set PAs in one of 29 (3%) comparison phase sessions, and engaged equally in unmodeled and A-set PAs in one of 29 (3%) comparison phase sessions. In paired comparisons of target sessions, Lucas allocated more of his total PA engagement to the A- than B-set in 14 of 15 (93%) paired target sessions and an equal allocation amount to the A- and B-set in one of 15 (7%) paired target sessions. In paired comparisons of non-target sessions, Lucas allocated more of his total PA engagement to the A- than B-set in 13 of 14 (93%) paired non-target sessions more to the B- than A-set in one of 14 (7%) paired non-target sessions.

In the maintenance phase, Lucas was engaged in PAs an average of 26% of the total duration of maintenance sessions, an increase of 13% from baseline. His average allocation of engagement in the maintenance phase was 32%, 51%, and 17% for unmodeled, A-set, and B-set PAs, respectively. Lucas engaged longer in unmodeled than A- or B-set PAs in one of four (25%) maintenance sessions and longer in A-set than unmodeled or B-set PAs in three of four (75%) of maintenance sessions. Lucas allocated more of his total PA engagement to the A- than B-set in all four (100%) maintenance sessions.

Eli. In baseline, Eli was engaged in PAs an average of 28% of the total duration of baseline sessions. In the video modeling comparison phase, he was engaged in PAs an average of 35% of the total duration of intervention sessions, an increase of 7% from baseline. In comparing A- to B-sessions, Eli's average total PA engagement in A-sessions was 33% and 36% in B-sessions, a slight difference of 3% in favor of Video Model B. In paired comparison sessions, Eli's total engagement in PAs was higher in A- than B-sessions in six of 15 (40%) comparisons and higher in B- than A-sessions in nine of 15 (60%) comparisons.

Across 29 comparison phase sessions (excluding the first comparison phase session because the B-set was not introduced until the second comparison phase session), Eli's average allocation of engagement in the comparison phase was 88%, 2%, and 10% for unmodeled, A-set, and, B-set PAs, respectively. Eli engaged longer in unmodeled than A- or B-set PAs in all 29 (100%) comparison phase sessions. In paired comparisons of target sessions, Eli allocated more of his total PA engagement to the A- than B-set in 2 of 15 (13%) paired target sessions, more to the B- than A-set in 11 of 15 (73%) paired target sessions, and was at 0% engagement for both the A- and B-set in 2 of 15 (13%) paired target sessions. In paired comparisons of non-target sessions, Eli allocated more of his total PA engagement to the A- than B-set in 1 of 14 (7%) paired non-target sessions, more to the B- than A-set in 9 of 14 (64%) paired non-target sessions and was at 0% engagement for both the A- and B-set in 4 of 15 (29%) paired non-target sessions.

In the maintenance phase, Eli was in engaged in PAs an average of 33% of the total duration of maintenance sessions, an increase of 5% from baseline. His average allocation of engagement in the maintenance phase was 82%, 12%, and 6% for unmodeled, A-set, and B-set PAs, respectively. Eli engaged longer in unmodeled than A- or B-set PAs in all four (100%) maintenance sessions. Eli allocated more of his total PA engagement to the A- than B-set in three of four (75%) maintenance sessions and more to the B- than A-set in one of four (25%) maintenance sessions.

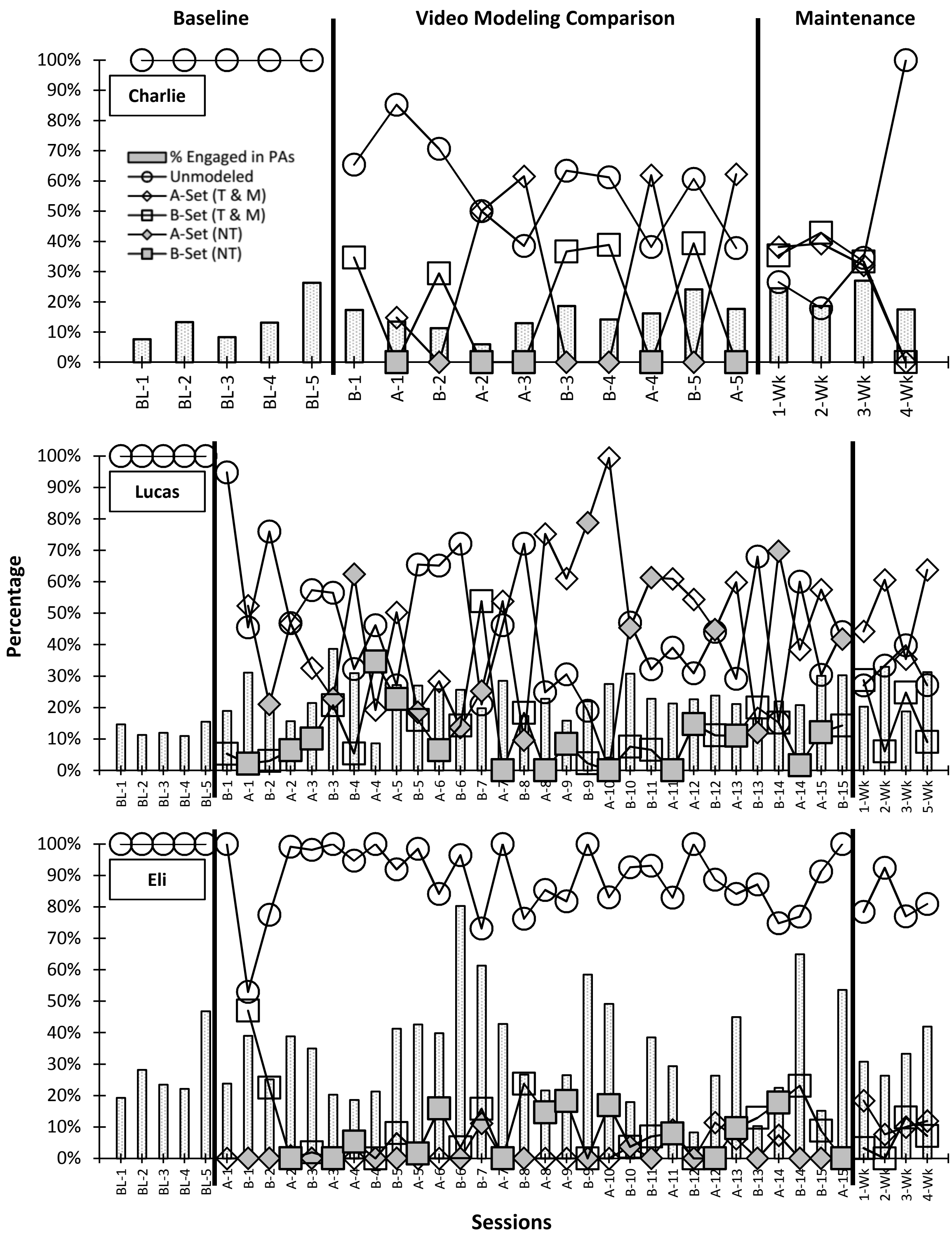

Figure 13. Percentage of total session engaged in play actions (bars) and percentage of total play action engagement allocated to unmodeled and modeled A- and B-set play actions (non-target sessions gray-filled) in the baseline, comparison, and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Play Narrations

Narrated play actions. For each participant, the percentage and number of unmodeled and modeled A- and B-set PAs that were narrated in the baseline, video modeling comparison, and maintenance phases is shown in Figure 14. Missing data points indicate that there were no PAs of that particular type demonstrated for that particular session; therefore, there were no opportunities for PNs to occur.

Charlie. In baseline, Charlie demonstrated an average of 7.0 narrated PAs per session. Across all baseline sessions, 44% (35 of 80) of all PAs demonstrated were narrated. In the video modeling comparison phase, Charlie demonstrated an average of 4.8 narrated PAs in A-sessions (a decrease of 2.2 from baseline) and 10.0 narrated PAs in B-sessions (an increase of 3.0 from baseline). Across all A-sessions, 29% (24 of 83) of PAs of all types and across all B-sessions, 53% (50 of 95) of PAs of all types were narrated. Per PA type by session type, Charlie narrated 40% (21 of 52) of unmodeled PAs and 10% (3 of 31) of modeled A-set PAs in A-sessions and he narrated 45% (25 of 55) of unmodeled PAs and 83% (33 of 40) of B-set PAs in B-sessions. In comparing paired target sessions, Charlie narrated a higher percentage of B- than A-set PAs in three of five (60%) paired target sessions and an equal percentage (100%) of narrated A- and B-set PAs in two of five (40%) paired target sessions. He narrated a higher percentage of unmodeled PAs in A- than B-sessions in two of five (40%) paired sessions and a higher percentage in B- than A-sessions in three of five (60%) paired sessions. Comparisons of narrated A- and B-set PAs in non-target sessions cannot be made because he never demonstrated any A- or B-set PAs in non-target sessions.

In the maintenance phase, Charlie demonstrated an average of 5.8 narrated PAs per session (a decrease of 1.2 from baseline), with 31% (23 of 75) of PAs of all types narrated. Per

PA type, Charlie narrated 0% (0 of 32) of unmodeled PAs, 5% (1 of 20) of A-set PAs, and 100% (23 of 23) B-set PAs across all maintenance sessions. Charlie narrated a higher percentage of B- than A-set PAs in three of three (100%) maintenance sessions in which there were opportunities for narrated play actions to occur for both A- and B-set PAs (a comparison could not be made for the final maintenance session because he did not demonstrate any modeled PAs of either type).

Lucas. Across all sessions in all phases, Lucas demonstrated one narrated PA for the entirety of the study. This narrated play action occurred in the third baseline session, thus resulting in an average of 0.2 narrated PAs per baseline session and 1% (one of 91) of all baseline PAs narrated.

Eli. Across all sessions in baseline, Eli demonstrated one narrated PA, which made the baseline average 0.2 narrated PAs per session and 1% (one of 88) of all baseline PAs narrated. In the video modeling comparison phase, Eli demonstrated an average of 3.9 narrated PAs in A-sessions (an increase of 3.7 from baseline) and 6.7 narrated PAs in B-sessions (an increase of 6.5 from baseline). Across all A-sessions, 15% (59 of 403) of PAs of all types and across all B-sessions, 22% (100 of 446) of PAs of all types were narrated. Per PA type by session type, Eli narrated 11% (40 of 371) of unmodeled PAs and 11% (one of nine) of modeled A-set PAs in A-sessions and he narrated 17% (67 of 400) of unmodeled PAs and 78% (32 of 41) of B-set PAs in B-sessions. In comparing paired target sessions in which there were opportunities for narrated play actions to occur for both A- and B-set PAs, Eli narrated a higher percentage of B- than A-set PAs in four of four (100%) paired target sessions. He narrated a higher percentage of unmodeled PAs in A- than B-sessions in five of 15 (33%) paired sessions, a higher percentage in B- than A-sessions in 9 of 15 (60%) paired sessions and an equal percentage in one of 15 (7%) paired sessions. There was one paired set of non-target sessions in which there were opportunities for narrated PAs to occur for both A- and B-set PAs, and for this pair, Eli narrated a higher percentage of B- than A-set PAs.

In the maintenance phase, Eli demonstrated an average of 4.5 narrated PAs per session (an increase of 4.3 from baseline), with 17% (18 of 106) of PAs of all types narrated. Per PA type, Eli narrated 16% (15 of 92) of unmodeled PAs, 0% (0 of nine) of A-set PAs, and 60% (three of five) B-set PAs across all maintenance sessions. Eli narrated a higher percentage of B- than A-set PAs in three of three (100%) maintenance sessions in which there were opportunities for narrated play actions to occur for both A- and B-set PAs (a comparison could not be made for the second maintenance session because he did not demonstrate any B-set PAs).

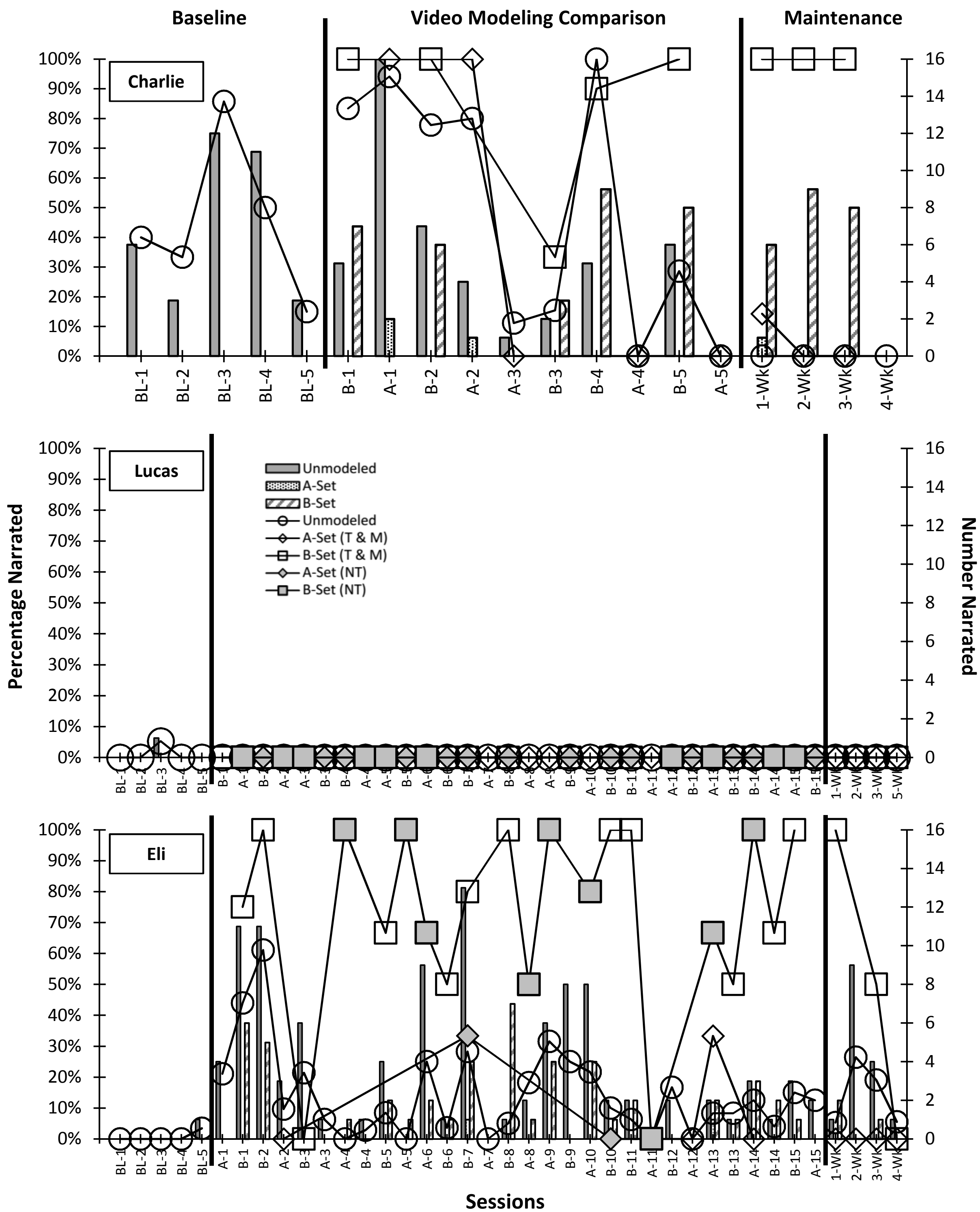

Figure 14. Percentage (lines; values graphed on primary Y-axis) and number (bars; values graphed on secondary Y-axis) of unmodeled and modeled A- and B-set play actions (non-target sessions gray-filled) that were narrated in the baseline, comparison, and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Usage of modeled and unmodeled play narrations. For each participant, usage of modeled and unmodeled PNs within each session is summarized in Table 11. Unmodeled PNs were measured through all three phases of the study. Measurement of modeled PNs (i.e., those targeted by Video Model B) began upon the introduction of Video Model B in the comparison phase. Modeled PNs were classified into three different subtypes based on the type of PA with which they were used: (a) corresponding PNs were those used to narrate the same PAs with which they were targeted in Video Model B (see Table 7 for an example), (b) transferred PNs were those used to narrate any PAs other than the PAs with which they were targeted in Video Model B, and (c) PNs used as a form of delayed echolalia were those that occurred in the absence of any concurrent PA or other appropriate play. Modeled PNs were then classified into three different subtypes based on their content: (a) complete imitations were those in which 100% of words provided by the model were imitated, (b) partial imitations with substitutions were those in which greater than 50% of words provided by the model were imitated and at least one additional word not provided by the model was included in the PN, and (c) partial imitations without substitutions were those in which greater than 50% of words provided by the model were imitated an no additional words were included in the PN.

Table 11
Usage of Play Narrations

	Charlie				
	BL	VM Comparison		Maintenance	
Type of Play Narration	Avg. (Total)	Avg. (Total)	Change	Avg. (Total)	Change
Unmodeled	7.0 (35)	4.2 (42)	-2.8	0 (0)	-4.2
Modeled-Corresponding	---	3.2 (32)	---	5.8 (23)	+2.6
Complete	---	2.5 (25)	---	5.8 (23)	+3.3
Partial w/ substitutions	---	0.6 (6)	---	0 (0)	-0.6
Partial w/o substitutions	---	0.1 (1)	---	0 (0)	-0.1
Modeled-Transferred	---	0.8 (8)	---	0.3 (1)	-0.5
Complete	---	0 (0)	---	0 (0)	---
Partial w/ substitutions	---	0.8 (8)	---	0.3 (1)	-0.5
Partial w/o substitutions	---	0 (0)	---	0 (0)	---
Delayed Echolalia	---	0.1 (1)	---	0 (0)	-0.1

Table 11, cont.

	Lucas				
	BL	VM Comparison		Maintenance	
Type of Play Narration	Avg. (Total)	Avg. (Total)	Change	Avg. (Total)	Change
Unmodeled	0.2 (1)	0 (0)	-0.2	0 (0)	---
Modeled-Corresponding	---	0 (0)	---	0 (0)	---
Complete	---	0 (0)	---	0 (0)	---
Partial w/ substitutions	---	0 (0)	---	0 (0)	---
Partial w/o substitutions	---	0 (0)	---	0 (0)	---
Modeled-Transferred	---	0 (0)	---	0 (0)	---
Complete	---	0 (0)	---	0 (0)	---
Partial w/ substitutions	---	0 (0)	---	0 (0)	---
Partial w/o substitutions	---	0 (0)	---	0 (0)	---
Delayed Echolalia	---	0 (0)	---	0 (0)	---

Table 11, cont.

	Eli				
	BL	VM Comparison		Maintenance	
Type of Play Narration	Avg. (Total)	Avg. (Total)	Change	Avg. (Total)	Change
Unmodeled	0.2 (1)	0.9 (28)	+0.7	1.0 (4)	+0.1
Modeled-Corresponding	---	1.6 (45)	---	0.8 (3)	-0.8
Complete	---	1.2 (36)	---	0.8 (3)	-0.4
Partial w/ substitutions	---	0.2 (5)	---	0 (0)	-0.2
Partial w/o substitutions	---	0.1 (4)	---	0 (0)	-0.1
Modeled-Transferred	---	3.0 (86)	---	2.8 (11)	-0.2
Complete	---	1.9 (55)	---	2.5 (10)	+0.6
Partial w/ substitutions	---	0.8 (22)	---	0 (0)	-0.8
Partial w/o substitutions	---	0.3 (9)	---	0.3 (1)	0
Delayed Echolalia	---	0.4 (12)	---	0 (0)	-0.1

Note: Avg. = average usage rate per session across all sessions within the phase. Change = change in average rate from previous phase.

Charlie. From baseline to intervention, Charlie's average usage rate of unmodeled PNs declined from 7.0 per baseline session to 4.2 per intervention session, a decrease of 2.8. In the maintenance phase, Charlie demonstrated zero unmodeled PNs, leading to a further decline in average usage rate from 4.2 per intervention session to 0 in maintenance and an overall decline of 7.0 from baseline to maintenance. In the comparison phase, Charlie demonstrated an average of 3.2 corresponding modeled PNs per intervention session. Seventy-eight percent (25 of 32) of corresponding modeled PNs used in intervention sessions were complete imitations, 19% (6 of 32) were partial imitations with substitutions, and 3% (1 of 32) were partial imitations without substitutions.

In the maintenance phase, Charlie's average usage rate of corresponding modeled PNs increased to 5.8 per maintenance session, an increase of 2.6 from intervention. In the maintenance phase, 100% (23 of 23) of corresponding modeled PNs used were complete imitations. Charlie demonstrated a total of eight transferred modeled PNs in the comparison phase, an average rate of 0.8 per intervention session. All eight (100%) transferred modeled PNs used were partial imitations with substitutions. In the maintenance phase, Charlie demonstrated one instance of a transferred modeled PN, also a partial imitation with substitutions. Across all intervention and maintenance sessions, Charlie had one instance of using a modeled PN as a form of delayed echolalia, which occurred during the comparison phase.

Lucas. Across the entirety of the study, Lucas had one instance of using any PN of any kind, which was an unmodeled PN that he demonstrated in the baseline phase.

Eli. From baseline to intervention, Eli's average usage rate of unmodeled PNs increased from 0.2 per baseline session (one instance) to 0.9 per intervention session, an increase of 0.7. In the maintenance phase, Eli used an average of 1.0 (four total) unmodeled PNs per session, which was an increase of 0.1 from the comparison phase, and an overall increase of 0.8 from baseline to maintenance. In the comparison phase, Eli demonstrated an average of 1.6 corresponding modeled PNs per intervention session. Eighty percent (36 of 45) of corresponding modeled PNs used in intervention sessions were complete imitations, 11% (five of 45) were partial imitations with substitutions, and 9% (4 of 45) were partial imitations without substitutions. In the maintenance phase, Eli's average usage rate of corresponding modeled PNs decreased to 0.8 per maintenance session, a decrease of 0.8 from intervention. In the maintenance phase, 100% (three of three) of corresponding modeled PNs used were complete imitations. In the comparison phase, Eli's average usage rate of transferred modeled PNs was 3.0 per intervention session. Of these, 64% (55 of 86) were complete imitations, 26% (22 of 86) were partial imitations with substitutions, and 10% (nine of 86) were partial imitations without substitutions.

In the maintenance phase, Eli had an average usage rate of 2.8 transferred modeled PNs per maintenance session, a decrease of 0.2 from the comparison phase. Ninety-one percent of these (10 of 11) were complete imitations and 9% (1 of 11) were partial without substitutions. In the comparison phase, Eli had 12 total instances of using modeled PNs as a form of delayed echolalia, an average usage rate of 0.4 per intervention session. He did not have any instances of delayed echolalia in the maintenance phase.

Attention to Video Models

For each participant, attention to Video Models A and B in conjunction with total number of occurrences of A- and B-set PAs in target sessions (split to show unique and repeat occurrences) in the video modeling comparison phase is shown in Figure 15.

Charlie. Charlie did not show any clear differentiation in his attention to Video Model A versus B, as both were near ceiling levels. For Video Model A, his average attention to the video model was 98% and for Video Model B, his average attention to the video model was 96%. After the first two sets of paired target sessions, there was also little to no differentiation in his demonstration of A- versus B-set PAs.

Lucas. Lucas was also near ceiling levels in his attention to the video models, averaging 96% attention to Video Model A and 94% attention to Video Model B. Despite his attention data being near ceiling levels, there might be some discernable differentiation between the two video models. In paired comparisons, Lucas attended more to Video Model A than B in 11 of 15 (73%) paired viewings and more to Video Model B than A in 4 of 15 (27%) paired viewings. There was a slight decreasing trend in his attention to Video Model B over time. For the first five, middle five, and last five B-sessions, Lucas's average attention to Video Model B was 98%, 93%, and 90%, respectively, which is an 8% decrease from the first to the last five B-sessions. In comparison, his attention to Video Model A for the first five, middle five, and last five A-sessions was 98%, 97%, and 94%, respectively, which is a 4% decrease from the first to the last five A-sessions. In A-sessions, Lucas demonstrated an average of 4.1 unique and 6.9 total occurrences of A-set PAs as compared to an average of 2.6 unique and 3.3 total occurrences of B-set PAs in B-sessions. When broken down into averages for the first, middle, and last five A-sessions, Lucas demonstrated an average of 3.4, 4.8, and 4.0 unique and 6.0, 8.0, and 6.8 total A-set PAs. For first, middle, and last five B-sessions, Lucas demonstrated an average of 1.8, 3.0, and 3.0 unique and 2.0, 4.4, and 3.6 total B-set PAs.

Eli. Eli had lower average attention to both video models than Charlie or Lucas, averaging 58% attention to Video Model A and 66% attention to Video Model B, an 8% difference in favor of Video Model B. In paired comparisons, Eli attended more to Video Model A than B in six of 14 (43%) paired viewings and more to Video Model B than A in eight of 14 (43%) paired viewings. Please note, there were 15 paired viewings, but attention data was not available for the A-6 session because of a webcam recording error. There was a decreasing trend in Eli's attention to Video Model B over time. For the first five, middle five, and last five B-sessions, Eli's average attention to Video Model B was 69%, 71%, and 57%, respectively, which is an 12% decrease from the first to the last five B-sessions. In comparison, his attention to Video Model A for the first five, middle five (excluding A-6), and last five A-sessions was 60%, 57%, and 58%, respectively, a 2% decrease from the first to the last five A-sessions. In A-sessions, Eli demonstrated an average of 0.6 unique and 0.6 total occurrences of A-set PAs as compared to an average of 1.9 unique and 2.7 total occurrences of B-set PAs in B-sessions. When broken down into averages for the first, middle, and last five A-sessions, Eli demonstrated an average of 0.2, 0, and 1.6 unique and 0.2, 0, and 1.6 total A-set PAs. For first, middle, and last five B-sessions, Eli demonstrated an average of 2.0, 2.2, and 1.4 unique and 3.4, 3.0, and 1.6 total B-set PAs.

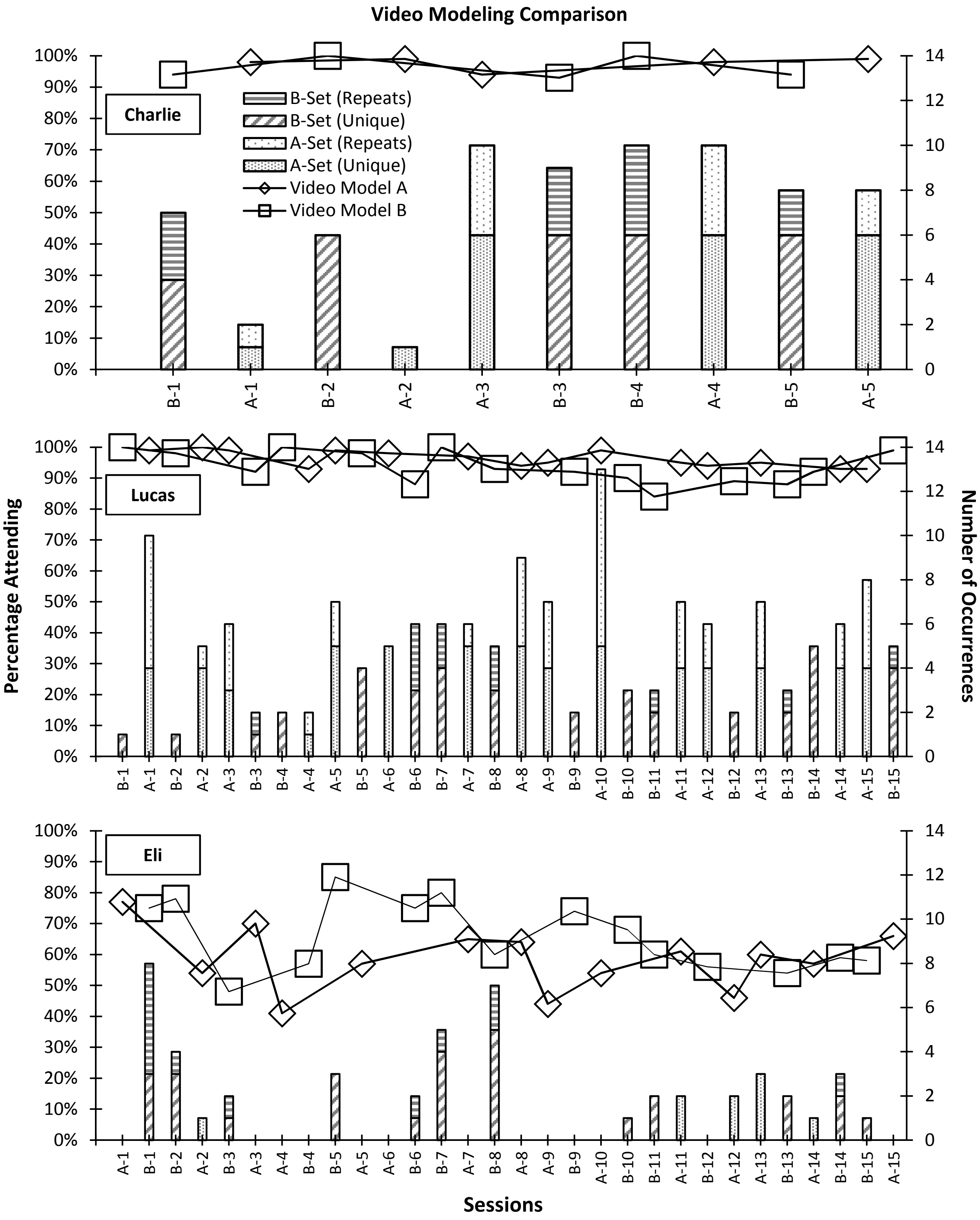

Figure 15. Percentage of attention to Video Models A and B (lines; values graphed on primary Y-axis) and number of total occurrences of A- and B-set play actions in target sessions (stacked bars split into unique and repeat occurrences; values graphed on secondary Y-axis) in the video modeling comparison phase for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Summary of Comparison Data

A summary of data reported in these results comparing the Video Model A to the Video Model B intervention is provided in Table 12.

Table 12
Comparison Data of Video Models A and B

Session Type / Comparison Metric	Charlie VM-A / A-set	Charlie VM-B / B-set
Target Sessions		
Sessions to criteria	5	4
Cumulative frequency of unique PAs across all sessions	6	6
Number of sessions to attain cumulative frequency unique total	3	2
Average # of unique occurrences per session	4.0	5.6
% of paired comparisons with more unique occurrences	0%	40%
Average # of total occurrences per session	6.2	8.0
% of paired comparisons with more total occurrences	20%	40%
Average % of duration engaged allocated to PAs of its type	50%	36%
% of PAs of its type that were narrated	10%	83%
Average % attention to video models	98%	96%
Non-Target Sessions		
Cumulative frequency of unique PAs across all sessions	0	0
Number of sessions to attain cumulative frequency unique total	---	---
Average # of unique occurrences per session	0	0
% of paired comparisons with more unique occurrences	0%	0%
Average # of total occurrences per session	0	0
% of paired comparisons with more total occurrences	0%	0%
Average % of duration engaged allocated to PAs of its type	0%	0%
% of PAs of its type that were narrated	n/o	n/o
Maintenance Sessions		
Cumulative frequency of unique PAs across all sessions	6	6
Number of sessions to attain cumulative frequency unique total	1	1
Average # of unique occurrences per session	4.5	4.5
% of paired comparisons with more unique occurrences	0%	0%
Average # of total occurrences per session	5.0	5.8
% of paired comparisons with more total occurrences	25%	50%
Average % of duration engaged allocated to PAs of its type	27%	28%
% of PAs of its type that were narrated	5%	100%

Table 12, cont.

Session Type Comparison Metric	Lucas	
	VM-A / A-set	VM-B / B-set
Target Sessions		
Sessions to criterion	---	---
Cumulative frequency of unique PAs across all sessions	6	6
Number of sessions to attain cumulative frequency unique total	2	13
Average # of unique occurrences per session	4.1	2.6
% of paired comparisons with more unique occurrences	80%	13%
Average # of total occurrences per session	6.9	3.3
% of paired comparisons with more total occurrences	80%	7%
Average % of duration engaged allocated to PAs of its type	53%	15%
% of PAs of its type that were narrated	0%	0%
Average % attention to video models	96%	94%
Non-Target Sessions		
Cumulative frequency of unique PAs across all sessions	6	5
Number of sessions to attain cumulative frequency unique total	2	15
Average # of unique occurrences per session	3.4	1.5
% of paired comparisons with more unique occurrences	79%	21%
Average # of total occurrences per session	5.6	2.0
% of paired comparisons with more total occurrences	86%	14%
Average % of duration engaged allocated to PAs of its type	38%	9%
% of PAs of its type that were narrated	0%	0%
Maintenance Sessions		
Cumulative frequency of unique PAs across all sessions	6	5
Number of sessions to attain cumulative frequency unique total	2	3
Average # of unique occurrences per session	4.3	3.0
% of paired comparisons with more unique occurrences	75%	25%
Average # of total occurrences per session	6.5	4.3
% of paired comparisons with more total occurrences	75%	25%
Average % of duration engaged allocated to PAs of its type	51%	17%
% of PAs of its type that were narrated	0%	0%

Table 12, cont.

Session Type Comparison Metric	Eli	
	VM-A / A-set	VM-B / B-set
Target Sessions		
Sessions to criterion	---	---
Cumulative frequency of unique PAs across all sessions	3	6
Number of sessions to attain cumulative frequency unique total	11	7
Average # of unique occurrences per session	0.6	1.9
% of paired comparisons with more unique occurrences	13%	67%
Average # of total occurrences per session	0.6	2.7
% of paired comparisons with more total occurrences	13%	67%
Average % of duration engaged allocated to PAs of its type	2%	12%
% of PAs of its type that were narrated	11%	83%
Average % attention to video models	58%	66%
Non-Target Sessions		
Cumulative frequency of unique PAs across all sessions	2	5
Number of sessions to attain cumulative frequency unique total	7	9
Average # of unique occurrences per session	0.2	1.4
% of paired comparisons with more unique occurrences	7%	64%
Average # of total occurrences per session	0.3	1.6
% of paired comparisons with more total occurrences	7%	64%
Average % of duration engaged allocated to PAs of its type	1%	8%
% of PAs of its type that were narrated	20%	74%
Maintenance Sessions		
Cumulative frequency of unique PAs across all sessions	3	4
Number of sessions to attain cumulative frequency unique total	1	3
Average # of unique occurrences per session	2.0	1.3
% of paired comparisons with more unique occurrences	50%	25%
Average # of total occurrences per session	2.3	1.3
% of paired comparisons with more total occurrences	50%	0%
Average % of duration engaged allocated to PAs of its type	12%	6%
% of PAs of its type that were narrated	0%	60%

Note: VM-A = Video Model A; VM-B = Video Model B. The maximum cumulative frequency of unique PAs that can be demonstrated is 6 for each set.

CHAPTER IV

DISCUSSION

The research questions under investigation in this study were:

1. Can identified recommended practices, practices based on the principles of observational learning, and practices for which more research is needed for video modeling interventions be incorporated into the study procedures?
2. Is video modeling effective for teaching toy play actions to children with ASD who demonstrate delayed echolalia?
3. Is video modeling effective for teaching corresponding toy play narrations to children with ASD who demonstrate delayed echolalia?
4. What are the relative effects of video modeling with versus without modeled toy play narrations on modeled and unmodeled toy play actions and what are the relative changes in unmodeled toy play actions from baseline to intervention?
5. What are the relative effects of video modeling with versus without modeled toy play narrations on narration of modeled and unmodeled toy play actions and what are the relative changes in usage of modeled and unmodeled toy play narrations?
6. What are the relative associations between child attention to video models with versus without modeled toy play narrations and frequencies of modeled toy play actions?
7. What are the relative maintenance effects of video modeling with versus without modeled toy play narrations upon withdrawal of the video modeling interventions?

A discussion of findings related to these research questions follows, organized by research question in the order listed above. Following the discussion of findings, limitations of the current study, implications for future research and practice, and conclusions are discussed.

Discussion of Findings

Research Question #1: Can identified recommended practices, practices based on the principles of observational learning, and practices for which more research is needed for video modeling interventions be incorporated into the study procedures? Based on a review of research of video modeling interventions for children with ASD (i.e., Busick, 2010), practices identified as recommended, practices based on the principles of observational learning, and one practice in need of more research were incorporated into the study procedures. The identified recommended practices and practices based on the principles of observational learning incorporated into the study were: (a) assessing and ensuring that children included in the study had related imitation skills (an identified recommended practice and based on principles of observational learning), (b) assessing and ensuring that children were able to retain the modeled behaviors (based on principles of observational learning), (c) ensuring that children attended to video models when watched (an identified recommended practice and based on principles of observational learning), (d) including features that promote child motivation (based on principles of observational learning), (e) teaching behavior sets that included at least six unique behaviors in each set (an identified recommended practice), and (f) providing children with consecutive viewings of video models before target sessions (an identified recommended practice). The practice in need of more research that was specifically targeted by this study was the inclusion of children who demonstrated delayed echolalia with screen media.

Despite the obvious relation between imitation ability and video modeling, few published studies have incorporated direct assessment of imitation into their study procedures. A review by Lindsay and colleagues (2013) found only six examples of published studies that directly assessed imitation prior to the introduction of the video modeling intervention. In this study, three direct assessments were conducted to ensure that each child included in the study had related imitation skills in their repertoire: (a) the *Mullen Scales of Early Learning* (Mullen, 1995) to assess developmental age, (b) the object imitation subscale of the *Motor Imitation Scale* (Stone, Ousley, & Littleford, 1997) to assess motor imitation, and (c) a play-based assessment to assess verbal imitation. The criterion level for developmental age was set at a developmental age equivalent of 24 months. This level was selected because it is at or near the end of the age range at which most children are capable of deferred imitation (e.g., Meltzoff, 1985; Piaget, 1962), meaning they would be able to retain the modeled behaviors. All three children included in the study tested above the developmental age criterion level: Charlie (chronological age: 8.1 years) tested at the ceiling level of the Mullen, meaning his developmental age equivalent was above 5.7 years, Lucas's (chronological age: 4.1 years) developmental age was estimated at 3.6 years, and Eli's (chronological age: 4.3 years) developmental age was estimated at 2.5 years. The criterion level for the object imitation subscale of the MIS was set at a score of 12 (out of 16), and all three children recorded scores at 100% (16 of 16) on this assessment. For the verbal imitation assessment, children were required to correctly imitate 70% (7 of 10) of play narrations provided. Charlie, Lucas, and Eli correctly imitated 100%, 90%, and 90% of play narrations provided, respectively. Therefore, the practices of assessing and ensuring that children included in the study (a) had related imitation skills and (b) were able to retain the modeled behaviors were incorporated into the study procedures.

Two procedural steps were built into the study to ensure that children attended to the video models when watched: (a) prompting children to attend to the video models if they diverted their attention and (b) recording and measuring child attention to video models. Procedural fidelity was measured to assess the interventionist's implementation of the prompting procedure. However, across all sessions assessed for procedural fidelity, there was only one opportunity that required the use of this procedure (for Eli), and the prompting procedure was correctly implemented in this one instance. Anecdotally speaking, the prompting procedure was required and used with all three children to varying degrees, and most of all with Eli, who had the lowest levels of attention to the video model. However, for all three children, in most cases in which they diverted their attention, opportunities that required prompts did not occur because the child self-directed his attention back to the video model before a prompt was required (based on the prompt delivery rules). Evidence of this anecdotal report is supported by each child's average duration of inattention per occurrence (i.e., when a child diverted his attention, for how long did he do so). Charlie's average duration of inattention per occurrence was 1.5 s, Lucas's average duration of inattention per occurrence was 1.4 s, and Eli's average duration of inattention per occurrence was 2.8 s. Child attention to the video models when viewed was recorded using the embedded webcam of the laptop computer on which the video models were shown. These recordings were then used to measure the duration each child attended to the video model (expressed as a percentage of the total duration length of the video model). Both Charlie (*M* for Video Model A = 98%; *M* for Video Model B = 96%) and Lucas (*M* for Video Model A = 96%; *M* for Video Model B = 94%) had near-ceiling average levels of attention to the video models, whereas Eli (*M* for Video Model A = 58%; *M* for Video Model B = 66%) had more variability and lower levels in his attention to the video models. Therefore, procedural steps were successfully incorporated into the study to promote and measure child attention to the video, with infrequent opportunities that required the use of the prompting strategy and measurement of attention to the video models that allowed for the analysis of associations between child attention and the primary dependent measures.

Procedural steps for implementation of the video modeling interventions included showing each video model two consecutive times prior to each measurement session. Procedural fidelity data show that that this procedural step was implemented with 100% correct implementation for all three children.

For each child, the researcher solicited the parent's input to identify a target toy set that the child would likely be interested in and motivated to play with. Two behavior sets of six unique modeled play actions per set were targeted by the video modeling interventions. For the Video Model B intervention, a set of six unique modeled play narrations were targeted in conjunction with the six target play actions. To further promote child motivation, the three most-played-with toy figures in the baseline phase were used to demonstrate all modeled play actions (two play actions per figure per set). To promote equivalence between the two sets, play actions were also matched in pairs based on toy figure used, form, function, and response requirements, then randomly assigned to either set. Establishing equivalent behavior sets aimed to protect against the child being differentially motivated by one set of play actions over the other. Therefore, the practices of (a) using motivating toy sets and modeling play actions using motivating toy figures, (b) teaching behavior sets that included at least six unique behaviors in each set were incorporated into the study procedures.

This study was designed in large part to investigate a specific practice that was identified as one in need of more research: specifically targeting children with ASD who demonstrate delayed echolalia for a video modeling intervention. The investigation of this practice was based on the hypothesis that delayed echolalia as a child characteristic and video modeling as an intervention might be a particularly well-suited match. Findings related to this hypothesis are discussed in subsequent sections of other research questions. Delayed echolalia was assessed via parent report using the researcher-designed echolalia and imitation questionnaire (see Appendix D). The criteria for inclusion in the study was that the parent had to (a) report that the child demonstrated delayed echolalia (delay of at least 1 min) of screen media at least once a day and (b) give at least one specific example of a phrase that the child imitated as a form of delayed echolalia. All three parents reported that their children demonstrated delayed echolalia several times a day and that they would continue to imitate phrases from screen media many months after first hearing them. However, since parent report was used in lieu of direct assessment, the presence, frequency, and functions of delayed echolalia were not confirmed observationally, which is a limitation of the study.

Research Question #2: Is video modeling effective for teaching toy play actions to children with ASD who demonstrate delayed echolalia? For each child, two video modeling interventions were used to teach two sets of six unique toy play actions (12 total unique toy play actions targeted for each child).

Charlie. Of the three children in the study, Charlie was the only child to reach the mastery criteria (100% of target modeled play actions demonstrated within the target session for three consecutive target sessions) for both target sets. He reached the mastery criteria for the A-set in the fifth A-session and he reached the mastery criteria for the B-set in the fourth B-session. By the end of the third A-session, he had demonstrated all six toy play actions in the A-set at least once and by the end of the second B-session, he had demonstrated all six toy play actions in the B-set at least once (see Figure 2 for cumulative frequencies across sessions).

Lucas. Lucas did not reach the mastery criteria for either target set of toy play actions. However, he did demonstrate all six toy play actions from each set at least once during the intervention phase. By the end of the second A-session, he had demonstrated all six toy play actions in the A-set at least once and by the end of the thirteenth B-session, he had demonstrated all six toy play actions in the B-set at least once.

Eli. Eli did not reach the mastery criteria for either target set of toy play actions. But he did demonstrate all six toy play actions from the B-set at least once during the intervention phase, which he attained by the end of the seventh B-session. For the A-set, he only demonstrated three of six toy play actions at least once during the intervention phase, a level which he attained by the end of the eleventh A-session.

Overall findings. Across all three children in the study, two of six (33%) target sets of toy play actions were demonstrated at the mastery criteria level (both by Charlie). Of 36 total toy play actions that were targeted by the video modeling interventions, 33 (92%) were demonstrated at least once in the intervention phases. The three that were never demonstrated were all A-set PAs for Eli. This level of acquisition supports the overall effectiveness of video modeling for teaching toy play actions to children with ASD who demonstrate delayed echolalia.

Research Question #3: Is video modeling effective for teaching corresponding toy play narrations to children with ASD who demonstrate delayed echolalia? For each child, one of the two video modeling interventions (Video Model B) included corresponding play narrations that were modeled concurrently with target play actions (B-set).

Charlie. In the intervention phase, Charlie narrated all six modeled B-set play actions using their corresponding play narrations at least once for each play action. Across all intervention sessions (A- and B-sessions), Charlie demonstrated a total of 40 modeled B-set play actions (see Figures 2 & 3). Thirty-two of these 40 (80%) were narrated using a corresponding play narration (see Table 11). Of the 32 corresponding play narrations used, 25 (78%) were complete imitations (100% of words imitated) of the modeled play narrations provided in Video Model B.

Lucas. Lucas never used a modeled play narration in the intervention phase (or maintenance phase). Throughout the entirety of the study, he only used one play narration, an unmodeled narration used during the baseline phase of the study; hence, his zero-level usage of modeled play narrations was essentially equivalent to his near-zero-level usage of unmodeled play narrations. Lucas imitated live-modeled play narrations during the pre-study verbal imitation assessment, so it is unlikely that his non-use of modeled play narrations was due to a skill deficit.

Eli. Like Charlie, Eli also narrated all six modeled B-set play actions using their corresponding play narrations at least once for each play action during the intervention phase. Across all intervention sessions, Eli demonstrated a total of 64 modeled B-set play actions. Forty-five of these 64 (70%) were narrated using a corresponding play narration. Of these 45 play narrations used, 35 (80%) were complete imitations of the modeled play narrations provided in Video Model B.

Overall findings. Across all three children in the study, 18 corresponding play narrations were targeted by the Video Model B interventions. Complete imitations of 12 of these 18 (67%) were used in correspondence with their target play actions during intervention phases. Charlie and Eli used corresponding play narrations at high levels throughout their interventions. Lucas never used any corresponding play narrations, but he also had near-zero usage of unmodeled play narrations. Overall, video modeling was effective at teach corresponding play narrations to two of three children in the study, whereas Lucas's lack of use of modeled play narrations was unlikely to be due to a verbal imitation skill deficit.

Research Question #4: What are the relative effects of video modeling with versus without modeled toy play narrations on modeled and unmodeled toy play actions and what are the relative changes in unmodeled toy play actions from baseline to intervention?

Modeled toy play actions in target sessions. The primary analysis of interest was the investigation of the relative effect of video modeling with versus without modeled toy play narrations on modeled toy play actions in target intervention sessions. The hypothesis guiding this analysis was that for children with ASD who demonstrate delayed echolalia, the pairing of verbal stimuli (in this study, toy play narrations) with other target behaviors (in this study, toy play actions) as an intervention component might increase the effectiveness of video modeling interventions. The rationale behind this hypothesis was that delayed echolalia is a form of verbal imitation and children who display this characteristic with verbal stimuli in videos (e.g., movies, television shows) might have a propensity to imitate other behaviors that are paired with verbal stimuli in video-based interventions.

To test this hypothesis, a comparison of two video modeling interventions targeting toy play actions was conducted. These interventions were designed so that the only considerable difference between the two was the absence (Video Model A) or presence (Video Model B) of toy play narrations (verbal stimuli) paired with the target toy play actions. To analyze this comparison, an adapted alternating treatments design was selected for four reasons: (a) AATDs are designed for comparisons, (b) AATDs allow for rapid (i.e., session-by-session) shifts from one intervention to the other, (c) toy play actions targeted by one video modeling intervention had to be different from toy play actions targeted by the other video modeling intervention because toy play actions learned, non-reversible behaviors, and (d) AATDs require the use of behavior sets and one of the recommended practices incorporated into this study was targeting behavior sets that included at least six unique behaviors (for information on AATDs, see Wolery, et al., 2014). A crucial element of AATDs is establishing equivalent target behavior sets so that any differential effects can be contributed to the differences between the interventions under comparison. Several procedural efforts were made to ensure that the two sets of toy play actions targeted by the compared video modeling interventions were equivalent (see "Establishing equivalence of behavior sets," p. 48).

Charlie. For Charlie, there was some evidence of an effect in favor of video modeling with play narrations over video modeling without play narrations on the acquisition and use of modeled toy play actions. However, the magnitude of difference in favor of video modeling with play narrations was moderate at best because Charlie's acquisition rate and attainment of the mastery criteria was relatively rapid for both target behavior sets, resulting in only five pairs of comparison sessions to analyze for differences in effect. The strongest evidence of an effect in favor of Video Model B took place in the first two pairs of target intervention sessions. In the first pair of target sessions, Charlie demonstrated one of six A-set play actions and four of six B-set play actions. In the second pair of target sessions, Charlie again demonstrated just one of six A-set play actions, compared to all six B-set play actions (see Figure 1). For the final three pairs of target sessions, he demonstrated all six play actions from each set. His cumulative frequency of modeled toy play actions across target sessions went from one to two to all six A-set play actions in the first, second, and third A-sessions, as compared to the B-set, in which he was at four after the first B-session and all six after the second B-session (one session earlier than the A-set; see Figure 3). There was also some differentiation between Video Model A and B in total occurrences of modeled play actions in target sessions, but primarily only in the first two paired target sessions, as with unique occurrences (see Figure 2). For the final three paired target sessions, total occurrences of A-set play actions was equal to or, in one case, higher than total occurrences of B-set play actions. In terms of duration, Charlie actually allocated more of his play action engagement to A-set (*M* = 50%) than B-set (*M* = 36%) play actions in target sessions, but his total duration engaged in play actions of all types was slightly higher in B-sessions (*M* = 17%) than A-sessions (*M* = 13%; see Figure 13).

Lucas. By nearly every measure, Lucas's modeled play action data in target sessions showed clear effects in the opposite direction than was predicted by the hypothesis, that is, Lucas's data showed a differential effect in favor of video modeling without play narrations. Lucas did not attain the mastery criteria for either set of modeled play actions, but across all target sessions (cumulative frequency), he demonstrated all six A-set play actions 11 target sessions earlier than the B-set (A-2 versus B-13). His average rate of unique and total modeled play actions in target sessions were noticeably higher for the A-set (*Unique M* = 4.1, *Total M* = 6.9) than the B-set (*Unique M* = 2.6, *Total M* = 3.3). He demonstrated higher levels of unique and total A- than B-set play actions in 80% of paired target sessions. Of the time he was engaged in play actions, he allocated 38% more of this time engaging in A-set (*M* = 53%) than B-set (*M* = 15%) play actions in target sessions, but his total duration engaged in play actions of all types was slightly higher in B-sessions (*M* = 25%) than A-sessions (*M* = 23%).

Eli. Eli's modeled play action data in target sessions showed the clearest effects in support of the prediction made by the hypothesis, that is, a differential effect in favor of video modeling with play narrations. He did not attain the mastery criteria for either set of modeled play actions, but he attained the cumulative frequency maximum across target sessions only for the B-set (attained in the seventh B-session), whereas his cumulative frequency maxed out at three for A-set play actions (attained in the eleventh A-session). His average rate of unique and total modeled play actions in target sessions were higher for the B-set (*Unique M* = 1.9, *Total M* = 2.7) than the A-set (*Unique M* = 0.6, *Total M* = 0.6). He demonstrated higher levels of unique and total B- than A-set play actions in 67% of paired target sessions. While Eli spent more total time engaged in play actions of all types in intervention sessions (*A-session total engagement M* = 33%, *B-session total engagement M* = 36%), he also allocated less of that time than the other two children to demonstrating modeled play actions: averaging 12% allocation to B-set play actions and 2% allocation to A-set play actions in target session, a 10% difference in favor of the B-set.

Modeled toy play actions in non-target sessions. While modeled toy play actions demonstrated in target sessions was of greatest interest, the analysis of non-target sessions was also of interest because in order for the child to demonstrate modeled play actions in non-target sessions, there were two major challenges he likely had to overcome: (a) target play actions were probably more salient than non-target play actions because the child had just watched the video model demonstrating target play actions immediately prior to the session and (b) non-target sessions required longer levels of retention in order for non-target play actions to be demonstrated (i.e., either until the second session on the same measurement day or the first session on the following measurement day, depending on the block randomized order of the sessions). These challenges are reflected in the data for Lucas and Eli, whose rates of modeled behaviors in non-target sessions were lower than in target sessions for both A- and B-sets (Charlie had zero levels in non-target sessions for both sets). For the A-set, Lucas's average rate of unique and total demonstrations in non-target sessions were 0.7 and 1.3 lower than in target sessions and 1.1 and 1.3 lower than in target sessions for the B-set. Eli's average rate of unique and total demonstrations in non-target sessions were 0.4 and 0.3 lower than in target sessions for the A-set and 0.5 and 1.1 lower than in target sessions for the B-set (see Table 12).

Charlie. Although Charlie was the only child to reach the mastery criteria for either set of modeled play actions (which he did for both), he was also the only child who did not demonstrate any modeled play actions in non-target sessions. Therefore, there were no comparative differential effects to analyze in non-target sessions for Charlie. However, his zero levels in non-target sessions compared to his 100% levels in target sessions might provide additional insight into the effect the video modeling interventions had on his toy play. In target sessions, once Charlie started to demonstrate all six behaviors for each set, he did so in a scripted fashion, that is, he demonstrated all six target behaviors in the exact order and usually with consecutive demonstrations just as they were demonstrated in the video model. He also refrained from demonstrating any unmodeled play actions until after he first completed the video model "script." He played in this way, using this scripted format with (a) no deviations from the order in which the target behaviors were demonstrated on the video model, (b) refraining from demonstrating any unmodeled play actions until after the modeled play actions had all been demonstrated, and (c) no demonstrations of the non-target play actions for the final four B-sessions and final three A-sessions. In the first three maintenance sessions, he played in a similar scripted fashion, except that he played his way through both modeled play scripts in exact order (he demonstrated all B-set play actions in order first, then all A-set play actions in order after completing the B-set play actions), then he would demonstrate unmodeled play actions. In the final maintenance session, he only demonstrated unmodeled play actions. Therefore, his zero levels of modeled play actions in non-target sessions might be explained by the fact that the non-target modeled play actions were not part of the "script," so he refrained from demonstrating them.

Lucas. As with target sessions, Lucas showed a differential effect in favor of Video Model A in non-target sessions as well. He attained the cumulative frequency maximum for the A-set after only two non-target sessions, whereas he maxed out at five B-set behaviors in non-target sessions, attained in the fifteenth non-target session (see Figure 6). Lucas had considerably higher rates of unique and total A-set (*Unique M* = 3.4, *Total M* = 5.6) than B-set (*Unique M* = 1.5, *Total M* = 2.0) play actions in non-target sessions. He demonstrated more unique and total A-set than B-set play actions in 79% and 86% of paired non-target sessions, respectively. Furthermore, his rates of A-set play actions were higher in sessions that were non-target for A and target for B (i.e., comparing A-set to B-set rates within B-sessions only) and he demonstrated more unique A-set than B-set play actions in 50% of B-target-sessions and more total A-set than B-set play actions in 65% of B-sessions (see video modeling comparison phases in Figures 7 and 8 for these comparisons). He allocated 29% more of his total toy play engagement to A-set (*M* = 38%) than B-set (*M* = 9%) play actions in non-target sessions, and also allocated 23% more of his total play engagement to A-set than B-set play actions within B-target-sessions (averages of 38% versus 15%, respectively).

Eli. Eli's data in non-target sessions were consistent with data patterns in target sessions: a differential effect in favor of Video Model B. Eli did not attain the cumulative frequency maximum for either set in non-target sessions, but he maxed out at five for the B-set as compared to two for the A-set. He had higher rates of unique and total B-set (*Unique M* = 1.4, *Total M* = 1.6) than A-set (*Unique M* = 0.2, *Total M* = 0.3) play actions in non-target sessions, and higher rates of B-set play actions within A-target-sessions. He demonstrated more unique and total A-set than B-set play actions in 64% of paired non-target sessions and he demonstrated more unique and total B-set than A-set play actions in 50% of A-target-sessions. His allocation of total toy play engagement was low for both sets in non-target sessions (*A-set M* = 1%, *B-set M* = 8%), but with a 7% higher allocation in favor of the B-set. His allocation to B-set play actions was also higher (by 6%) than A-set play actions within A-target sessions (averages of 8% versus 2%, respectively).

Unmodeled toy play actions. Before introducing the video modeling interventions in the comparison phase, a baseline phase was conducted to measure unmodeled toy play actions for two main reasons: (a) to determine and select play action targets for the video modeling interventions that were never demonstrated in baseline as unmodeled play actions (see "Determining modeled play action behavior sets," p. 47) and (b) to determine if the introduction of the video modeling interventions were associated with positive, negative, or no changes in unmodeled toy play actions.

Charlie. For Charlie, the introduction of the video modeling interventions were associated with negative changes in rates of unique and total unmodeled play actions as compared to baseline rates for both Video Models A and B (see Figures 10 & 11). Charlie's average rates of unique and total unmodeled play actions per session decreased from baseline (*Unique M* = 13.6, *Total M* = 16.0) by 7.2 and 5.6 in A-sessions (*Unique M* = 6.4, *Total M* = 10.4) and by 4.4 and 5.0 in B-sessions (*Unique M* = 9.2, *Total M* = 11.0). Unique and total levels of unmodeled play actions were lower than the baseline median in 100% and 80% of A-sessions, respectively, and were lower than the baseline median in 80% (for both unique and total levels) of B-sessions.

In baseline sessions, Charlie was engaged in toy play actions for an average of 14% of the total duration of the session. In intervention sessions, he was engaged in toy play actions (of all kinds) an average of 13% in A-sessions and 17% in B-sessions (see Figure 13). Therefore, the total amount of time Charlie spent engaged in toy play actions did not change much from baseline to intervention, but the allocation of that total time engaged decreased for unmodeled play actions as it was replaced with time spent engaged in modeled play actions. This change in allocation, but not overall play, is also reflected by the total number of play actions per baseline session (all unmodeled) compared to the total number of play actions of all kinds (unmodeled plus modeled) per intervention session: In baseline, he averaged 16.0 total play actions per session, in A-sessions he averaged 16.0 total play actions per session, and in B-sessions he averaged 19.0 total play actions per session (see Figures 2 and 11). Therefore, per the duration and total rates, the introduction of the video modeling interventions was not associated with a negative change in his overall levels of toy play, but video modeling might have had a negative impact on his play style and fluidity of play (as described above in the discussion of "Modeled toy play actions in non-target sessions").

Lucas. For Lucas, the introduction of the video modeling interventions were associated with somewhat positive changes in rates of unique and total unmodeled play actions as compared to baseline rates for both Video Models A and B, but there were also higher amounts of variability in intervention than baseline. Lucas's average rates of unique unmodeled play actions per session increased somewhat from baseline (*Unique M* = 10.8, *SD* = 3.4) by 1.2 in A-sessions

(*Unique M* = 11.6, *SD* = 6.9) and 2.3 in B-sessions (*Unique M* = 13.1, *SD* = 4.2), but his average rates of total unmodeled play actions per session decreased from baseline (*Total M* = 18.2, *SD* = 4.4) by 4.1 in A-sessions (*Total M* = 14.1, *SD* = 8.8) and 0.7 in B-sessions (*Total M* = 17.5, *SD* = 5.9). Unique and total levels of unmodeled play actions were lower than the baseline median in 60% and 67% of A-sessions, respectively, and were higher than the baseline median in 67% (unique) and 60% (total) of B-sessions.

In baseline sessions, Lucas was engaged in toy play actions for an average of 13% of the total duration of the session. In intervention sessions, he was engaged in toy play actions (of all kinds) an average of 23% in A-sessions and 25% in B-sessions. Therefore, the total amount of time Lucas spent engaged in toy play actions increased from baseline to intervention. In comparison to Lucas, it seems less the case for Lucas that the introduction of modeled play actions served to replace unmodeled toy play, but instead served an additive function, in which he combined his unmodeled toy play with modeled toy play, thus increasing his overall levels of toy play engagement. This increase in overall play is also reflected by the total number of play actions per baseline session (all unmodeled) compared to the total number of play actions of all kinds (unmodeled plus modeled) per intervention session: In baseline, Lucas averaged 18.2 total play actions per session, in A-sessions he averaged 23.1 total play actions per session (an increase of 4.9), and in B-sessions he averaged 26.1 total play actions per session (an increase of 7.9). Therefore, per the duration and total rates, the introduction of the video modeling interventions was associated with a positive change in his overall levels of toy play.

Eli. For Eli, the introduction of the video modeling interventions were not associated with any clear changes in rates of unique modeled play actions as compared to baseline rates, particularly when accounting for the amount of variability in Eli's data. Eli's average rates of unique unmodeled play actions per session increased from baseline (*Unique M* = 13.0, *SD* = 6.5) by 1.1 in A-sessions (*Unique M* = 14.1, *SD* = 4.0) and decreased by a negligible 0.1 in B-sessions (*Unique M* = 12.9, *SD* = 5.4). Unique levels of unmodeled play actions were higher than the baseline median in 80% of A-sessions and 67% of B-sessions. However, there was a more considerable change in rates of total modeled play actions from baseline to intervention: The average rate of total unmodeled play actions per session increased from baseline (*Total M* = 17.6, *SD* = 6.9) by 7.1 in A-sessions (*Total M* = 24.7, *SD* = 9.3) and 9.1 in B-sessions (*Total M* = 26.7, *SD* = 10.6). Total levels of unmodeled play actions were higher than the baseline median in 93% of A-sessions and 87% of B-sessions. Eli's levels of engagement in toy play actions and total number of play actions per session also reflect this increase. In baseline, Eli engaged in toy play actions for an average of 28% of the total duration of baseline sessions, compared to 33% in A-sessions and 36% in B-sessions. In baseline, he demonstrated an average of 17.6 total play actions (all unmodeled), versus 26.9 and 29.7 in A- and B-sessions (unmodeled plus modeled).

Whereas Lucas's increases in total levels of play can largely be explained by his relatively sustained levels of unmodeled play plus the additive effects modeled play, this is an insufficient explanation of Eli's increases in total play levels, because Eli showed relatively marginal increases in his modeled play (in comparison to the other children's modeled play and in comparison to his own levels of unmodeled play). Rather, his increases in total play were due mostly to increases in unmodeled play from baseline to intervention. However, upon further analysis of his data, the introduction of the video modeling interventions might have had little to do with his increases in unmodeled play. Among the three children in the study, Eli had the largest differences between his rates of unique versus total unmodeled play actions, with average differences of 11.1, 10.3, and 13.8 in baseline, A-sessions, and B-sessions, respectively. The larger the difference between unique and total play actions, the greater the probability that the child was engaging in more repetitive types of play (because each repeat of the same toy play action increased the number of total play actions, but did not increase the number of unique play actions). In comparison, there were little to no discrepancies between the rates of unique versus total modeled play actions (see Table 12), which suggests that the video modeling interventions were not responsible for any increases in repetitive play.

There is evidence in the data of Eli's tendency toward repetitive play, and also that his repetitive play increased and diversity of play decreased over the course of the study. One indication of this might be in the patterns of his unmodeled cumulative frequency data (see Figure 12). Charlie and Lucas have relatively linear, steadily-rising trends in their cumulative frequency data, showing that they continued to add unique, never-before-demonstrated unmodeled play actions to their play catalogs. Eli, on the other hand, had a steeper incline than the other two children in baseline, followed by a steady decline in that trend to nearly-flat levels by the end of the comparison phase, which continued into maintenance. One way to quantify diversity of play is by comparing the relative frequencies of figures that were used in play actions. Each child had 12 figures to select from; thus, an equal distribution of figure use would result in each figure being used in approximately 8% of all play actions. In Eli's case, the figure he used most frequently was used in 24% of all unmodeled play actions in the baseline phase. In the intervention phase, his frequency of use with this figure increased to 54% (51% in A-sessions, 57% in B-sessions) of all unmodeled play actions and further increased to 88% of all unmodeled play actions in the maintenance phase. Therefore, while Eli's total levels of play increased from baseline to intervention, the (a) discrepancy between unique versus total demonstrations of unmodeled play actions (and lack of discrepancy between unique versus total modeled play actions), (b) declining trend in his cumulative frequency data, and (c) figure-use frequency data seem to indicate that these increases are explained more by increases in his repetitive play than by the introduction of the video modeling interventions.

Overall findings. The hypothesis under investigation was that video modeling with play narrations might be more effective than video modeling without play narrations for teaching modeled play actions to children with ASD who demonstrate delayed echolalia. Overall, the findings of this study provide inconclusive evidence in support of this hypothesis. For two of three children in the study (Charlie and Eli), there was evidence of differential effects in favor of video modeling with play narrations. But those favorable effects must be interpreted with qualifications and limitations. For Charlie, the differentiation in favor of video modeling with play narrations was minor, primarily only present in the first two pairs of comparison sessions, and followed by equalization of the two video modeling interventions for the remainder of the comparison. Furthermore, the video modeling interventions might have had negative effects on the fluidity of Charlie's play and caused him to play in a more scripted, rigid fashion.

Lucas showed a differential effect in the opposite direction of the predicted hypothesis. By nearly every measure, his data support the effectiveness of video modeling without play narrations over video modeling with play narrations.

Eli showed the clearest differential effect in favor of the predicted hypothesis. By all comparative measures, video modeling with play narrations was more effective for Eli. However, the video modeling interventions also had the smallest overall effects for Eli compared to the other two children in the study (see the discussion of "Research Question #3" above), so the magnitude of any differential effects are mitigated by the smaller overall effects of video modeling as a whole. Furthermore, Eli's increasing level of repetitive play over the course of the study, while probably not a direct result of the video modeling interventions, is a negative change associated with the study procedures that also obscures and limits the strength of support in favor of video modeling with play narrations.

Research Question #5: What are the relative effects of video modeling with versus without modeled toy play narrations on narration of modeled and unmodeled toy play actions and what are the relative changes in usage of modeled and unmodeled toy play narrations? The narration of play actions was measured because the presence or absence of play narrations as a component was the key difference between the two video modeling interventions. For children with ASD who demonstrate delayed echolalia, their usage of delayed echolalia might be distributed across a variety of forms and functions (Tager-Flusberg, Paul, & Lord, 2005). To capture possible varieties of play narration functions, modeled play narrations were classified and measured in terms of whether they occurred: (a) with the same play action with which they were targeted (corresponding), (b) with a different play action than the one with which they were targeted (transferred), or (c) in the absence of any ongoing appropriate play (delayed echolalia). Increases in modeled play narrations transferred to other play actions was considered a positive side effect equivalent to spontaneous (i.e., untrained) generalization across behaviors. Increases in play-absent delayed echolalia was considered an unintended, negative side effect of the intervention. To capture possible varieties of forms, modeled play narrations were also classified and measured in terms of imitation types: (a) complete imitations, (b) partial imitations with substitutions, or (c) partial imitation without substitutions.

Charlie. Video modeling with play narrations appeared to have clear differential effects on Charlie’s narration of modeled play actions. Charlie narrated 83% of B-set play actions in target sessions, but only narrated 10% of A-set play actions in target sessions (there were no opportunities to narrate modeled play actions in non-target sessions; see Figure 14). All but one (32 of 33, 97%) of his narrated B-set play actions were narrated using a complete or partial corresponding play narration (i.e., the same play narration that was paired with the play action in Video Model B), whereas none (zero of three) of narrated A-set play actions were narrated using a transferred play narration (i.e., a play narration from Video Model B used to narrated a play action other than the one in which it was paired). This finding probably lends further evidence to the notion that Charlie treated the video models as play scripts. The intervention did not have any substantial negative effect on delayed echolalia, as Charlie only demonstrated one instance of using modeled play narrations as a form of delayed echolalia in the intervention phase (zero instances in maintenance).

The introduction of the video modeling interventions did not seem to have an effect on Charlie's overall levels of narration of unmodeled play actions. He narrated 44% of unmodeled play actions in the baseline phase, as compared to 40% in A-sessions and 45% in B-sessions. While there was not much change from baseline to intervention in his overall levels of narration of unmodeled play actions, some of his usage of unmodeled play narrations to narrate unmodeled play actions was replaced with usage of transferred modeled play narrations to narrate unmodeled play actions: Seventeen percent (eight of 46) of narrated unmodeled play actions in intervention were narrated with transferred modeled play narrations. Similar to his replacement of unmodeled play actions with modeled play actions, his replacement of unmodeled play narrations with modeled play narrations resulted in a reduction in usage of unmodeled play narrations from an average of 7.0 per baseline session to 4.2 per intervention session (a decrease of 2.8; see Table 11). However, all eight modeled play narrations that were transferred to unmodeled play actions were partial imitations with substitutions, and in his case, all of these substitutions were word changes or additions that made the narrations more descriptive of the play actions than if he had used a complete imitation. In other words, he used the basic structure of the modeled play narrations and substituted words to make his narrations more appropriate and better-fitting to the play actions with which they were paired.

Lucas. Video modeling with play narrations had no apparent effect on Lucas's narration of modeled toy play actions, as he only demonstrated one unmodeled play narration in baseline and did not demonstrate any play narrations of any kind in the comparison (or maintenance) phase.

Eli. Like Charlie, video modeling with play narrations also appeared to have clear differential effects on Eli's narration of modeled play actions. Eli narrated 83% of B-set play actions in target sessions, but only narrated 11% of A-set play actions in target sessions (in non-target sessions, he narrated 74% of B-set play actions and 20% of A-set play actions). All but three (45 of 48, 94%) of his narrated B-set play actions were narrated using a complete or partial corresponding play narration, whereas none (zero of two) of the narrated A-set play actions were narrated using a transferred play narration. The introduction of video modeling with play narrations seemed to have some negative effects on Eli's usage of modeled play narrations as a form of delayed echolalia: He demonstrated 12 instances of delayed echolalia with modeled play narrations in the intervention phase (zero instances in maintenance).

Unlike Charlie, the introduction of the video modeling interventions did seem to have an effect on Eli's overall levels of narration of unmodeled play actions. He narrated 1% of unmodeled play actions in the baseline phase, as compared to 11% in A-sessions and 17% in B-sessions. His increase in unmodeled play narrations was due mostly to the usage of transferred modeled play narrations: Eighty percent (86 of 107) of narrated unmodeled play actions in intervention were narrated with transferred modeled play narrations. All transferred modeled play narrations demonstrated in the intervention phase were transferred to unmodeled play narrations, resulting in an average rate of 3.0 narrated unmodeled play actions per intervention session, an increase of 2.8 from baseline. Whereas all of Charlie's play narrations transferred to unmodeled play actions included word substitutions that made the narrations more descriptive and better-fitting, Eli was less likely to use word substitutions in his transferred narrations of unmodeled play actions: Twenty-six percent of his transferred narrations were word-substituted versus 76% that were either complete imitations or partial imitations with no word substitutions.

Overall findings. The video modeling interventions had no effect on Lucas's narration of play actions. His narration of play actions in baseline was at near-zero levels (except for one instance) in baseline and remained at zero levels in intervention (and maintenance). For Charlie and Eli, video modeling with play narrations seemed to have positive effects on their narration of play actions. They narrated substantially higher percentages of B- than A-set play actions. They also demonstrated transference of modeled play narrations to unmodeled play actions. Charlie used transferred modeled play narrations for a lower percentage of unmodeled play actions than Eli, but in every case in which he did so, used word substitutions that made his narrations more descriptive of the play actions that were narrated. Eli was less apt to use word substitutions, but still did so for nearly a quarter of all modeled play narrations transferred to unmodeled play actions. However, he was more apt than Charlie to transfer modeled narrations overall, which was largely responsible for the 10% and 16% increases in narrated unmodeled play actions from baseline to A- and B-intervention-sessions, respectively. Eli's transference of modeled play narrations to unmodeled play actions is equivalent to spontaneous generalization across behaviors. The potential negative side effect of using modeled play actions as play-absent delayed echolalia was more substantial for Eli (12 instances) than Charlie (one instance).

Lucas and Eli's baseline narration data were quantitatively equivalent to each other: Each child demonstrated a single instance of narrated play action. However, these data do not capture what might have been meaningful differences between the two. During measurement sessions, Lucas infrequently spoke or verbalized in any way. His near-zero levels of play narrations corresponded to his low levels of vocalizations or verbalizations of any kind. On the other hand, Eli's near-zero levels of play narrations does not reflect his frequency of other types of vocalizations or verbalizations. Eli vocalized and verbalized quite frequently during the measurement sessions, but the large majority of these verbal responses were unintelligible to the researcher (both during the live sessions and when reviewed on the video recordings). Qualitatively speaking, these verbal responses looked and sounded like "self-talk," were generally not directed toward the researcher, and were probably forms of delayed echolalia in many cases.

To obtain some quantitative measurement and validation of these observed vocalization/verbalization differences between Lucas and Eli, the researcher selected at random one baseline session for each child, and coded these sessions for the presence or absence of vocalizations or verbalizations of any kind using a 5-s partial interval recording system. Each selected session was divided into equal 5-s intervals (5-min sessions = 60 5-s intervals). If the child made any vocalization or verbalization of any kind during the observed interval, the interval was coded as "vocalization/verbalization present." If no vocalizations or verbalizations of any kind occurred during the observed interval, the interval was coded as "vocalization/verbalization absent." The number of intervals with vocalizations/verbalizations present was divided by the total number of intervals in the session (60) and multiplied by 100 to generate the percentage of intervals in which vocalizations/verbalizations occurred. In the coded baseline session for Lucas, he demonstrated some type of vocalization or verbalization in 10% (6 of 60) of intervals. In the coded baseline session for Eli, he demonstrated some type of vocalization or verbalization in 53% (32 of 60) of intervals.

These differences in general levels of vocalizing and verbalizing during play might be an important predictor variable (correlated, not causal) of the opposite differential effects that the video modeling interventions had on Lucas and Eli. That is, video modeling without play narrations might be more effective for children who demonstrate lower levels of vocalizing and verbalizing during play and video modeling with play narrations might be more effective for children who demonstrate higher levels of vocalizing and verbalizing (or certain specific types, e.g., "self-talk") during play. However, this study was not designed to select or control for these differences and further investigation would be required to analyze this hypothesis.

Research Question #6: What are the relative associations between child attention to video models with versus without modeled toy play narrations and frequencies of modeled toy play actions? Child attention to the video models was measured for two primary reasons: (a) to monitor the procedural fidelity of intervention (see discussion of Research Question #1 above) and (b) to analyze potential covariation between attention to the video models and frequencies of modeled toy play actions.

Charlie. Charlie's levels of attention to both video models were consistent and high throughout the course of the intervention. He was near ceiling levels for both video models, averaging 98% attention to Video Model A and 96% to Video Model B. There was no clear differentiation between his attention to the two video models and no clear association between attention to the video models and frequencies of modeled toy play actions.

Lucas. Lucas's levels of attention to both video models was high and near ceiling levels, but more consistent for Video Model A than B. He averaged 96% attention to Video Model A and 94% attention to Video Model B. For the first, middle, and last five A-sessions, his levels of attention differed by no more than 4%, averaging 98%, 97%, and 94%, respectively. His attention for the first, middle, and last five B-sessions, however, showed a slight but steady decreasing trend from 98%, to 93%, to 90%, respectively. While Lucas did show lower levels of B-set play actions than A-set play actions, his lower levels of B-set play actions did not seem to covary with the decreasing trend in his levels of attention to Video Model B: For B-set play actions in the first, middle, and last five B-sessions, he averaged 3.4, 4.8, and 4.0 unique demonstrations and 6.0, 8.0, and 6.8 total demonstrations.

Eli. Eli's attention to Video Model A (*M* = 58%) was 8% lower than Video Model B (*M* = 66%). While there was little to no within-series variation in his attention to Video Model A (*Ms of first, middle, and last five A-sessions* = 60%, 57%, and 58%), his between-series variation (i.e., higher overall levels of attention to Video Model B than A) was associated with higher levels of modeled play actions in favor of Video Model B: For first, middle, and last five A- versus B-sessions, he averaged 0.2, 0, and 1.6 unique A-set play actions versus 2.0, 2.2, and 1.4 unique B-set play actions and 0.2, 0, and 1.6 total A-set play actions versus 3.4, 3.0, and 1.6 total B-set play actions. There was more within-series variation in Eli's attention to Video Model B, with attention in the first, middle, and last five B-sessions averaging 69%, 71%, and 57%. There might be some evidence of covariation between his attention to Video Model B and levels of B-set play actions. His levels of attention to Video Model B in the first versus middle five B-sessions were relatively equivalent and likewise, his levels of play actions in the first versus middle five B-sessions were also relatively equivalent (*Unique M of first five versus middle five* = 2.0 vs. 2.2; *Total M of first five versus middle five* = 3.4 versus 3.0). However, his level of attention for the final five B-sessions was 12% lower than for the first five B-sessions and 14% lower than for the middle five B-sessions. Likewise, his average levels of unique B-set play actions in the final five B-sessions were 0.6 and 0.8 lower than the first and middle five B-sessions, respectively, and his average levels of total B-set play actions in the final five B-sessions were 1.8 and 1.4 lower than the first and middle five B-sessions, respectively.

Overall findings. Charlie did not have any meaningful between- or within-series variation in his attention to the video models, averaging at near-ceiling levels of attention for both video models. Lucas did not have any meaningful between-series variation in his attention to the video models. There was some within-series variation in his attention to Video Model B, with a shallow, but steady, decreasing trend in his attention to Video Model B over the course of the intervention. However, this within-series variation did not seem to covary with his levels of B-set play actions. Eli had the highest degree of between-series variation in his attention to the video models. His higher levels of attention to Video Model B over A was associated with higher levels of B- over A-set play actions. Eli also had some within-series variation in his attention to Video Model B and this variation might have also covaried with his variation in levels of B-set play actions, in which the final set of five B-sessions had the lowest levels of attention to Video Model B and the lowest levels of B-set play actions.

Research Question #7: What are the relative maintenance effects of video modeling with versus without modeled toy play narrations upon withdrawal of the video modeling interventions? The maintenance phase of the study was initiated one week after the conclusion of the comparison phase, with maintenance sessions conducted once a week for four weeks (Lucas's final maintenance session was conducted five weeks after the conclusion of the comparison phase, due to scheduling conflicts). In the maintenance phase, the video modeling interventions were withdrawn and maintenance sessions followed the same procedures as baseline sessions.

Charlie. Charlie was the only child to attain the mastery criteria for both target sets of modeled play actions. In the maintenance phase, he maintained mastery-level performance, demonstrating 100% of play actions from both target sets for the first three maintenance sessions (see Figure 7). In the final maintenance session, he did not demonstrate any modeled play actions from either target set. Charlie showed excellent skill retention throughout the course of the intervention phase and into the maintenance phase; therefore, it is unlikely that this drop to zero levels in the final maintenance session was due to lack of maintenance, but was more likely due to lack of interest or motivation in demonstrating the modeled play actions. The maintenance levels of A- and B-set play actions were essentially equivalent in every way, except in terms of their narration rates: One-hundred percent (23 of 23) of B-set play actions were narrated and only 5% (1 of 20) of A-set play actions were narrated. All 23 of the narrations used with the B-set play actions were corresponding models and complete imitations; thus, Charlie also demonstrated 100% maintenance of target modeled play narrations.

In maintenance, Charlie continued to treat the video models as play scripts, except that he played his way through the "scripts" of both video models instead of only the target video model as he did in the intervention phase. In each of the first three maintenance sessions, he played his way through the script for Video Model B (all play actions demonstrated in the same sequence as in the video model), followed by Video Model A (all play actions demonstrated in the same sequence as in the video model), and then proceeded to demonstrate unmodeled toy play actions only after completion of the modeled play actions from both video models.

Charlie's total duration of engagement in play actions increased somewhat in maintenance (*M* = 22%) from baseline (*M* = 14%) and intervention (*M* = 15%; see Figure 13). His total number of play actions of all kinds demonstrated per maintenance session (*M* = 18.8) was an average of 3.0 higher than baseline (*M* = 16.0), and roughly equivalent to his totals in intervention (*M* = 17.9), indicating that any increases in total duration were due mostly to slightly longer demonstrations of each play action, on average (see Figures 8 and 10). To compare intervention durations to maintenance durations, for intervention, an average of 15% total duration engaged in a 5-min session equates to an average of 45 s of total duration engaged in play actions per session, and for each play action demonstrated (*M of total play actions per intervention session* = 17.9), equates to an average of 2.5 s per play action demonstrated. In maintenance, an average of 22% total duration engaged equates to an average of 66 s of total duration engaged in play actions per session, and for each toy play action demonstrated (*M of total play actions per maintenance session* = 18.8), equates to an average of 3.5 s per play action demonstrated, meaning that in maintenance he demonstrated each play action 1 s longer, on average, than he did in intervention.

Charlie's total numbers of unmodeled play actions demonstrated per session continued to trend downward from intervention (*M* = 10.7) to maintenance (*M* = 8.0) as they did from baseline (*M* = 16.0) to intervention. This continued decrease in unmodeled play actions aligns with the notion that modeled play actions served more of a replacement than an additive function to his overall toy play, because in maintenance he incorporated both sets of modeled play actions (in the first three maintenance sessions), so there were twice as many modeled toy play actions to replace unmodeled toy play actions. In the final maintenance session, in which there was no modeled play to replace unmodeled play, his total number of unmodeled play actions (18) increased to a level comparable to the baseline average.

The video modeling interventions seemed to have a negative maintenance effect on Charlie's narration of unmodeled play actions and usage of unmodeled play narrations. In maintenance, he did not narrate any unmodeled play actions demonstrated (0 of 32), as compared to baseline, in which he narrated 44% of unmodeled play actions and intervention, in which he narrated 43% of unmodeled play actions. He also did not use any unmodeled play narrations in maintenance, whereas he averaged 7.0 unmodeled play narrations in baseline and 4.2 unmodeled play narrations in intervention (see Table 11). For a child who was playing relatively fluidly and spontaneously narrating nearly half of his play actions in baseline, these losses in play fluidity and spontaneous narrations is certainly an undesirable result.

Lucas. Lucas did not attain the mastery criteria for either target set of play actions, but he did demonstrate all modeled play actions from each set at least once during the intervention phase (see Figure 9). The differential effects in favor of Video Model A in the intervention phase maintained upon withdrawal of the video modeling interventions. He demonstrated all six A-set play actions (attained after the second maintenance session) and five of six B-set play actions (attained after the third maintenance session, see Table 12). His average unique and total demonstrations of modeled A-set play actions (*Unique M* = 3.4, *Total M* = 5.6) were higher than B-set play actions (*Unique M* = 1.5, *Total M* = 2.0). He demonstrated more unique and total A-set than B-set play actions in three of four maintenance sessions. He allocated 51% of his time engaged in toy play to A-set play actions, compared to 17% allocated to B-set play actions. As in intervention, Lucas did not narrate any modeled play actions in the maintenance phase.

Lucas's total duration of engagement in play actions in maintenance (*M* = 26%) remained above baseline levels (*M* = 13%) and comparable to intervention levels (*M* = 24%). His total number of play actions of all kinds demonstrated per maintenance session (*M* = 23.8) also remained above baseline levels (*M* = 18.2) and comparable to intervention levels (*M* = 24.7), whereas his total number of unmodeled play actions in maintenance sessions (*M* = 13.0) decreased by an average of 2.7 from intervention (*M* = 15.7) and 5.2 from baseline (*M* = 18.2). Total unmodeled play actions were lower than the baseline median level in all four maintenance sessions. Together, these findings suggest that the modeled play actions maintained some of their additive effects upon Lucas's total play, but might have also served more of a replacement function of unmodeled toy play in maintenance than they did in intervention.

As with his lack of narration of modeled play actions, Lucas also maintained zero levels of narration of unmodeled play actions.

Eli. Eli did not attain the mastery criteria for either target set of play actions. He demonstrated all modeled play actions from the B-set at least once during the intervention phase, but demonstrated only four of six modeled play actions from the A-set at least once during the intervention phase. Some of the differential effects in favor of Video Model B in the intervention maintained upon withdrawal of the video modeling interventions, but others did not. He demonstrated four of six B-set play actions and three of six A-set play actions. Unlike intervention, in maintenance his average unique and total demonstrations of modeled A-set play actions (*Unique M* = 2.0, *Total M* = 2.3) were higher than B-set play actions (*Unique M* = 1.3, *Total M* = 1.3). He demonstrated more unique and total A-set than B-set play actions in two of four maintenance sessions (unique demonstrations were equal in one maintenance session and total demonstrations were equal in two maintenance sessions). He allocated 12% of his time engaged in toy play to A-set play actions, compared to 6% allocated to B-set play actions. The clearest maintained effect in favor of Video Model B was in Eli's narration rates: He narrated 60% (three of five) of B-set play actions and 0% (0 of 9) of A-set play actions. All three narrated B-set play actions were narrated using complete corresponding play narrations. In addition, he also used transferred modeled play narrations to narrate 12% (11 of 92, 10 of which were complete imitations) of unmodeled play actions demonstrated. Across all modeled play narrations used (corresponding and transferred) in maintenance, Eli used five of the six different target modeled play narrations at least once (all of which were used in their complete forms).

Eli's total duration of engagement in play actions in maintenance (*M* = 33%) remained slightly above baseline levels (*M* = 28%) and comparable to intervention levels (*M* = 35%). His total number of play actions of all kinds demonstrated per maintenance session (*M* = 26.5) also remained above baseline levels (*M* = 17.6) and comparable to intervention levels (*M* = 28.6). Likewise, his total number of unmodeled play actions in maintenance sessions (*M* = 23.0) remained above baseline levels (*M* = 17.6) and comparable to intervention (*M* = 25.7). Total unmodeled play actions were higher than the baseline median level in all four maintenance sessions. The discrepancy between numbers of unique versus total unmodeled play actions remained high in maintenance (*Unique M* = 11.8, *Total M* = 23.0, a difference of 11.2), whereas the discrepancy between numbers of unique versus total modeled play actions remained low (see Table 12). The frequency of his use of the most-used toy figure rose even higher in maintenance from baseline (*M* = 24% of all unmodeled play actions) and intervention (*M* = 54% of all unmodeled play actions) frequencies: In maintenance sessions, 88% (81 of 92) of all unmodeled play actions demonstrated included the use of the same toy figure. Together, these data suggest that Eli's repetitive play tendencies maintained and possibly worsened during the maintenance phase.

Eli used an average of 1.0 unmodeled play narrations per session, which was 0.6 higher than his usage of unmodeled play narrations in baseline (*M* = 0.2) and practically equivalent to intervention usage levels (*M* = 0.9).

Overall findings. The apparent effect of the video modeling interventions on Charlie playing in a more scripted fashion maintained upon withdrawal of the interventions. In the intervention phase, Charlie did not combine the two video modeling "scripts," demonstrating all modeled play actions from the target video model in sequence, completely abstaining from demonstrating any modeled play actions from the non-target video model, and abstaining from demonstrating any unmodeled play actions until he completed the "script." Upon withdrawal of the interventions, he did combine the two "scripts," first demonstrating all modeled toy play actions from Video Model B in sequence, then demonstrating all modeled toy play actions from Video Model A in sequence, and abstaining from demonstrating any unmodeled play actions until he played his way through both Video Model A and B "scripts." He adhered to this play sequence for the first three maintenance sessions, then did not demonstrate any modeled play actions in the final maintenance session. While the modeled play actions were incorporated into his overall toy play catalog, his usage of modeled toy play actions did not add to his overall levels of toy play, rather, modeled toy play seemed to act as more of a replacement for unmodeled toy play. The only play actions Charlie narrated in the maintenance phase were modeled play actions from Video Model B, all of which were narrated using the corresponding modeled play narrations from Video Model B. Charlie's narration of unmodeled play actions and usage of unmodeled play narrations dropped to zero levels in maintenance. Combined, these findings indicate that the video modeling interventions had negative overall effects on the fluidity and spontaneity of Charlie's play style and play-related speech.

For Lucas, the differential effects in favor of video modeling without play narrations maintained upon withdrawal of the video modeling interventions. Play narrations remained at zero levels in maintenance. Lucas's overall levels of toy play in maintenance remained higher than baseline levels, but modeled toy play appeared to have less of an additive effect and more of a replacement effect to his unmodeled play as compared to his overall levels of toy play in intervention.

For Eli, by most measures, the differential effects in favor of video modeling with play narrations did not maintain upon withdrawal of the video modeling interventions, except in terms of his play narrations. While Eli demonstrated fewer instances of modeled play actions from Video Model B than A, over half of those demonstrated from Video Model be were narrated (all with corresponding modeled play narrations), whereas none of the modeled play actions from Video Model A were narrated. In addition, Eli also used transferred modeled play narrations to narrate 12% of unmodeled play narrations that were demonstrated. Perhaps the clearest effect that maintained, and possibly worsened, was Eli's tendency toward repetitive play. This tendency is evident by the large discrepancy between unique versus total unmodeled play rates and his increasing frequency in use of the most-used toy figure, which rose in use from nearly a quarter of all unmodeled play actions in baseline to over half of all unmodeled play actions in intervention to nearly 90% of all unmodeled play actions in maintenance. However, the small discrepancy between unique versus total modeled play rates as compared to the large discrepancy between these two for unmodeled toy play suggests that the video modeling interventions were probably not responsible for Eli's increases in repetitive play over the course of the study.

Limitations

There are several noteworthy limitations regarding the procedures and findings of this study. First, the *Mullen Scales of Early Learning* (Mullen, 1995) was used to determine that each child included in the study had a developmental age equivalent of at least 24 months. This criterion level was selected because it was deemed the upper bound at which deferred imitation is likely (Meltzoff, 1985; Piaget, 1962). However, this was an indirect and probabilistic method of assessing deferred imitation, whereas a direct assessment of deferred imitation would have been more confirmatory. Also, while the Mullen was capable of assessing developmental criterion levels for the study, a developmental age equivalent for Charlie was not able to be determined because he was at the testing ceiling level.

Second, delayed echolalia with screen media was assessed indirectly using a researcher-designed questionnaire. This is a limitation because delayed echolalia was not assessed and confirmed directly. More so, even if this questionnaire was valid at determining the presence of delayed echolalia with screen media, it might not be sensitive enough in quantifying and qualifying "delayed echolalia" as a construct. The proposed hypothesis was based simply on the presence of delayed echolalia, but the results of the study suggest that either there is little to no relationship between delayed echolalia and the video modeling interventions employed or that presence alone is not predictive enough. If the latter is the case, a more sensitive assessment that is able to distinguish between different levels and types of delayed echolalia might be more predictive of success with video modeling.

Third, while several procedures were implemented to try to ensure that the two sets of modeled play actions were equivalent in terms of figures used and response requirements, other factors might have resulted in the modeled play action sets being non-equivalent. Perhaps the most threatening form of non-equivalence that was not controlled for was child preference or motivation for the selected modeled play actions. That is, if the child preferred, or was motivated, to demonstrate modeled play actions in one set more so than the other, this could have contributed to any differential effects between the two video models. While the random assignment of modeled play actions to either the A- or B-set controls for this and other threats to non-equivalence to some extent, the relatively small number of modeled play actions limits the degree that randomization can control for all types of non-equivalence.

Fourth, in addition to limitations related to non-equivalence, the relatively small number of modeled play actions and their sequenced presentation format in the video models might have contributed to less diversified and more scripted play for at least one child in the study (Charlie).

Fifth, while modeled play narrations were meant to serve the function of a play-based language target, their concurrent presentation with modeled play actions might have served the function of a verbal cue or prompt for the modeled play actions. If they did serve this function, then the comparison between the two variations would be more akin to video modeling with verbal cueing/prompting versus video modeling without verbal cueing/prompting.

Sixth, lower levels of IOA for some of the dependent variables (e.g., unmodeled play narrations) potentially limits the findings related to these dependent variables. These concerns are discussed in the reporting of IOA results (p. 61).

Seventh, social validity was not assessed and generalization sessions were not conducted. The lack of measurement in these areas limits the external validity of the study findings.

Implications

The findings from this study lead to several implications for future research and practice. First, one purpose of this study was to incorporate recommended practices and procedures from Busick (2010) into one cohesive unit. One of these procedures was measuring child attention to the video model. The method for doing so was using the embedded webcam on the laptop in which the video models were shown to record the child while watching the video models. As far as the researcher is aware, this method has not been used in previous studies. Measurement methods of any kind to measure child attention have been used infrequently (20% of studies according studies sampled from 2010 – 2015), but computers, tablets, and smartphones have been frequently used to present video models and many of these devices have built-in video recording equipment. It is recommended that built-in or embedded recording equipment be used to record and measure child attention to video models on the devices in which they are shown.

Second, regarding the limitation that the scripted and sequenced nature of typical video models might have a negative effect on diversification and fluidity of play, future research should investigate video modeling variations that randomize the presentation sequence of the target play behaviors for each viewing. Randomly presenting the order of the play actions could potentially counteract tendencies toward repetition. Also, relatively small numbers of modeled play actions could make repetitive and scripted behaviors more likely (because the sequence is shorter). Future studies could use baseline data to determine the "ideal" amount of modeled play behaviors to target based on the frequency of unmodeled behaviors in baseline.

Third, regarding limitations related to the construct of "delayed echolalia," more sensitive measures to assess, quantify, and qualify delayed echolalia should be developed. Other studies have identified and categorized several functions of delayed echolalia (e.g., Prizant & Rydell, 1984). If there are interactions between the relative effect of narrated versus unnarrated video modeling and delayed echolalia, these interactions might be specific to certain function-types, for example.

Fourth, and related to the previous point, perhaps delayed echolalia does not have any predictive power on the relative effect of narrated versus unnarrated video modeling, but the frequency of spontaneous vocalizations/verbalizations does. In the current study, Lucas was generally a low-frequency vocalizer/verbalizer, whereas Eli was a high-frequency vocalizer/verbalizer. Lucas showed a differential effect in favor of unnarrated video modeling, whereas Eli showed a differential effect in favor of narrated video modeling. Future research should investigate potential interactions between high versus low frequencies of vocalizing/verbalizing and narrated versus unnarrated video modeling.

Fifth, delayed echolalia is a verbal behavior. However, the dependent variable of greatest interest in the current study was toy play. If delayed echolalia does have predictive power for the relative effect of narrated video modeling, perhaps this effect is greatest for language and communication-based target behaviors. Eli, for example, demonstrated higher frequencies of modeled play narrations than he did modeled play actions and he used almost twice as many transferred modeled play narrations (i.e., spontaneous generalization across behaviors) than he did corresponding modeled play narrations. Future research should compare the relative effect of video modeling on language and communication skills for children with versus without delayed echolalia.

Conclusions

This study adds to an extensive body of research demonstrating the overall effectiveness of video modeling for teaching a variety of skills in core deficit areas for children with ASD.

Further, it extends previous research by demonstrating the overall effectiveness of video modeling for teaching toy play skills specifically to children with ASD who demonstrate delayed echolalia with screen media. However, support for the hypothesis that incorporating narrations might enhance the relative effect of video modeling for children with ASD who demonstrate delayed echolalia with screen media was inconclusive and insufficient at best. The relative effect of narrated video modeling was differential across the three children in the study.

For the first child in the study, there was a slight—and perhaps practically insignificant—relative effect in favor of narrated video modeling over unnarrated video modeling. However, the introduction of the video modeling interventions also appeared to have a negative effect on his overall toy play. Future research should investigate and consider the appropriateness of using video modeling interventions with a population of children (i.e., ASD) who have tendencies to demonstrate repetitive and scripted behaviors (American Psychiatric Association, 2013). This tendency might be beneficial for teaching some skills and detrimental for teaching others.

For the second child in the study, there was a clear relative effect in the opposite direction of the proposed hypothesis—in favor of unnarrated over narrated video modeling. This observed relative effect might be associated with the child's low levels of spontaneous vocalizations and verbalizations throughout the study. Future research should investigate whether levels of spontaneous vocalizations and verbalizations is a child characteristic that is predictive of success with certain variations of video modeling interventions (e.g., narrated versus unnarrated).

For the third child in the study, the clearest relative effect in the predicted direction of the proposed hypothesis—in favor of narrated over unnarrated video modeling—was observed. However, the magnitude of the overall effect of the video modeling interventions in increasing modeled toy play was the smallest for this child; therefore, the magnitude of the relative effect in favor of narrated video modeling might not have practical significance. Furthermore, repeated exposure to the study procedures was associated with increases in repetitive, stereotypic play behaviors for this child. Perhaps the most positive outcome for this child was the increase in his use of modeled play narrations, both corresponding with the modeled play actions in which they were targeted and transferred (i.e., generalized across behaviors) to other play actions with which they were not targeted. This child also demonstrated the most repetitive and stereotypic (and most likely echolalic) verbal behaviors prior to the introduction of the video modeling interventions. Future research should better quantify and qualify the characteristics of delayed echolalia and investigate how these characteristics interact with video modeling interventions designed for other skills that might be more suitable than toy play (e.g., language and communication) as the primary target outcomes.

Appendix A
Reference List of Studies Included in Busick (2010) Review

Apple, A.L., Billingsley, F., & Schwartz, I.S. (2005). Effects of video modeling alone and with self-management on compliment-giving behaviors of children with high-functioning ASD. *Journal of Positive Behavior Interventions, 7,* 33-46.

Bellini, S., Akullian, J., & Hopf, A. (2007). Increasing social engagement in young children with autism spectrum disorders using video self-modeling. *School Psychology Review, 36,* 80-90.

Buggey, T. (2005). Video self-modeling applications with students with autism spectrum disorders in a small private school setting. *Focus on Autism and Other Developmental Disabilities, 20*(1)*,* 52-63.

Buggey, T., Toombs, K., Gardener, P., & Cervitti, M. (1999). Training responding behaviors in students with autism: Using videotaped self-modeling. *Journal of Positive Behavior Interventions, 1,* 205-214.

Charlop, M.H., & Milstein, J.P. (1989). Teaching autistic children conversational speech using video modeling. *Journal of Applied Behavior Analysis, 22,* 275-285.

Charlop-Christy, M.H., Le, L., & Freeman, K.A. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. *Journal of Autism and Developmental Disorders, 30,* 537-552.

D'Ateno, P., Mangiapanello, K., & Taylor, B.A. (2003). Using video modeling to teach complex play sequences to a preschooler with autism. *Journal of Positive Behavior Interventions, 5,* 5-11.

Gena, A., Couloura, S., & Kymissis, E. (2005). Modifying the affective behavior of preschoolers with autism using in-vivo or video modeling and reinforcement contingencies. *Journal of Autism and Developmental Disorders, 35,* 545-556.

Hine, J.F., & Wolery, M. (2006). Using point-of-view video modeling to teach play to preschoolers with autism. *Topics in Early Childhood Special Education, 26,* 83-93.

MacDonald, R., Clark, M, Garrigan, E., & Vangala, M. (2005). Using video modeling to teach pretend play to children with autism. *Behavioral Interventions, 20,* 225-238.

Maione, L., & Mirenda, P. (2006). Effects of video modeling and video feedback on peer-directed social language skills of a child with autism. *Journal of Positive Behavior Interventions, 8*(2), 106-118.

Nikopoulos, C. K., & Keenan, M. (2003). Promoting social initiation in children with autism. *Behavioral Interventions*, *18*, 87–108.

Nikopoulos, C. K., & Keenan, M. (2004). Effects of video modeling on social initiations by children with autism. *Journal of Applied Behavior Analysis*, *37*, 93–96.

Nikopoulos, C.K., & Keenan, M. (2007). Using video modeling to teach complex social sequences to children with autism. *Journal of Autism and Developmental Disorders, 37,* 678-693.

Paterson, C.R., & Arco, L. (2007). Using video modeling for generalizing toy play in children with autism. *Behavior Modification, 31,* 660-681.

Reeve, S.A., Reeve, K.F., Townsend, D.B., & Poulson, C.L. (2007). Establishing a generalized repertoire of helping behavior in children with autism. *Journal of Applied Behavior Analysis, 40,* 123-136.

Sherer, M., Pierce, K.L., Paredes, S., Kisacky, K.L., Ingersoll, B., & Schreibman, L. (2001). Enhancing conversation skills in children with autism via video technology: Which is better, "Self" or "Other" as a model? *Behavior Modification, 25,* 140-158.

Simpson, A., Langone, J., & Ayres, K.M. (2004). Embedded video and computer based instruction to improve social skills for students with autism. *Education and Training in Developmental Disabilities, 39,* 240-252.

Taylor, B.A., Levin, L., & Jasper, S. (1999). Increasing play-related statements in children with autism toward their siblings: Effects of video modeling. *Journal of Developmental and Physical Disabilities, 11,* 253-264.

Wert, B.Y., & Neisworth, J.T. (2003). Effects of video self-modeling on spontaneous requesting in children with autism. *Journal of Positive Behavior Interventions, 5,* 30-34.

Appendix B

Reference List of Systematic and Meta-Analytic Reviews on Variations and Relative Effects of Video Modeling Published since Busick (2010) Review

Mason, R. A., Davis, H. S., Boles, M. B., & Goodwyn, F. (2013). Efficacy of point-of-view video modeling: A meta-analysis. *Remedial and Special Education, 34*(6), 333-345. doi:http://dx.doi.org/10.1177/0741932513486298

Mason, R. A., Ganz, J. B., Parker, R. I., Boles, M. B., Davis, H. S., & Rispoli, M. J. (2013). Video-based modeling: Differential effects due to treatment protocol. *Research in Autism Spectrum Disorders, 7*(1), 120-131. doi:http://dx.doi.org/10.1016/j.rasd.2012.08.003

Mason, R. A., Ganz, J. B., Parker, R. I., Burke, M. D., & Camargo, S. P. (2012). Moderating factors of video-modeling with other as model: A meta-analysis of single-case studies. *Research in Developmental Disabilities, 33*(4), 1076-1086. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1013493256?accountid=14816

Shukla-Mehta, S., Miller, T., & Callahan, K. J. (2010). Evaluating the effectiveness of video instruction on social and communication skills training for children with autism spectrum disorders: A review of the literature. *Focus on Autism and Other Developmental Disabilities, 25*(1), 23-36. doi:http://dx.doi.org/10.1177/1088357609352901

Sng, C. Y., Carter, M., & Stephenson, J. (2014). A Review of Video Modelling and Scripts in Teaching Conversational Skills to Individuals with Autism Spectrum Disorders. *Review Journal of Autism and Developmental Disorders,1*(2), 110-123.

Wang, S., Cui, Y., & Parrila, R. (2011). Examining the effectiveness of peer-mediated and video-modeling social skills interventions for children with autism spectrum disorders: A meta-analysis in single-case research using HLM. *Research in Autism Spectrum Disorders, 5*(1), 562-569. doi:http://dx.doi.org/10.1016/j.rasd.2010.06.023

Appendix C

Reference List for Sample of Video Modeling Studies Published between 2010 - 2015

Study Reference (first sorted by publication year, then in alphabetical order by first author's last name)	Pub. Year
1. Blum-Dimaya, A., Reeve, S. A., Reeve, K. F., & Hoch, H. (2010). Teaching children with autism spectrum disorders to play a video game using activity schedules and game-embedded simultaneous video modeling. *Education & Treatment of Children, 33*(3), 351-370. doi:http://dx.doi.org/10.1353/etc.0.0103	2010
2. Geiger, K. B., LeBlanc, L. A., Dillon, C. M., & Bates, S. L. (2010). An evaluation of preference for video and in vivo modeling. *Journal of Applied Behavior Analysis, 43*(2), 279-283. doi:http://dx.doi.org/10.1901/jaba.2010.43-279	2010
3. Rosenberg, N. E., Schwartz, I. S., & Davis, C. A. (2010). Evaluating the utility of commercial videotapes for teaching hand washing to children with autism. *Education & Treatment of Children, 33*(3), 443-455. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/747781534?accountid=14816	2010
4. Sancho, K., Sidener, T. M., Reeve, S. A., & Sidener, D. W. (2010). Two variations of video modeling interventions for teaching play skills to children with autism. *Education & Treatment of Children, 33*(3), 421-442. doi:http://dx.doi.org/10.1353/etc.0.0097	2010
5. Akmanoglu, N., & Tekin-Iftar, E. (2011). Teaching children with autism how to respond to the lures of strangers. *Autism: The International Journal of Research and Practice, 15*(2), 205-222. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/870287456?accountid=14816	2011
6. Buggey, T., Hoomes, G., Sherberger, M. E., & Williams, S. (2011). Facilitating social initiations of preschoolers with autism spectrum disorders using video self-modeling. *Focus on Autism and Other Developmental Disabilities, 26*(1), 25. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/855758475?accountid=14816	2011
7. Buggey, T. (2012). Effectiveness of video self-modeling to promote social initiations by 3-year-olds with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 27*(2), 102-110. doi:http://dx.doi.org/10.1177/1088357612441826	2012
8. Mechling, L. C., & Ayres, K. M. (2012). A comparative study: Completion of fine motor office related tasks by high school students with autism using video models on large and small screen sizes. *Journal of Autism and Developmental Disorders, 42*(11), 2364-2373. doi:http://dx.doi.org/10.1007/s10803-012-1484-1	2012

9. Dupere, S., MacDonald, R. P. F., & Ahearn, W. H. (2013). Using video modeling with substitutable loops to teach varied play to children with autism. *Journal of Applied Behavior Analysis, 46*(3), 662-668. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1449312098?accountid=14816 — 2013

10. Mechling, L. C., & Swindle, C. O. (2013). Fine and gross motor task performance when using computer-based video models by students with autism and moderate intellectual disability. *The Journal of Special Education, 47*(3), 135-147. doi:http://dx.doi.org/10.1177/0022466911433859 — 2013

11. Moore, D. W., Anderson, A., Treccase, F., Deppeler, J., Furlonger, B., & Didden, R. (2013). A video-based package to teach a child with autism spectrum disorder to write her name. *Journal of Developmental and Physical Disabilities, 25*(5), 493-503. doi:http://dx.doi.org/10.1007/s10882-012-9325-x — 2013

12. Shrestha, A., Anderson, A., & Moore, D. W. (2013). Using point-of-view video modeling and forward chaining to teach a functional self-help skill to a child with autism. *Journal of Behavioral Education, 22*(2), 157-167. doi:http://dx.doi.org/10.1007/s10864-012-9165-x — 2013

13. Smith, M., Ayres, K., Mechling, L., & Smith, K. (2013). Comparison of the effects of video modeling with narration vs. video modeling on the functional skill acquisition of adolescents with autism. *Education and Training in Autism and Developmental Disabilities, 48*(2), 164-178. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1503665190?accountid=14816 — 2013

14. Yakubova, G., & Taber-Doughty, T. (2013). Effects of video modeling and verbal prompting on social skills embedded within a purchasing activity for students with autism. *Journal of Special Education Technology, 28*(1), 35. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1552813318?accountid=14816 — 2013

15. Akmanoglu, N., Yanardag, M., & Batu, E. S. (2014). Comparing video modeling and graduated guidance together and video modeling alone for teaching role playing skills to children with autism. *Education and Training in Autism and Developmental Disabilities, 49*(1), 17-31. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1518032467?accountid=14816 — 2014

16. Drysdale, B., Lee, C. Y. Q., Anderson, A., & Moore, D. W. (2014). Using video modeling incorporating animation to teach toileting to two children with autism spectrum disorder. *Journal of Developmental and Physical Disabilities.* doi:http://dx.doi.org/10.1007/s10882-014-9405-1 — 2014

Appendix C, cont.

17.	Lee, C. Y. Q., Anderson, A., & Moore, D. W. (2014). Using video modeling to toilet train a child with autism. *Journal of Developmental and Physical Disabilities, 26*(2), 123-134. doi:http://dx.doi.org/10.1007/s10882-013-9348-y	2014
18.	Rudy, N. A., Betz, A. M., Malone, E., Henry, J. E., & Chong, I. M. (2014). Effects of video modeling on teaching bids for joint attention to children with autism. *Behavioral Interventions, 29*(4), 269-285. doi:http://dx.doi.org/10.1002/bin.1398	2014
19.	Spriggs, A. D., Knight, V., & Sherrow, L. (2014). Talking picture schedules: Embedding video models into visual activity schedules to increase independence for students with ASD. *Journal of Autism and Developmental Disorders.* doi:http://dx.doi.org/10.1007/s10803-014-2315-3	2014
20.	Malmberg, D. B., Charlop, M. H., & Gershfeld, S. J. (2015). A two experiment treatment comparison study: Teaching social skills to children with autism spectrum disorder. *Journal of Developmental and Physical Disabilities.* doi:http://dx.doi.org/10.1007/s10882-015-9420-x	2015

Appendix D
Echolalia and Imitation Questionnaire

1. About how many hours per day does your child watch cartoons, movies, TV shows, and/or commercials?

0-1 1-2 3-5 5-10 More than 10

2. About how many times per day does your child repeat phrases from cartoons, movies, TV shows, or commercials immediately after hearing them?

0 1-2 3-5 5-10 More than 10

3. About how many times per day does your child repeat phrases from cartoons, movies, TV shows, or commercials at least 1 minute after hearing them?

0 1-2 3-5 5-10 More than 10

4. About how many times per day does your child repeat phrases he/she has heard from cartoons, movies, TV shows, or commercials at least 1 day after hearing them?

0 1-2 3-5 5-10 More than 10

5. Can you give some specific examples of phrases heard from cartoons, movies, TV shows, or commercials your child has repeated?

6. Does your child ever change phrases he/she has heard from cartoons, movies, TV shows, or commercials or does he/she repeat them exactly as they were stated?

7. Does your child ever use phrases he/she has heard from cartoons, movies, TV shows, or commercials to communicate with others?

8. How long does your child continue to use phrases he/she has heard from cartoons, movies, TV shows, or commercials?

The same day only Many days later Many weeks later Many months later

9. Does your child ever imitate other types of behaviors he/she has seen in cartoons, movies, TV shows, or commercials? For example, physical movements such as playing with toys, making facial expressions, dancing, pretending, clapping, playing instruments, etc.

10. Can you give some examples of behaviors seen in cartoons, movies, TV shows, or commercials he has imitated?

Appendix E
Object Imitation Subscale of Motor Imitation Scale
(Stone, Ousley, & Littleford, 1997)

General rule of scoring the MIS; score of 2 reflects a complete imitation, score of 1 reflects a partial imitation or an attempt but unsuccessful similar action, and a score of 0 reflects no imitation.

1. Bang spoon on table
   2 = purposefully bangs spoon on table one or more times
   1 = purposefully shakes but doesn't touch table with spoon, and holds spoon and performs another action with object (not mouthing)
   0 = none of the above

2. Shake noisemaker
   2 = purposefully shakes noisemaker back and forth at least once to make "rattle" noise
   1 = purposefully holds rattle and/or performs another action
   0 = none of the above

3. Push car across the tabletop
   2 = purposefully moves car in at least one direction across tabletop (keeps car in hand)
   1 = purposefully "hopped" car across tabletop or rolled it in an obviously different motion, releases car (shoves across table), moves car on roof, rolls on own or examiner's body
   0 = none of the above

4. Slides teacup across the tabletop
   2 = purposefully slides cup in at least one direction across tabletop (keeps cup in hand)
   1 = purposefully "hopped" cup across tabletop or pushes in an obviously different motion, releases cup resulting in shoving it across table
   0 = none of the above

5. Walk toy dog across tabletop
   2 = purposefully "hops" toy dog in at least one direction across tabletop
   1 = purposefully "hops" toy dog in place
   0 = none of the above

6. Walk hairbrush across the tabletop
   2 = purposefully "hops" brush in at least one direction across tabletop
   1 = purposefully "hops" brush in place
   0 = none of the above

7. Place small block on top of head
   2 = purposefully places block on top of own head using one or both hands
   1 = purposefully lifts block but does not place on head or puts on examiner's head
   0 = none of the above

8. Hold string of play beads behind neck
   2 = purposefully lifts beads to front of neck and puts ends at or behind plane defined by shoulders
   1 = purposefully lifts beads to back of neck holding ends in front (i.e., clasp in front) or puts beads on examiner's neck
   0 = none of the above

Appendix F

Procedures and Data Collection for Play-Based Assessment to Assess Verbal Imitation Ability

A 20-minute play session with preferred familiar toys and sets (as reported by parents and/or caregivers) will be conducted. The PI will imitate the child's toy play actions. For each toy play action the child demonstrates, the PI will use a two-level prompting hierarchy to assess the child's verbal imitation ability. First, the PI will verbally model a play narration. The structure of each modeled play narration will include an action verb, subject, and a prepositional phrase with object (e.g., "Driving car up the ramp," "Baby sleep in bed," "Plane lands on building"). To be counted as a correct imitation, the child must imitate all parts of the modeled play narration. Errors in verb tense, word order, pluralization, articles, or other morphological endings will be disregarded. If the child does not correctly imitate the narration within 3 s, the PI will directly verbally instruct the child to say the play narration (e.g., "Say (play narration)"). To be included in the study, the child must correctly imitate at least 70% (7 out of 10) of all modeled play narrations (using either level of the prompting hierarchy).

Implementer: ______________ Session: ______________ Date: _____________

Participant: _______________

Assent: Are you ready to come play with me? Yes No

Child Assent Obtained: _________________ Initials ___________

Trial	Modeled Play Narration	Prompt #1 (Model)	Prompt #2 (Verbal Instruction)
1		C I NR	C I NR
2		C I NR	C I NR
3		C I NR	C I NR
4		C I NR	C I NR
5		C I NR	C I NR
6		C I NR	C I NR
7		C I NR	C I NR
8		C I NR	C I NR
9		C I NR	C I NR
10		C I NR	C I NR
Total Correct (From Both Columns)			
Percent Correct			
Mean Length Of Utterance Of Correctly Imitated Play Narrations			

C = Correct response, I = Incorrect response, NR = No response

Figure 7 with Secondary Observer's Data

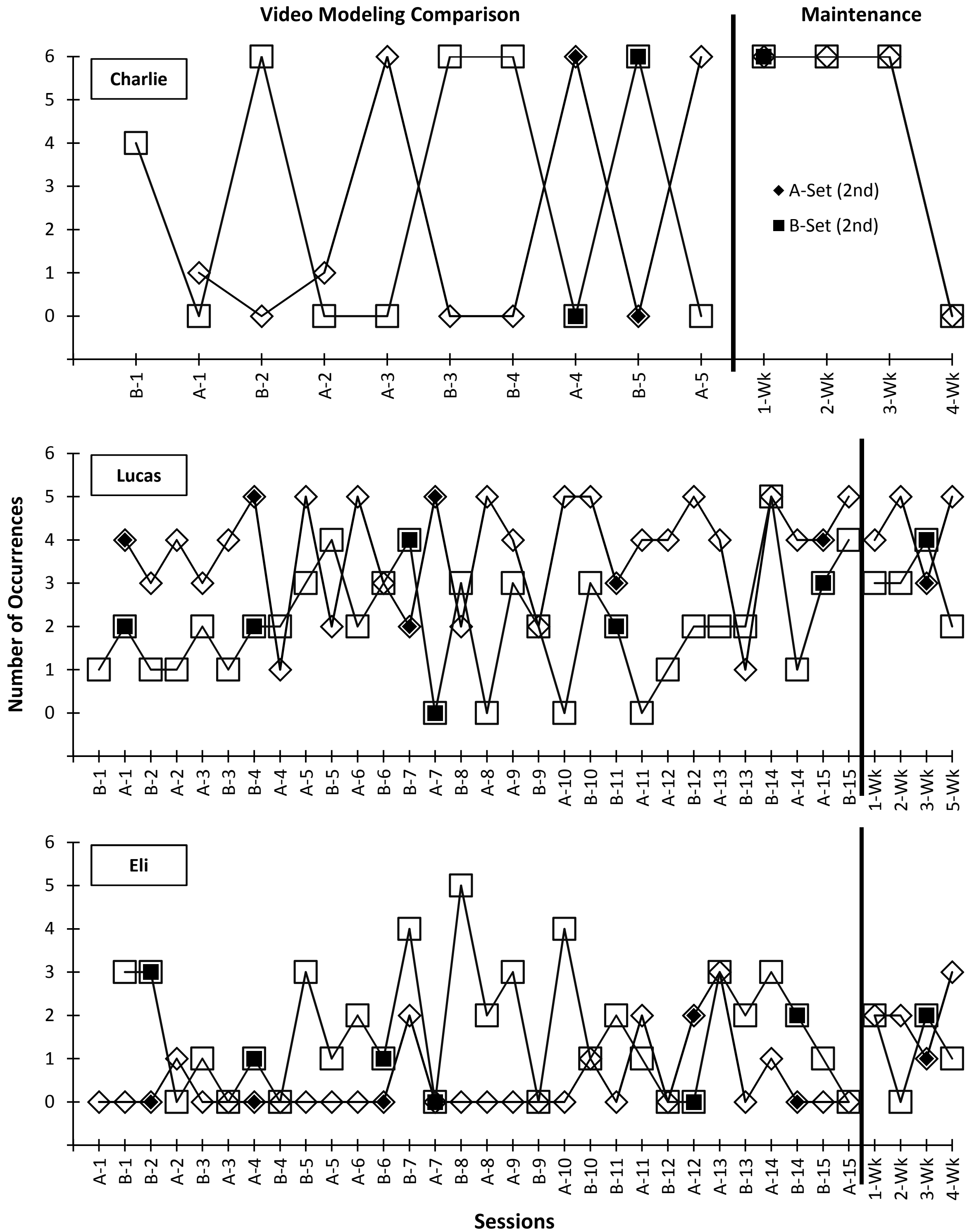

Figure 7 (with secondary observer's data). Number of unique modeled play actions per session in the comparison and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Figure 8 with Secondary Observer's Data

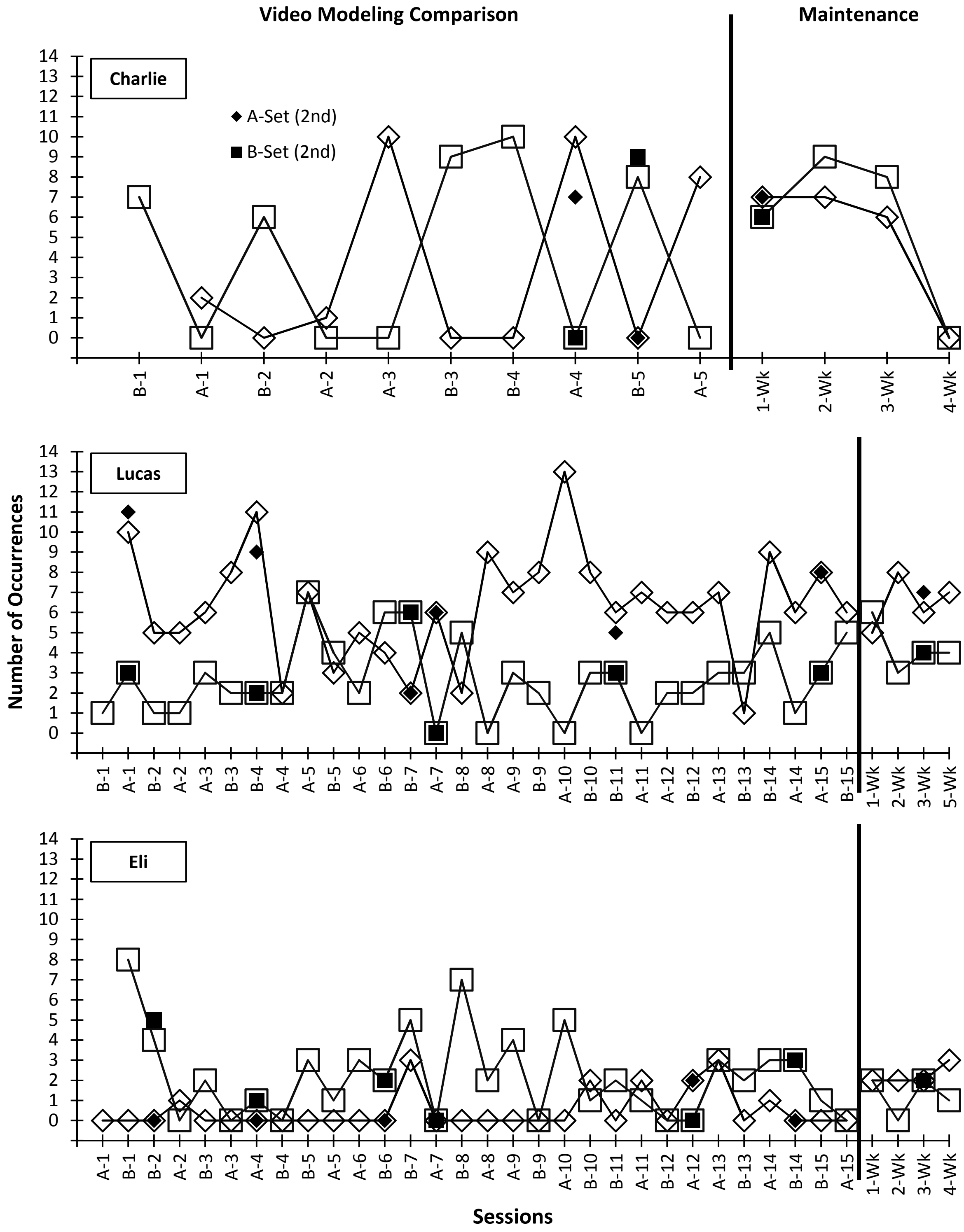

Figure 8 (with secondary observer's data). Number of total modeled play actions per session in the comparison and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Figure 10 with Secondary Observer's Data

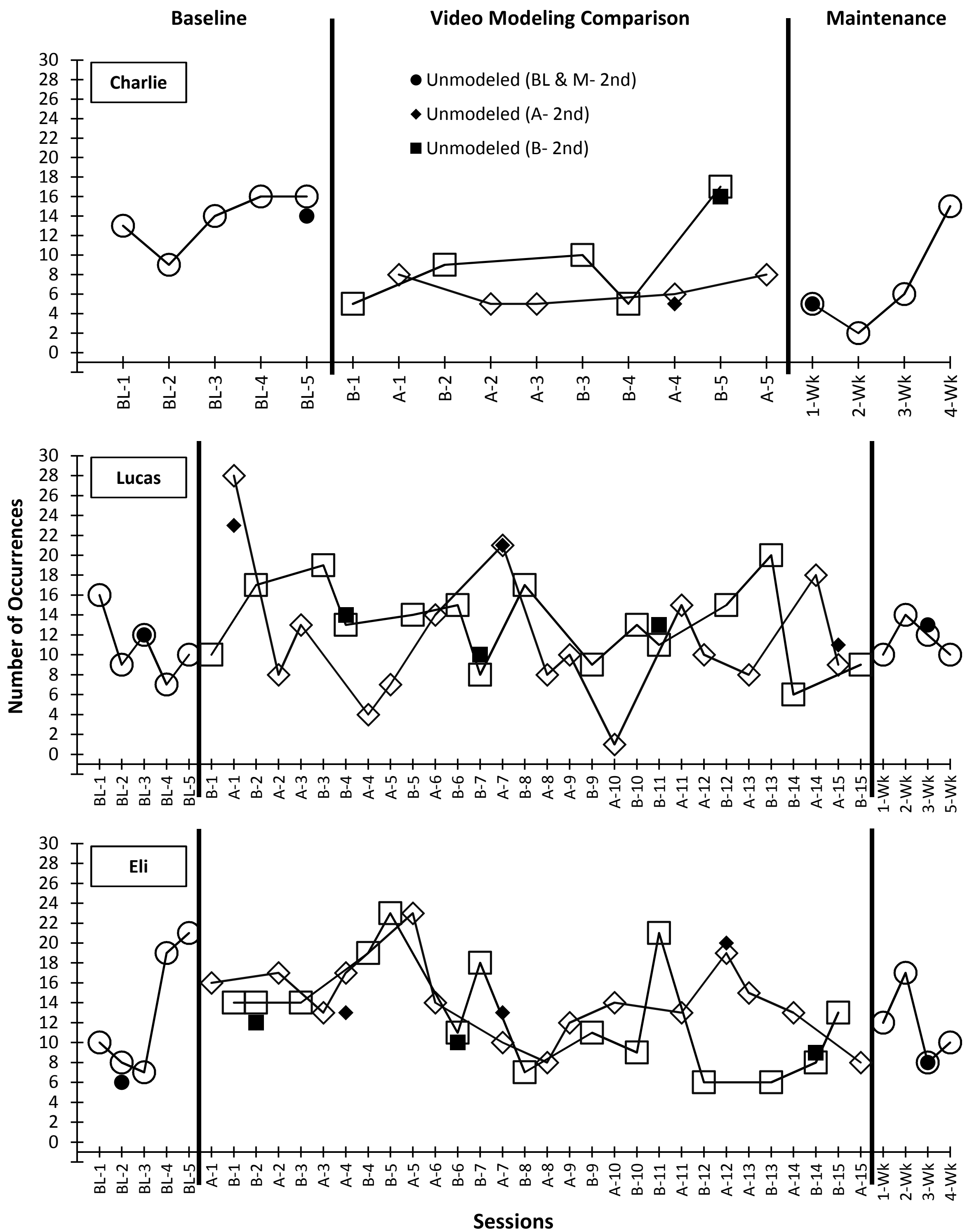

Figure 10 (with secondary observer's data). Number of unique unmodeled play actions per session in the baseline, comparison (split between A- and B-sessions), and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Appendix J

Figure 11 with Secondary Observer's Data

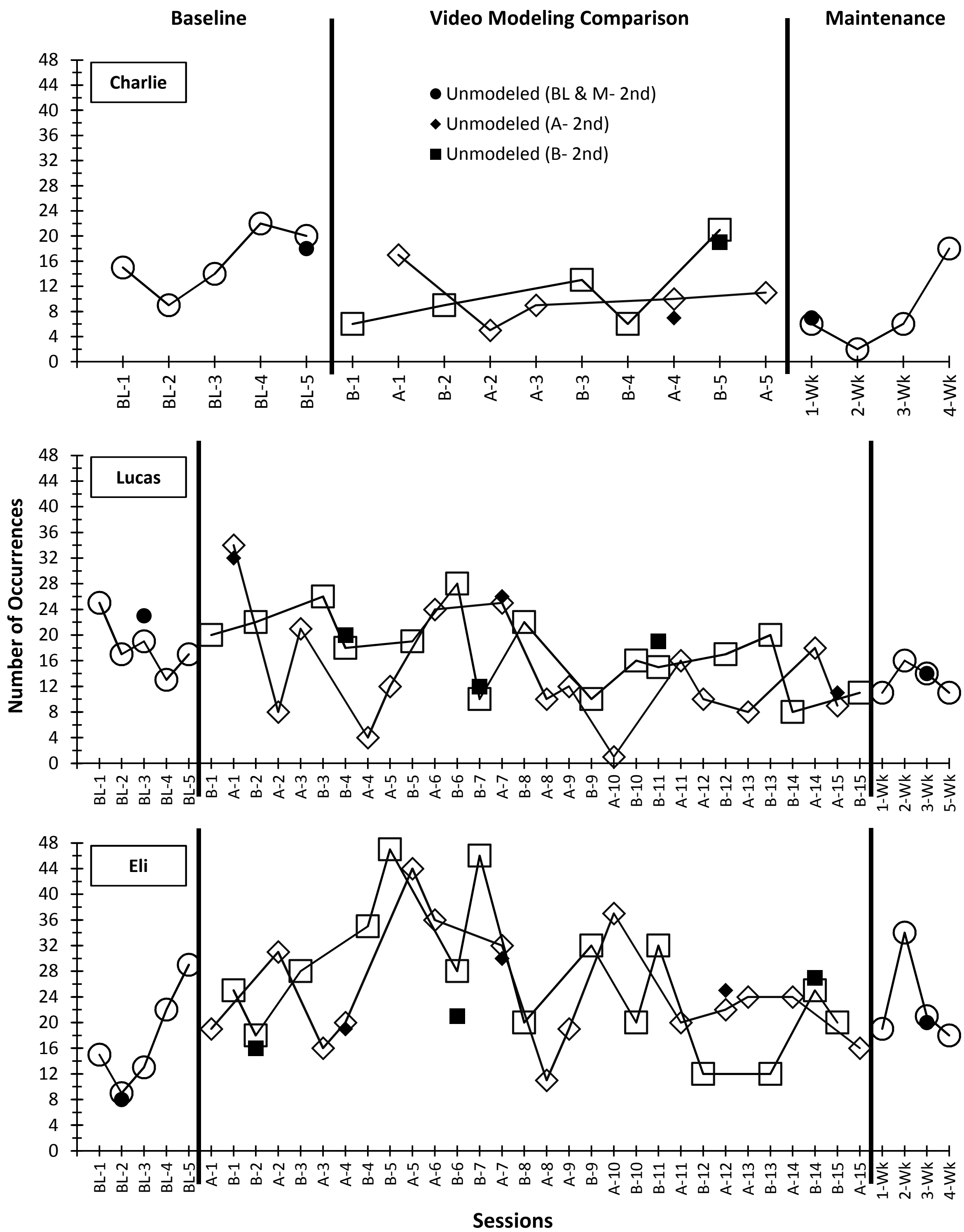

Figure 11 (with secondary observer's data). Number of total unmodeled play actions per session in the baseline, comparison (split between A- and B-sessions), and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Figure 13 with Secondary Observer's Data

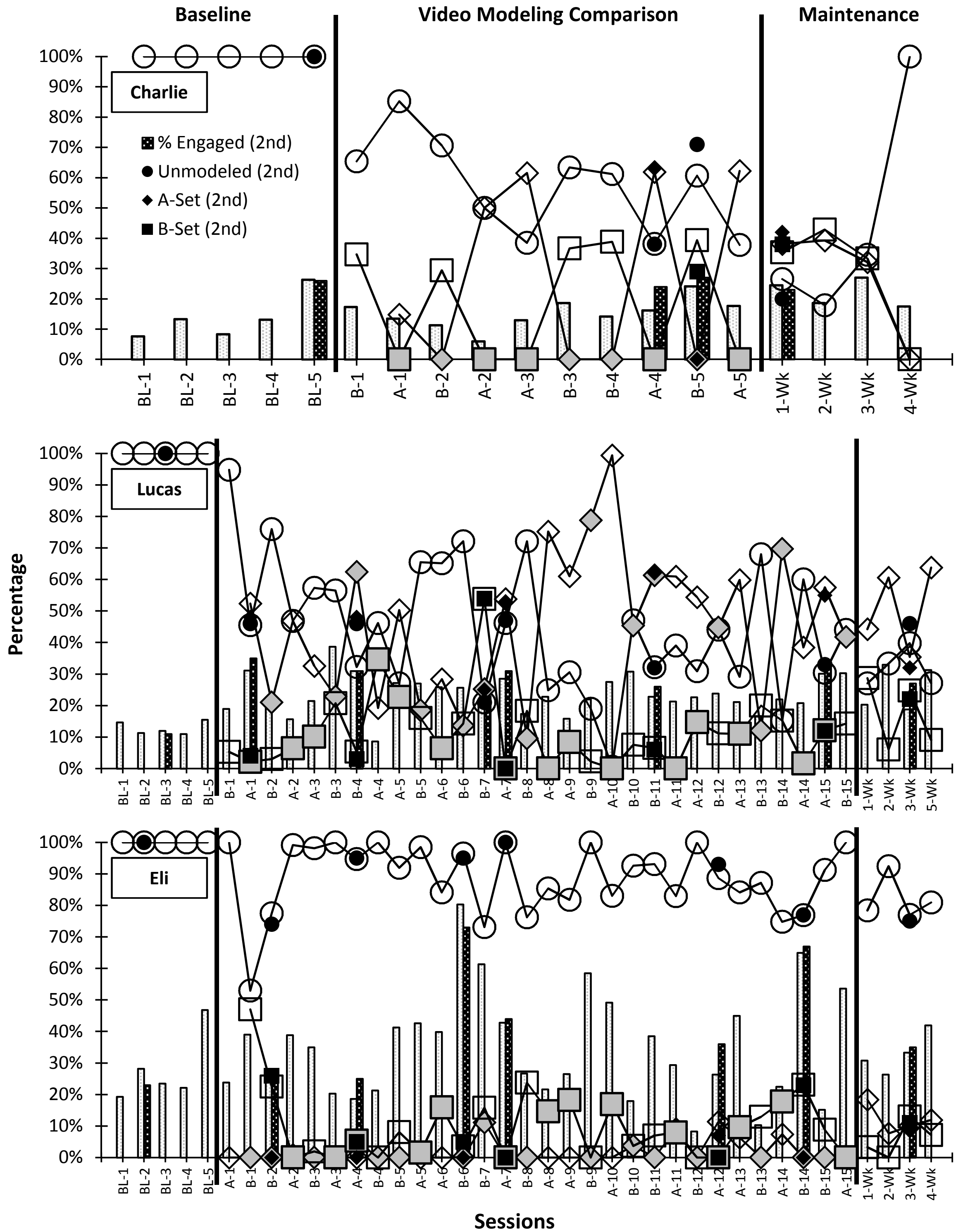

Figure 13 (with secondary observer's data). Percentage of total session engaged in play actions (bars) and percentage of total play action engagement allocated to unmodeled and modeled A- and B-set play actions (non-target sessions gray-filled) in the baseline, comparison, and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

Figure 14 with Secondary Observer's Data

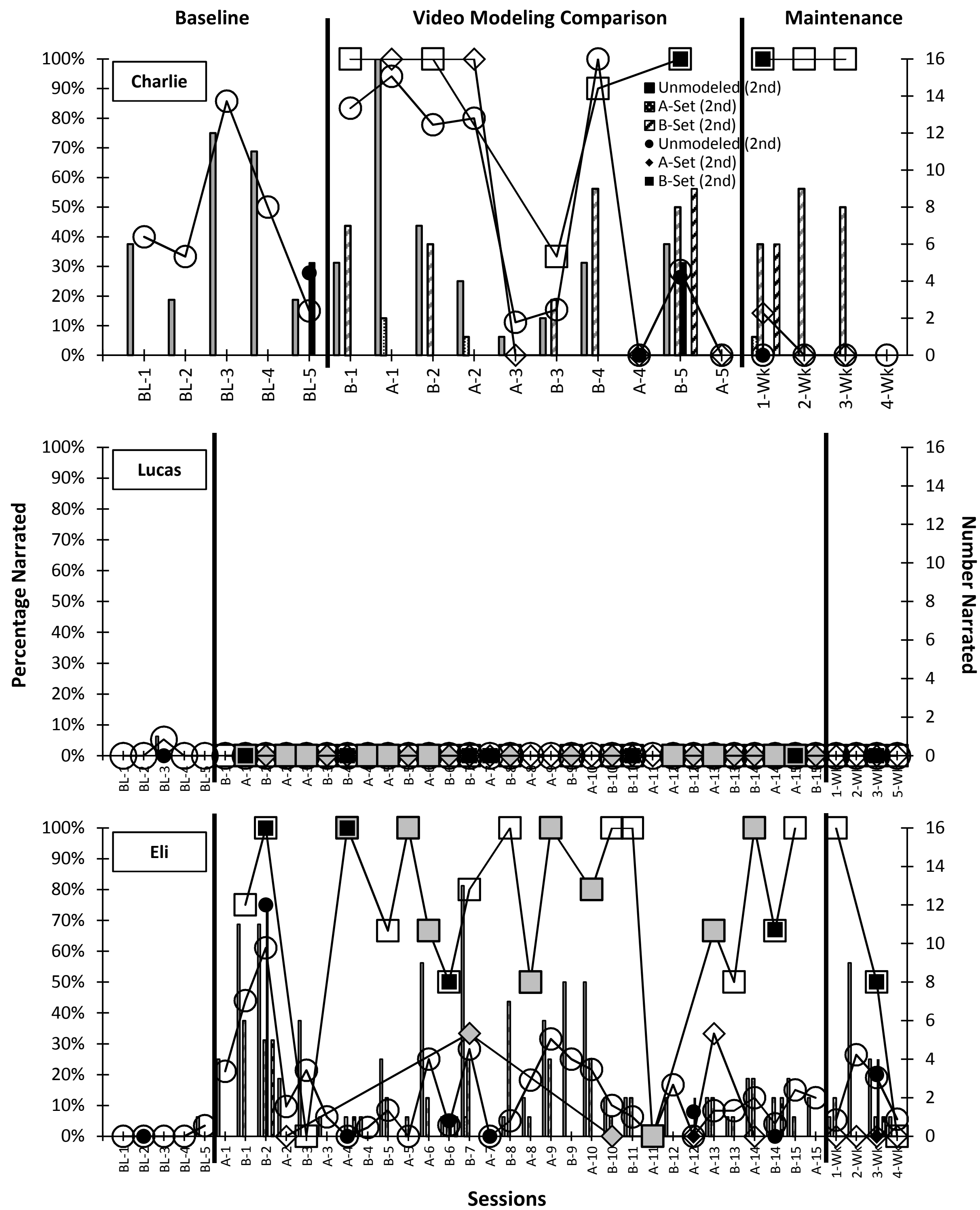

Figure 14 (with secondary observer's data). Percentage (lines; values graphed on primary Y-axis) and number (bars; values graphed on secondary Y-axis) of unmodeled and modeled A- and B-set play actions (non-target sessions gray-filled) that were narrated in the baseline, comparison, and maintenance phases for Charlie (top panel), Lucas (middle panel), and Eli (bottom panel).

REFERENCES

Akmanoglu, N., & Tekin-Iftar, E. (2011). Teaching children with autism how to respond to the lures of strangers. *Autism: The International Journal of Research and Practice, 15*(2), 205-222. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/870287456?accountid=14816

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Apple, A.L., Billingsley, F., & Schwartz, I.S. (2005). Effects of video modeling alone and with self-management on compliment-giving behaviors of children with high-functioning ASD. *Journal of Positive Behavior Interventions, 7,* 33-46.

Ayres, K., & Ledford, J.R. (2014). Dependent measures and measurement systems. In D.L. Gast & J.R. Ledford (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed.) (pp. 124-153). New York, NY: Routledge.

Bandura, A. (1977). *Social learning theory.* Englewood Cliffs, NJ: Prentice Hall.

Bellini, S., & Akullian, J. (2007). A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorders. *Exceptional Children, 73*(3), 264-287. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/621658332?accountid=14816

Bellini, S., Akullian, J., & Hopf, A. (2007). Increasing social engagement in young children with autism spectrum disorders using video self-modeling. *School Psychology Review, 36,* 80-90.

Blum-Dimaya, A., Reeve, S. A., Reeve, K. F., & Hoch, H. (2010). Teaching children with autism spectrum disorders to play a video game using activity schedules and game-embedded simultaneous video modeling. *Education & Treatment of Children, 33*(3), 351-370. doi:http://dx.doi.org/10.1353/etc.0.0103

Buggey, T. (2005). Video self-modeling applications with students with autism spectrum disorders in a small private school setting. *Focus on Autism and Other Developmental Disabilities, 20*(1)*,* 52-63.

Buggey, T. (2012). Effectiveness of video self-modeling to promote social initiations by 3-year-olds with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 27*(2), 102-110. doi:http://dx.doi.org/10.1177/1088357612441826

Buggey, T., Hoomes, G., Sherberger, M. E., & Williams, S. (2011). Facilitating social initiations of preschoolers with autism spectrum disorders using video self-modeling. *Focus on Autism and Other Developmental Disabilities, 26*(1), 25. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/855758475?accountid=14816

Buggey, T., Toombs, K., Gardener, P., & Cervitti, M. (1999). Training responding behaviors in students with autism: Using videotaped self-modeling. *Journal of Positive Behavior Interventions, 1,* 205-214.

Busick, M. (2010). *An analytic review of video modeling for individuals with autism spectrum disorders: Bandura's criteria for observational learning and procedural variations.* Unpublished manuscript, Department of Special Education, Peabody College, Vanderbilt University, Nashville, TN.

Charlop, M. H. (1983). The effects of echolalia on acquisition and generalization of receptive labeling in autistic children. *Journal of Applied Behavior Analysis, 16*(1), 111-126. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/616748713?accountid=14816

Charlop, M.H., & Milstein, J.P. (1989). Teaching autistic children conversational speech using video modeling. *Journal of Applied Behavior Analysis, 22,* 275-285.

Charlop-Christy, M.H., Le, L., & Freeman, K.A. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. *Journal of Autism and Developmental Disorders, 30,* 537-552.

Cooper, J.O., Heron, T.E., & Heward, W.L. (2007). Improving and assessing the quality of behavioral measurement. In *Applied behavior analysis* (2nd ed.) (pp. 102-124). Columbus, OH: Pearson Education, Inc.

D'Ateno, P., Mangiapanello, K., & Taylor, B.A. (2003). Using video modeling to teach complex play sequences to a preschooler with autism. *Journal of Positive Behavior Interventions, 5,* 5-11.

Dupere, S., MacDonald, R. P. F., & Ahearn, W. H. (2013). Using video modeling with substitutable loops to teach varied play to children with autism. *Journal of Applied Behavior Analysis, 46*(3), 662-668. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1449312098?accountid=14816

Gast, D.L., & Ledford, J.R. (Eds.). (2014). *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed.). New York, NY: Routledge.

Gast, D. L., & Spriggs, A. D. (2014). Visual analysis of graphic data. . In D.L. Gast & J.R. Ledford (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed.) (pp. 176-210). New York, NY: Routledge.

Geiger, K. B., LeBlanc, L. A., Dillon, C. M., & Bates, S. L. (2010). An evaluation of preference for video and in vivo modeling. *Journal of Applied Behavior Analysis, 43*(2), 279-283. doi:http://dx.doi.org/10.1901/jaba.2010.43-279

Gena, A., Couloura, S., & Kymissis, E. (2005). Modifying the affective behavior of preschoolers with autism using in-vivo or video modeling and reinforcement contingencies. *Journal of Autism and Developmental Disorders, 35,* 545-556.

Hine, J.F., & Wolery, M. (2006). Using point-of-view video modeling to teach play to preschoolers with autism. *Topics in Early Childhood Special Education, 26,* 83-93.

Horner, R.H., Carr, E.G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71,* 165-179.

Kratochwill, T.R., & Levin, J.R. (2014). Enhancing the scientific credibility of single-case intervention research: Randomization to the rescue. In T.R. Kratochwill & J.R. Levin (Eds.), *Single-case intervention research: Methodological and statistical advances* (pp. 53-89). Washington, DC: American Psychological Association.

Lee, C. Y. Q., Anderson, A., & Moore, D. W. (2014). Using video modeling to toilet train a child with autism. *Journal of Developmental and Physical Disabilities, 26*(2), 123-134. doi:http://dx.doi.org/10.1007/s10882-013-9348-y

Leung, J., & Wu, K. (1997). Teaching receptive naming of Chinese characters to children with autism by incorporating echolalia. *Journal of Applied Behavior Analysis, 30*(1), 59-68. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/619063956?accountid=14816

Lindsay, C. J., Moore, D. W., Anderson, A., & Dillenburger, K. (2013). The role of imitation in video-based interventions for children with autism. *Developmental Neurorehabilitation, 16*(4), 283-289. doi:http://dx.doi.org/10.3109/17518423.2012.758185

MacDonald, R., Clark, M, Garrigan, E., & Vangala, M. (2005). Using video modeling to teach pretend play to children with autism. *Behavioral Interventions, 20,* 225-238.

MacDonald, R.P., Dickson, C.A., Martineau, M., & Ahearn, W.H. (2015). Prerequisite skills that support learning through video modeling. *Education and Treatment of Children*, *38*(1), 33-47.

Maione, L., & Mirenda, P. (2006). Effects of video modeling and video feedback on peer-directed social language skills of a child with autism. *Journal of Positive Behavior Interventions, 8*(2), 106-118.

Malmberg, D. B., Charlop, M. H., & Gershfeld, S. J. (2015). A two experiment treatment comparison study: Teaching social skills to children with autism spectrum disorder. *Journal of Developmental and Physical Disabilities.* doi:http://dx.doi.org/10.1007/s10882-015-9420-x

Mason, R. A., Davis, H. S., Boles, M. B., & Goodwyn, F. (2013). Efficacy of point-of-view video modeling: A meta-analysis. *Remedial and Special Education, 34*(6), 333-345. doi:http://dx.doi.org/10.1177/0741932513486298

Mason, R. A., Ganz, J. B., Parker, R. I., Boles, M. B., Davis, H. S., & Rispoli, M. J. (2013). Video-based modeling: Differential effects due to treatment protocol. *Research in Autism Spectrum Disorders, 7*(1), 120-131. doi:http://dx.doi.org/10.1016/j.rasd.2012.08.003

Mason, R. A., Ganz, J. B., Parker, R. I., Burke, M. D., & Camargo, S. P. (2012). Moderating factors of video-modeling with other as model: A meta-analysis of single-case studies. *Research in Developmental Disabilities, 33*(4), 1076-1086. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1013493256?accountid=14816

Mechling, L. C., & Ayres, K. M. (2012). A comparative study: Completion of fine motor office related tasks by high school students with autism using video models on large and small screen sizes. *Journal of Autism and Developmental Disorders, 42*(11), 2364-2373. doi:http://dx.doi.org/10.1007/s10803-012-1484-1

Meltzoff, A. N. (1985). Immediate and deferred imitation in fourteen- and twenty-four-month-old infants. *Child Development,56*(1), 62-72. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/617018340?accountid=14816

Mullen, E. (1995). *Mullen scales of early learning*. Circle Pines, MN: AGS.

Nikopoulos, C.K., & Keenan, M. (2003). Promoting social initiation in children with autism. *Behavioral Interventions*, *18*, 87–108.

Nikopoulos, C.K., & Keenan, M. (2004). Effects of video modeling on social initiations by children with autism. *Journal of Applied Behavior Analysis*, *37*, 93–96.

Nikopoulos, C.K., & Keenan, M. (2007). Using video modeling to teach complex social sequences to children with autism. *Journal of Autism and Developmental Disorders, 37,* 678-693.

Paterson, C.R., & Arco, L. (2007). Using video modeling for generalizing toy play in children with autism. *Behavior Modification, 31,* 660-681.

Piaget, J. (1962) *Play, dreams, and imitation in childhood*. New York, NY: Norton.

Prizant, B.M. (1983). Language acquisition and communicative behavior in autism: Toward an understanding of the "whole" of it. *Journal of Speech and Hearing Disorders, 48,* 296-307.

Prizant, B.M., & Rydell, P.J. (1984). Analysis of functions of delayed echolalia in autistic children. *Journal of Speech and Hearing Research, 27*(2), 183-192.

Reichow, B., & Volkmar, F. R. (2010). Social skills interventions for individuals with autism: Evaluation for evidence-based practices within a best evidence synthesis framework. *Journal of Autism and Developmental Disorders, 40*(2), 149-166. doi:http://dx.doi.org/10.1007/s10803-009-0842-0

Reeve, S.A., Reeve, K.F., Townsend, D.B., & Poulson, C.L. (2007). Establishing a generalized repertoire of helping behavior in children with autism. *Journal of Applied Behavior Analysis, 40,* 123-136.

Rosenberg, N. E., Schwartz, I. S., & Davis, C. A. (2010). Evaluating the utility of commercial videotapes for teaching hand washing to children with autism. *Education & Treatment of Children, 33*(3), 443-455. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/747781534?accountid=14816

Rudy, N. A., Betz, A. M., Malone, E., Henry, J. E., & Chong, I. M. (2014). Effects of video modeling on teaching bids for joint attention to children with autism. *Behavioral Interventions, 29*(4), 269-285. doi:http://dx.doi.org/10.1002/bin.1398

Sancho, K., Sidener, T. M., Reeve, S. A., & Sidener, D. W. (2010). Two variations of video modeling interventions for teaching play skills to children with autism. *Education & Treatment of Children, 33*(3), 421-442. doi:http://dx.doi.org/10.1353/etc.0.0097

Sandall, S., Hemmeter, M.L., Smith, B. J., & McLean, M. (2005). *DEC recommended practices in early intervention / early childhood special education.* Longmont, CO: Sopris West.

Sherer, M., Pierce, K.L., Paredes, S., Kisacky, K.L., Ingersoll, B., & Schreibman, L. (2001). Enhancing conversation skills in children with autism via video technology: Which is better, "Self" or "Other" as a model? *Behavior Modification, 25,* 140-158.

Shukla-Mehta, S., Miller, T., & Callahan, K. J. (2010). Evaluating the effectiveness of video instruction on social and communication skills training for children with autism spectrum disorders: A review of the literature. *Focus on Autism and Other Developmental Disabilities, 25*(1), 23-36. doi:http://dx.doi.org/10.1177/1088357609352901

Simpson, A., Langone, J., & Ayres, K.M. (2004). Embedded video and computer based instruction to improve social skills for students with autism. *Education and Training in Developmental Disabilities, 39,* 240-252.

Smith, M., Ayres, K., Mechling, L., & Smith, K. (2013). Comparison of the effects of video modeling with narration vs. video modeling on the functional skill acquisition of adolescents with autism. *Education and Training in Autism and Developmental Disabilities, 48*(2), 164-178. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/1440031611?accountid=14816

Sng, C. Y., Carter, M., & Stephenson, J. (2014). A Review of Video Modelling and Scripts in Teaching Conversational Skills to Individuals with Autism Spectrum Disorders. *Review Journal of Autism and Developmental Disorders, 1*(2), 110-123.

Spriggs, A. D., Knight, V., & Sherrow, L. (2014). Talking picture schedules: Embedding video models into visual activity schedules to increase independence for students with ASD. *Journal of Autism and Developmental Disorders*, 1-16. doi:http://dx.doi.org/10.1007/s10803-014-2315-3

Stone, W.S., Ousley, O.Y., & Littleford, C.D. (1997). Motor imitation in young children with autism: What's the object? *Journal of Abnormal Child Psychology, 25,* 475-485.

Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In Volkmar, F. R., Paul, R., Klin, A., & Cohen, D. J. (Eds.), *Handbook of autism and pervasive developmental disorders, vol. 1: Diagnosis, development, neurobiology, and behavior* (3rd ed.) (pp. 335-364). Hoboken, NJ: John Wiley & Sons, Inc. Retrieved from http://search.proquest.com.proxy.library.vanderbilt.edu/docview/620781777?accountid=14816

Taylor, B.A., Levin, L., & Jasper, S. (1999). Increasing play-related statements in children with autism toward their siblings: Effects of video modeling. *Journal of Developmental and Physical Disabilities, 11,* 253-264.

Wang, S., Cui, Y., & Parrila, R. (2011). Examining the effectiveness of peer-mediated and video-modeling social skills interventions for children with autism spectrum disorders: A meta-analysis in single-case research using HLM. *Research in Autism Spectrum Disorders, 5*(1), 562-569. doi:http://dx.doi.org/10.1016/j.rasd.2010.06.023

Wang, P., & Spillane, A. (2009). Evidence-based social skills interventions for children with autism: A meta-analysis. *Education and Training in Developmental Disabilities*, *44*(3), 318-342.

Wert, B.Y., & Neisworth, J.T. (2003). Effects of video self-modeling on spontaneous requesting in children with autism. *Journal of Positive Behavior Interventions, 5,* 30-34.

Wolery, M., Gast, D. L., & Ledford, J.R. (2014). Comparison designs. In D.L. Gast & J.R. Ledford (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed.) (pp. 297-345). New York, NY: Routledge.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., . . . Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders.* doi:http://dx.doi.org/10.1007/s10803-014-2351-z