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Using Prompt Delay and Instructive Feedback to Teach Pretend Play Skills to Children with Autism Spectrum Disorder

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USING PROMPT DELAY AND INSTRUCTIVE FEEBDACK TO TEACH PRETEND PLAY SKILLS TO CHILDREN WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

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Pretend play involves carrying out routines, acting out roles, referencing absent or imaginary properties of objects, or substituting one object for another. Pretend play skills emerge in typically developing children by preschool age but are often absent or delayed in children with autism spectrum disorder (ASD). In the present study, we evaluated use of prompt delay, instructive feedback, and prompt delay with instructive feedback for the acquisition and maintenance of pretend play skills with children with ASD. Throughout training, we conducted free-play probes to evaluate generalization to a naturalistic setting. The results of the current study suggest that combining the prompt-delay and instructive-feedback procedures was most efficient for most participants. However, generalization to the free-play setting was limited. When clinically acceptable generalization was not observed during free-play probes, we used video modeling, contingent reinforcement, and prompts to increase responding during free-play probes.

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LIST OF ABBREVIATIONS

ASD	Autism Spectrum Disorder
MSWO	Multiple Stimulus Without Replacement
VR	Variable Ratio

CHAPER 1: INTRODUCTION

Children with autism spectrum disorder (ASD) demonstrate skill deficits or delays in a variety of domains, including play skills (Centers for Disease Control and Prevention, 2020). Independent play skills range from simple to more advanced (Casby, 2003). Casby described that early in life, play behavior begins with simple sensorimotor-exploratory actions (e.g., grasping and banging objects), followed by relational-nonfunctional actions (e.g., stacking and nesting objects), followed by functional-conventional actions (e.g., rolling toy cars), eventually evolving into pretend play. Pretend play involves carrying out routines, acting out roles, referencing absent or imaginary properties of objects, and substituting one object for another (Barton et al., 2019). Pretend play skills emerge in typically developing children by preschool age but are often absent or delayed in children with ASD (Barton, 2010).

The development of play skills provides opportunities for children with ASD to interact and form social relationships with their peers (DiCarlo & Reid, 2004; Jung & Sainato, 2013). Researchers have associated play skills with decreases in inappropriate behavior (Jung & Sainato, 2013) and increases in expressive speech and cognitive development (Stanley & Konstantareas, 2007). Despite the importance of play skills, previous researchers have found that children with ASD engage in pretend play less often and with less variety than typically developing children (Barton & Wolery, 2008). In order to address these skill deficits, researchers have evaluated several intervention strategies for increasing play skills in children with ASD, including prompting (e.g., Colozzi et al., 2008; Kasari et al., 2006; Lifter et al., 2005), video modeling (e.g., D'Ateno et al., 2003; Hine & Wolery, 2006; MacDonald et al., 2005), pivotal response training (Stahmer, 1995; Stahmer et al., 2006), activity schedules (Morrison et al., 2002), integrated playgroups (Wolfberg et al., 2015; Zercher et al., 2001), script training and script fading (Goldstein et al., 1988; Akers et al., 2018), leveraging restricted interests (Baker et al., 1998; Baker, 2000), social stories (Barry & Burlew, 2004), the natural language paradigm (Gillett & LeBlanc, 2007), matrix training (Dauphin et al., 2004) and instructive feedback (Colozzi et al., 2008; Grow et al., 2017).

Most of the interventions described above included prompting or reinforcement strategies, often in combination with each other or with additional intervention components. For example, video modeling involves presenting a video of appropriate play behavior before presenting an opportunity for the participant to play. Researchers who have evaluated other interventions, such as pivotal response training, prompting, script training, and matrix training have delivered model or physical prompts within sessions. Many previous studies also described social reinforcement contingencies. For example, Gillett and LeBlanc (2007) provided access to play materials contingent on correct responding. Interestingly, MacDonald et al. (2005) and D'Ateno et al. (2003) observed increases in pretend play skills following exposure to video models even though the experimenter did not deliver prompts or programmed reinforcement within sessions.

Although the interventions described above led to increases in play behavior in children with ASD, some of these studies failed to define the target behaviors and intervention procedures sufficiently for replication (e.g., the pivotal response training intervention package described in Stahmer et al., [1995] included nine intervention components, and these intervention components were not described in detail sufficient for replicability). In the present study, we compared interventions for increasing pretend play skills, described with a level of detail sufficient for replication, with children with ASD. We evaluated prompt delay and instructive feedback in combination and alone such that we could draw conclusions about the effects of both intervention components.

Instructive feedback is a procedure that involves presenting additional learning opportunities, referred to as secondary targets, during the inter-trial interval of discrete-trial instruction (Werts et al., 1995). Instructive feedback may be feasible to implement because it does not require the experimenter to deliver additional consequences (e.g., prompts, reinforcement) based on child responses. Further, instructive feedback may improve the efficiency of discrete-trial instruction because many learners acquire secondary targets in the absence of explicit training (Nottingham et al., 2015). Several studies have demonstrated the efficacy of instructive feedback in the context of language training for children with ASD (e.g., Schnell et al., 2018; Carroll & Kodak, 2015; Vladescu & Kodak, 2013). To our knowledge, only two studies have evaluated the use of instructive feedback to increase play skills in children with ASD (Colozzi et al., 2008; Grow et al., 2017).

Colozzi and colleagues (2008) used simultaneous prompting and instructive feedback to increase motor and vocal play behavior in three children with ASD and one child with Down syndrome in individual and small-group educational settings. These authors prompted participants to engage a doll in an action (e.g., put hands in sink; primary target) and engage in a primary vocalization (e.g., baby washes). After delivering an edible contingent on prompted correct responses, the experimenter presented a vocal-verbal secondary target that expanded on the primary vocalizations (e.g., her hands). Overall, the four participants acquired approximately 75% of the secondary targets.

More recently, Grow and colleagues (2017) evaluated instructive feedback in the context of tact training to increase play skills with one child with ASD. The experimenter used a prompt-delay procedure to teach the participant to tact features of common nouns. After delivering an edible contingent on independent or prompted correct tacts (primary targets), the experimenter modeled a play action and vocalization (secondary targets). The results of free-play probes showed that the participant acquired multiple sets of secondary play targets before reaching the mastery criterion for the tacts.

The results of Grow and colleagues (2017) and Colozzi and colleagues (2008) suggest that instructive feedback can increase play skills in children with ASD. However, a few limitations warrant discussion. First, these studies included a total of five participants. Although the use of single-case research methodology allows for a demonstration of experimental control with a small number of participants (Kazdin, 2011), the generality of these findings is unknown. The present study extended the existing body of literature by increasing the number of participants included in studies of instructive feedback and play skills.

Additionally, although one of the benefits of instructive feedback is that it can improve instructional efficiency, these studies did not report efficiency data that allow readers to evaluate whether this benefit was achieved. Efficiency can be measured in terms of sessions, exposures, or total training time before mastery (Cariveau et al., 2019; Kodak et al., 2016). Colozzi and colleagues (2008) reported the number of training trials conducted before the mastery criterion was achieved for each set of primary targets for each child in small group and individual teaching sessions. However, the number of exposures to the secondary targets before acquisition occurred was not reported. Further, because instructive feedback was included across all conditions, it is not possible to determine the extent to which instructive feedback improved efficiency. Additionally, Grow and colleagues (2017) did not compare the duration of tact training with and without instructive feedback. The present study addressed these limitations by directly comparing the number of sessions, total training duration, and mean training time per mastered target for conditions with and without instructive feedback (Cariveau et al., 2019; Kodak et al., 2016).

The primary purpose of the present study was to evaluate the efficacy and efficiency of prompt delay, prompt delay with instructive feedback, and instructive feedback alone for acquisition and maintenance of two- or three-step pretend play sequences and related vocalizations for children with ASD. Throughout training, we conducted free-play probes to evaluate the extent to which the behaviors targeted during training generalized to a more naturalistic, free-play setting. If clinically significant increases in play actions and vocalizations were not observed during free-play probes, we evaluated the efficacy of video modeling, reinforcement, and physical prompts for increasing play actions and vocalizations during free play.

CHAPTER 2: METHOD

Participants, Setting, and Materials

Three children with ASD participated. We considered children for participation if they were between the ages of two and six years, were currently receiving early intensive behavioral intervention services in a community-based clinic located in the Midwest, and had clinical goals related to increasing play skills. The Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) was conducted within three months of the start of each participant's enrollment in the study. All participants' total scores and scores on individual skill domains are depicted in Table 1.

Michael was a 4-year-old male of Black, European, and Asian descent. Michael had been receiving 20 hr per week of behavior-analytic intervention services for 9 months at the start of the study. Michael communicated using short phrases. Michael had previously received intervention for teaching him to assemble toys with multiple parts (e.g., building blocks, marble maze). Based on Michael's total score on the VB-MAPP, he was considered a level two learner.

Amira was a 5-year, 3-month-old female of South Asian descent. Amira had been receiving 13 hr per week of behavior-analytic intervention services for 6 months at the start of the study. Amira communicated using phrases and complete sentences. Amira had previously received intervention for tolerating therapists engaging in parallel play with her but had not received intervention targeting specific play skills. Based on Amira's total score on the VB-MAPP, she was considered a level three learner.

Richard was a 3-year, 2-month-old male of European descent. Richard had been receiving 20 hr per week of behavior-analytic intervention services for two months at the start of the study. Richard communicated using two-word phrases. Richard had not previously received behavior-analytic intervention related to play skills. Based on Richard's total score on the VB-MAPP, he was considered an emerging level two learner.

Sessions took place in a quiet area of the community-based clinic. Table 2 lists the play materials included in sessions. Materials also included a video camera, tripod, preferred items, tokens and token boards, paper, pens, and clipboards.

Inclusion Criteria and Pre-Assessments

Prior to beginning the study, we administered pre-assessments to evaluate participants' prerequisite skills. In all pre-assessments, the experimenter delivered praise for general compliance (e.g., remaining seated at the table) approximately every four trials. The experimenter provided brief breaks with access to tangible items following every 2-4 demands.

Independent Play Skills

In order to be eligible for inclusion in the present study, we required that participants met full scoring criteria for all level one milestones in the independent play domain of the VB-MAPP (Sundberg, 2008). These milestones included skills such as manipulating and exploring a variety of objects in multiple settings, engaging in movement play, and engaging in cause-and-effect play. The experimenter assessed independent play skills by reviewing clinical records.

Echoics

The experimenter administered the Early Echoic Skills Assessment (EESA; Esch, 2008) to ensure participants could reliably echo spoken sounds. The experimenter presented each echoic target and allowed up to 5 s for the participant to respond. If the participant echoed with point-to-point correspondence, the experimenter provided praise. If the participant did not emit a vocalization or emitted a vocalization that did not have point-to-point correspondence with the experimenter's model, she modeled the vocalization again. The experimenter provided praise following the second presentation if the participant echoed or attempted to echo the target sound. The experimenter moved to the next trial without providing praise following non-responses to the second presentation of the target sound. If a participant scored at least 50 total points, with at least 15 points from Group 2 (2-syllable combinations), we targeted play actions and vocalizations in the study. If a participant scored less than 50 total points or less than 15 points in Group 2, we would not have targeted vocalizations in the study. However, all participants met the scoring criteria described above.

The experimenter also conducted echoic probes of the target vocalizations to identify participants' closest approximations for each vocal response. During echoic probes, the experimenter presented a model of the target vocalization and allowed up to 5 s for the participant to respond. The experimenter provided praise if the participant attempted to echo within 5 s. The experimenter recorded the participant's response verbatim using paper and pencil. The experimenter conducted up to three echoic probes for each target vocalization. If participants were unable to echo a target vocal response exactly, we accepted their closest approximation during the study. If a participant was able to echo a target vocal response with point-to-point correspondence, we did not accept approximations of vocal responses during the study.

Michael received a total score of 60 on the EESA, with 20 points from Group 2. Amira received a total score of 95.5 on the EESA, with 30 points from Group 2. Richard received a total score of 68.5 on the EESA, with 27.5 points for Group 2. We identified acceptable approximations for the target vocalizations that participants were unable to echo exactly.

Listener Discriminations

We probed listener discriminations for pictures of the nouns and verbs included in the target vocalizations to ensure participants were familiar with the stimuli in the target vocalizations. Table 3 shows a list of listener discrimination targets. The experimenter presented picture cards in a horizontal array of three on the table in front of the participant, ensured that the participant attended to each picture card in the array, said, "[target]," and allowed the participant up to 5 s to respond. If the participant responded correctly, the experimenter delivered praise and a token. If the participant responded incorrectly or did not respond, the experimenter moved to the next trial without providing any programmed consequences.

Based on the results of listener discrimination probes, we conducted listener discrimination pre-training for targets to which the participant did not respond correctly in the initial probe trial. A member of the participant's clinical team (e.g., a behavior technician) placed the picture cards in a horizontal array of three on the table in front of the participant, ensured that the participant attended to each picture card in the array, said, "[target]," and allowed the participant up to 5 s to respond. If the participant responded correctly, the therapist delivered praise and a token. If the participant responded incorrectly or did not respond, the therapist provided a model prompt by touching the correct picture and allowing the participant up to 5 s to imitate the model. If the participant did not correctly imitate the model prompt within 5 s, the therapist physically guided the participant to touch the correct picture. Following prompted correct responses, the therapist provided praise and a token. We continued listener discrimination pre-training until the participant responded correctly to all pre-training targets on at least 90% of opportunities across two consecutive sessions.

Michael required listener discrimination pre-training on nine targets. For Michael, we concurrently trained all nine targets, and he met the mastery criterion following six training sessions. Amira required listener discrimination pre-training on six targets. For Amira, we concurrently trained all six targets, and she met the mastery criterion following five training sessions. Richard required listener discrimination pre-training on 17 targets. For Richard, we divided the targets into two sets of six and one set of five and trained one set at a time. Richard met the mastery criterion for his first and second sets following four training sessions each. Richard met the mastery criterion for his third set following 14 training sessions.

Imitation

We conducted imitation probes to ensure participants could reliably imitate fine motor movements with objects. We probed the 10 two-step fine motor movements depicted in Table 4 with each participant. We developed the imitation pre-assessment targets based on the responses participants would be required to engage in during the study. For example, we probed pushing a specific button on a plastic, battery-powered book as an indirect assessment of whether participants would be able to push the “open” button on the cash register. Based on the results of imitation pre-assessments, we modified participants’ operational definitions for correct play actions during the study when necessary (e.g., Michael was unable to open and close a pair of scissors during imitation pre-assessments, so he was not required to open and close the scissors when pretending to trim the dog's nails in the vet set).

During imitation pre-assessment probes, the experimenter delivered the vocal instruction "do this" while modeling the motor movement and allowed up to 5 s for the participant to imitate. If the participant imitated correctly within 5 s, the experimenter delivered praise and a token. If the participant did not respond or responded incorrectly, the experimenter provided one additional presentation of the model. The experimenter delivered praise and a token following correct responses to the second presentation of the model. Participants were considered eligible for inclusion in the study if they correctly imitated at least eight of the probe targets.

Richard engaged in errors with several of the imitation probe targets. Richard often imitated only one of the actions in the two-step sequence. Based on this error pattern, we modified Richard's imitation pre-assessment targets (Table 4). For Richard and Michael, we identified approximations for play responses that they were unable to imitate exactly (e.g., Michael was permitted to hold the scissors to the dog's paws without inserting his fingers into the handles or opening and closing the blades).

Dependent Measures and Data Collection

During discrete-trial instruction, our primary dependent variable was *percentage of independent correct responses.* There were two components to correct responses during discrete-trial instruction: independent correct play actions and independent correct vocalizations. We defined *independent correct play actions* as the participant initiating the target play action within 5 s and completing all steps of the target play action within 10 s of attending to the materials (i.e., if the participant initiated a correct response within 5 s, the experimenter allowed up to 10 s total for them to complete the response). We defined *independent correct vocalization* as the participant emitting the target vocalization (or acceptable approximation) during the response interval, no more than 2 s after completing the play action (i.e., if the participant emitted the correct play action without vocalizing, the experimenter waited up to 2 s for them to emit the vocalization). We scored an *error* for play action if the participant engaged with the materials in any way other than the target play action. We scored an *error* for vocalization if the participant emitted an intelligible vocalization other than the target vocalization. We scored a *no response* for play action if the participant did not engage with the materials within 5 s of initiating the trial. We scored a *no response* for vocalization if the participant did not emit any intelligible vocalizations during the response interval. Finally, we scored a *prompted correct response* if the participant emitted the target play action or vocalization within 5 s of the experimenter's prompt (model or physical). During conditions that included instructive feedback, we scored *correct imitative behavior* if the participant imitated both trial components, play actions and vocalizations, following the experimenter's model. We scored an *imitated play action* if the participant initiated the target play action within 5 s and completed all steps of the target play action within 10 s of attending to the materials. We scored an *imitated vocalization* if the participant emitted the correct vocalization during the response interval, no more than 2 s after completing the play action.

We measured the efficiency of training for each condition by measuring the total duration of training, number of training sessions conducted, and mean training time per mastered target. We measured duration of training by starting a stopwatch immediately (i.e., within 1 s) before presenting the materials for the first trial of a session and stopping the stopwatch immediately upon completion of the last trial. We calculated the total training duration by summing the duration of 0-s and 5-s prompt delay sessions (free-play, baseline, and secondary target probe sessions were not included in training duration measures). We measured the number of training sessions for each condition by summing the total number of 0-s and 5-s prompt-delay sessions for each condition. We calculated mean training time per mastered target by dividing the total training duration by the number of targets mastered in the condition.

During free-play probes, we measured the frequency of target play actions, non-target play actions, target vocalizations, and non-target vocalizations. We scored an instance of a target play action when a participant emitted a response that met the operational definition for a play behavior targeted during discrete-trial instruction (Table 5). We scored an instance of a non-target play action when a participant used an object according to its intended function, excluding target play actions. We also included actions that involved reference to absent or imaginary properties (e.g., appearing to "drink" from an empty cup; Barton et al., 2018). We scored an instance of a target vocalization when a participant emitted a vocal response that met the operational definition for a vocalization targeted during discrete-trial instruction (Table 5). We scored an instance of a non-target vocalization when the participant emitted an intelligible vocalization that related to the play actions or materials, excluding target vocalizations. We included vocalizations that involved tacts of present materials or actions (e.g., "puppy"), intraverbal comments (e.g., "he says woof"), and mands (e.g., "come here puppy"). We scored a new instance of behavior after the participant stopped an action for at least 3 s or engaged in a different target or non-target action or vocalization. Following this on-set/off-set criterion, we scored the same action or vocalization up to two times in a row and did not score another instance of a given action or vocalization until the participant engaged in at least one other target or non-target action or vocalization (we developed this criterion to avoid scoring repetitive or stereotypic behavior as appropriate). For example, if a participant repeatedly brought a play phone to their ear five times in a row (with at least 3 s between each instance), only the first two instances of this action were scored. We converted frequency measures to rate by dividing the frequency by the session duration (min).

Interobserver Agreement and Treatment Integrity

Two independent observers collected data for 55% of discrete-trial sessions for Michael, 41% of discrete-trial sessions for Amira, and 39% of discrete-trial sessions for Richard. For discrete-trial sessions, we calculated interobserver agreement for percentage of independent correct play actions, percentage of independent correct play vocalizations, percentage of prompted correct play actions, percentage of prompted correct play vocalizations, percentage of imitated play actions (conditions with instructive feedback), and percentage of imitated vocalizations (conditions with instructive feedback) using the trial-by-trial method. An agreement was scored if the two observers scored the same occurrence or nonoccurrence of behavior within a trial. We divided the number of agreements by the total number of agreements plus disagreements and multiplied the quotient by 100. Mean agreement was 97% for Michael (range, 83-100%), 98% for Amira (range, 83-100%), and 96% for Richard (range, 81-100%).

Two independent observers collected data for 35% of free-play sessions for Michael, 63% of free-play sessions for Amira, and 43% of free-play sessions for Richard. For free-play sessions, we used the mean count-per-interval method (Cooper et al., 2007) to calculate interobserver agreement. For each 10-s interval, we divided the number of agreements by the number of agreements plus disagreements for each dependent measure and calculated a percentage by multiplying the quotient by 100. We calculated mean agreement for each session by calculating the average agreement for each interval (i.e., we summed the agreement coefficients for each interval and divided by the total number of intervals). Mean agreement was 95% for Michael (range, 59-100), 88% for Amira (range, 62-100), and 97% for Richard (range, 63-100). Sessions with lower agreement coefficients were typically due to one of the observers having difficulty discerning participants' vocalizations (e.g., due to background noise) or participants engaging in repetitive actions or vocalizations. Occasionally, disagreements also occurred when one observer scored behavior as a target or non-target action and the other observer determined that the behavior did not meet the operational definition (e.g., Richard lightly tapping the hammer against the table such that it was unclear whether an audible noise was produced). Following these disagreements, the first author reviewed the operational definitions and video recordings with the second observer and provided an opportunity for them to ask questions.

An independent observer also scored procedural integrity data for 55% of discrete-trial sessions for Michael, 41% of discrete-trial sessions for Amira, 39% of discrete-trial sessions for Richard, 35% of free-play sessions for Michael, 63% of free-play sessions for Amira, and 43% of free-play sessions for Richard (see Appendix A for measures and operational definitions). We divided the number of components implemented correctly by the total number of components and multiplied by 100. For discrete-trial sessions, mean integrity was 99% for Michael (range, 88-100), 100% for Amira (range, 92-100), and 100% for Richard (range, 98-100). For free-play sessions, mean integrity was 100% for Michael, 100% for Amira and 100% for Richard.

Preference Assessments and Token Economies

At the start of each day that we conducted sessions, we conducted a brief, 7-item multiple stimulus without replacement preference assessment (MSWO) to identify the top four preferred tangible items (Carr et al., 2000). During each subsequent session that day, the experimenter conducted a brief MSWO using the top four items identified in the 7-item MSWO. Throughout the study, all items included in the brief MSWOs were only available during research sessions (except for tablets, which were available to participants at other times during their clinical services).

We delivered tokens on a fixed-ratio 1 schedule for independent correct responses with all participants. All participants had used token economies during their clinical services prior to participating in this study. For all participants, tokens were small, laminated pictures of preferred items that fastened to a laminated token board with Velcro™. Michael exchanged tokens on a variable ratio (VR) 3 schedule, Amira exchanged tokens on a VR4 schedule, and Richard exchanged tokens on a VR2 schedule. Tokens were exchangeable for 20-s access to the top-ranked item following correct responses during sessions, but the experimenter honored mands for other items when possible.

Identification of Materials and Target Behaviors

We identified play materials based on literature searches of common imaginative play sets, the ability to equate the number of materials across sets, and the ability to target a wide variety of actions with a wide variety of materials. Each set of materials contained 14-16 items. We developed target play actions based on the materials' conventional uses, as well as interviews conducted by the first author with developmental and school psychologists with experience in assessing and teaching play skills with young children. During the interviews, the first author asked the interviewees to provide definitions of pretend play based on their knowledge and experience. The first author also asked the interviewees to describe examples of how typically developing children might engage in pretend play with each of the sets of materials. The first author based the operational definitions and target behaviors for the present study on the interviewees' responses as well as previous literature.

Each target play action was a two-step (Michael and Richard) or three-step (Amira) sequence. We equated actions within and across conditions for response difficulty and number of materials, and we avoided creating play actions with similarity to other play actions (e.g., we did not target pretending to eat multiple foods in the kitchen set). We developed target play vocalizations based on the materials involved in the play action and the interviews conducted with developmental and school psychologists. We equated vocalizations within and across conditions for number of syllables, number of words, and part of speech (i.e., noun, verb), and we avoided vocalizations with overlapping sounds.

Experimental Design and Procedure

We conducted two comparisons with each participant using an adapted alternating treatments design (Sindelar et al., 1985) embedded within a multiple-probe design (Gast et al., 2018) to compare the efficacy of using prompt delay, prompt delay with instructive feedback, and instructive feedback alone for increasing pretend play skills with children with ASD. Before beginning training, we conducted free-play probes and discrete-trial baseline sessions for each condition. During training, we conducted secondary target probes following every two series of teaching for conditions with instructive feedback (one series was one teaching session in each condition). We conducted free-play probes following every three series of teaching. During training of the first comparison in the multiple-probe design, we conducted a free-play probe and discrete-trial baseline session for each condition in the second comparison following every two-to-four series of teaching in the first comparison. We continued training in a condition until the participant reached the mastery criterion, two consecutive sessions with at least 90% independent correct responses, or until they met the discontinuation criterion, double the number of training sessions as the first-mastered condition (excluding 0-s prompt delay sessions). When a participant met the discontinuation criterion in a condition, we used the procedure that was efficacious to teach the target responses. We randomly assigned toy sets to each condition for each participant. Play action and vocalization targets for each participant are depicted in Table 5.

General Discrete-Trial Procedure

All discrete-trial sessions were 12 trials. We conducted two-to-four sessions per day, four-to-five days per week. We conducted all sessions at a table, with the experimenter seated next to the participant. The experimenter initiated a trial by placing the materials on the table in front of the participant, ensuring attending, and allowing up to 5 s for the participant to respond. If the participant engaged in a correct play action and the corresponding play vocalization within 5 s, the experimenter provided praise and a token.

Baseline

As described above, the experimenter provided praise and a token for independent correct responses. During baseline, the experimenter did not provide prompts following incorrect play actions or vocalizations. In order to maintain motivation to respond and decrease the likelihood that the participant would engage in problem behavior, the experimenter interspersed a mastered task (e.g., motor imitation) on a VR2 schedule and provided praise and a token for compliance with the mastered task. We conducted a minimum of three baseline sessions for each condition and moved to intervention following three consecutive baseline sessions with stable, low levels of correct responding.

Prompt Delay

Following baseline, the experimenter conducted a minimum of two sessions at a 0-s prompt delay, in which the experimenter immediately prompted a correct response and provided reinforcement. During the first 0-s session for each condition, the experimenter modeled the play actions and vocalization and allowed the participant up to 5 s to imitate the model. The experimenter physically guided a correct response if the child did not imitate within 5 s. Following the first 0-s session, the experimenter analyzed levels of correct responding to the model prompt. If a participant responded to fewer than 50% of trials correctly following model prompts, the experimenter no longer implemented a model prompt for primary targets during any phase of training. Rather, the experimenter used physical prompts any time a prompt was necessary. During his first series of 0-s prompt delay, Michael responded correctly to 8% of trials following model prompts, so we omitted the model prompt from all subsequent sessions and only used physical prompts. Amira correctly responded to model prompts on 79% of trials, so we included the model prompt in subsequent training sessions. Richard responded correctly to 45% of trials following model prompts, so we omitted the model prompt and only used physical prompts in subsequent sessions.

After two consecutive 0-s prompt-delay sessions with at least 90% prompted correct responses, the experimenter implemented a constant 5-s prompt delay. The experimenter presented the materials and allowed up to 5 s for the participant to respond. If the participant engaged in a correct play action and the corresponding play vocalization within 5 s, the experimenter delivered praise and a token. If the participant did not engage in the correct play action or corresponding play vocalization, the experimenter provided a prompt. Because multiple responses were required within each trial, it was possible for a participant to engage in the correct play action but engage in an error or omit the corresponding play vocalization, and the experimenter's prompt varied depending on the participant's error. If the participant engaged in an incorrect play action and an incorrect vocalization, the experimenter prompted both the play action and vocalization. If the participant engaged in a correct play action but an incorrect play vocalization, the experimenter only prompted the play vocalization. If the participant engaged in a correct vocalization but an incorrect play action, the experimenter only prompted the play action.

For all participants, when a prompt for the vocalization was necessary, the experimenter modeled the correct vocalization every 5 s until the participant echoed, or until 10 model prompts had been provided. For Amira, when a prompt for the play action was necessary, the experimenter modeled the correct play action and allowed up to 5 s for her to imitate. If she did not engage in the correct play action within 5 s of the experimenter's model, she provided a physical prompt. For Michael and Richard, when a prompt for the play action was necessary, the experimenter physically guided a correct response. The experimenter delivered praise and a token following prompted correct responses until the participant engaged in correct play actions and vocalizations on 33% of trials for two consecutive sessions. Thereafter, prompted correct responses resulted in praise only. Across all conditions, we conducted training sessions until the participant's responding reached the mastery criterion (i.e., two consecutive sessions with at least 90% independent correct responses).

Prompt Delay with Instructive Feedback

Training sessions (0-s and 5-s prompt-delay sessions) for the prompt-delay with instructive-feedback condition were conducted in an identical manner to the prompt-delay condition with one exception. Immediately after delivering praise and a token or tangible item (or following praise for a prompted correct response once differential reinforcement was initiated), the experimenter modeled a secondary play action and vocalization. The experimenter kept the materials on the table within the participant's reach for an additional 5 s (if the participant initiated a correct response within 5 s, the experimenter allowed up to 10 s for the participant to complete the response). The experimenter did not provide any consequences regardless of the participant's response (e.g., imitative or echoic behavior), and did not interact with the participant within 5 s of imitative or echoic behavior in order to avoid inadvertently reinforcing these responses.

Procedural Modifications: Error Correction (Michael and Richard). In the prompt-delay condition in his first comparison, Michael consistently failed to emit one target correctly (place screw in hole, then place screwdriver in screw). In his second comparison, Michael's correct responding stabilized or decreased below mastery levels in the prompt-delay and prompt-delay with instructive-feedback conditions. In Richard's second comparison, he consistently emitted an error with one vocalization ("close") in the prompt-delay with instructive-feedback condition. To increase the number of opportunities to respond correctly, we implemented the re-present until independent error-correction procedure (Carroll et al., 2015). That is, following an error, the experimenter prompted a correct response, provided praise, then re-presented the trial until the participant responded correctly independently or 10 error-correction trials had been conducted without an independent correct response. The experimenter delivered praise and a token following correct responses in error correction if differential reinforcement for independent correct responses had not yet been initiated (i.e., the participant had not engaged in correct play actions and vocalizations on 33% of trials for two consecutive sessions). Thereafter, correct responses in error correction resulted in praise only.

Instructive Feedback

The experimenter placed the materials on the table in front of the participant, immediately modeled a secondary play action and vocalization, and allowed up to 5 s for the participant to respond (if the participant initiated a correct response within 5 s, the experimenter allowed up to 10 s for the participant to complete the response). The experimenter did not provide any consequences regardless of the participant's response and did not interact with the participant for 5 s following imitative or echoic behavior. The experimenter delivered praise and a token for appropriate session behavior (e.g., sitting in their seat, orienting toward the experimenter) on a schedule yoked to that of the preceding prompt-delay and prompt-delay with instructive-feedback sessions (i.e., the experimenter calculated the mean frequency of reinforcement delivery in the immediately preceding prompt-delay and prompt-delay with instructive-feedback sessions and provided reinforcement on an equivalent schedule).

Secondary Target Probes

We conducted a probe for acquisition of secondary targets approximately every two series of training. These sessions were conducted in an identical manner to baseline, described above.

Maintenance

We collected weekly maintenance data following mastery of each condition for four weeks. Maintenance procedures were identical to baseline.

Free-Play Probes

During free-play probes, the experimenter placed all of the materials for one set of toys (e.g., the kitchen set; Table 2) on the table in front of the participant, ensured the participant scanned the entire array of materials, and provided the instruction, “I am going to do some work. We will play when I am all done. You can play with these toys.” The experimenter then sat in a chair in the corner of the session area and appeared to be busy by looking at a clipboard. If the participant manded for the experimenter’s attention during the session, the experimenter said, “Not right now, let’s talk about that later. Please play with your toys” following the first mand for attention. The experimenter ignored subsequent mands for attention. If a participant manded to terminate the session, the experimenter said, “I’m almost done, please play for a few more minutes” following the first mand to terminate the session (participants were more likely to engage in mands for attention in the first few sessions, but rarely emitted mands for attention thereafter). The experimenter ignored subsequent mands to terminate the session (this rarely occurred). If the participant engaged in dangerous behavior or attempted to elope from the table, the experimenter blocked the behavior using the least amount of attention possible (e.g., following elopement, the experimenter physically guided the participant back to the table without saying anything or making eye contact with the participant; dangerous behavior rarely occurred). Free-play probes were each 2 min. Regardless of the participant's behavior, following the session, the experimenter provided praise and access to a preferred tangible item while she set up for the next session. Following the last free-play session of the day, the experimenter allowed the participant to leave the session area.

Video Modeling with Contingent Reinforcement

If a participant's rate of play and vocalizations during free-play probes did not increase to clinically acceptable levels following mastery of the second comparison, we evaluated the efficacy of video modeling and contingent reinforcement. We developed the video models based on Hine & Wolery (2006). Video modeling with contingent reinforcement sessions were conducted in an identical manner to free-play probes, described above, with two exceptions. Prior to the session, the experimenter presented a video model on a laptop in front of the participant. The experimenter ensured the participant attended to the entire video model. If the participant looked away from the laptop screen for 2 s, the experimenter paused the video, pointed to the screen, and provided the instruction "keep watching." The experimenter provided praise for attending to the video model approximately once per min. Each video was approximately 2.5 min and showed the experimenter engaging in play and vocalizations with the materials for a condition (similar to Hine & Wolery, 2006). When filming the video models, the camera was held behind the experimenter's head, so that the video recorded the experimenter's point of view (Hine & Wolery). However, unlike Hine and Wolery, the experimenter was sometimes visible in our video models (the camera angle was not wide enough to record all of the materials without sometimes including parts of the experimenter's head or face). During each video, the experimenter modeled each target action and corresponding target vocalization in the condition at least once. The experimenter also modeled a variety of non-target actions and non-target vocalizations (range, 12-22 non-target actions; 10-21 non-target vocalizations; fewer non-target actions and vocalizations were modeled in the video models for the prompt-delay with instructive-feedback condition because the target behaviors occupied the majority of the video time). The order of target and non-target actions and vocalizations was counterbalanced across videos. The video model also showed the delivery of tokens, approximately once every 30 s, provided contingent on emitting target or non-target actions or vocalizations.

After presenting the video model, the experimenter began the free-play session. The experimenter ensured the participant scanned the array of materials, delivered the instruction, and began the 2-min timer. During the session, the experimenter held the participant's token board in their line of sight and delivered up to one token per 30-s interval, contingent on emitting target or non-target actions or vocalizations. Following the session, the experimenter pointed to the tokens and counted aloud how many tokens the participant had earned. Each token was exchangeable for 10-s access with a preferred tangible item.

Video Modeling with Prompts and Contingent Reinforcement (Richard Only)

If video modeling with contingent reinforcement did not lead to a clinically acceptable increase in a participant's rate of play and vocalizations during free-play probes, we added physical prompts to the intervention package. Sessions were conducted in an identical manner to the previous condition, with one exception. If the participant did not engage in any target or non-target actions or vocalizations during a 30-s interval, the experimenter physically prompted the participant to engage a two-step target action and modeled the corresponding vocalization until the participant echoed or the model had been presented 10 times. Following a correct prompted response (including the echoic response), the experimenter placed one token on the token board. This prompting procedure was repeated for each interval in which the participant did not engage in target or non-target actions or vocalizations.

CHAPTER 3: RESULTS

Figures 1-9 depict training, secondary target probe, and free-play probe data for Michael, Amira, and Richard (0-s prompt delay sessions are not graphed for any participants). Table 6 depicts data for instructional efficiency, Table 7 depicts data for echoic and imitative behavior (for the instructive-feedback and prompt-delay with instructive-feedback conditions), and Tables 8-10 depict maintenance data across conditions for Michael, Amira, and Richard. respectively. Additional analyses of the free-play data for Michael, Amira, and Richard are available in Appendices B, C, and D, respectively.

Across all conditions in both comparisons, Michael engaged in zero-levels of correct responding during baseline (Figure 1). In his first comparison (Figure 1, top two panels), Michael met the mastery criterion for the primary targets in the prompt-delay with instructive-feedback condition first, following 12 training sessions (2.2 hours). However, Michael had not achieved mastery-level responding for the secondary targets. We continued training, and Michael met the mastery criterion for the secondary targets following seven additional training sessions (1 additional hour). In the prompt-delay with instructive-feedback condition, Michael imitated and echoed on an average of 4% of trials (range, 0-16%). In the prompt-delay condition, Michael had not reached the mastery criterion following 14 training sessions, and he was consistently emitting errors for one target. We implemented error correction, and Michael met the mastery criterion following three additional sessions (17 total training sessions, 2.4 hours). In the instructive-feedback condition, Michael's responding during secondary target probes remained at zero-levels following 19 training sessions. Michael echoed and imitated on 0% of trials. We used the prompt-delay procedure to train the targets from the instructive-feedback condition and following nine training sessions (including two sessions with a 0-s prompt delay), Michael's correct responding remained variable and below the mastery criterion, so we implemented error correction. During training, Michael began to emit high-intensity problem behavior related to one target (opening the cash register), and it appeared he was afraid of the cash register drawer opening. During the first training session with error correction, Michael reached the error-correction cap (10 trials) during each trial with that target, and problem behavior continued to escalate during the session. We decided to discontinue training for that target and continue training with the other two targets in the condition. Michael mastered those two targets following six additional training sessions (35 total training sessions, 4.2 hours).

For Michael's first comparison, the prompt-delay with instructive-feedback condition required the least mean training time per mastered target (0.5 hours), followed by the prompt-delay condition (0.8 hours), and the instructive-feedback condition required the most mean training time per mastered target (2.1 hours). During weekly maintenance sessions, Michael engaged in high, but somewhat variable, levels of correct responding across conditions. Overall, Michael responded at or near mastery-levels across conditions during 4-week maintenance probes.

During his second comparison (Figure 1, bottom two panels), Michael's correct responding was stable or decreasing following eight training sessions in each condition (including two 0-s prompt delay sessions), so we decided to implement error correction in both the prompt-delay and prompt-delay with instructive-feedback conditions. Michael met the mastery criterion for the primary and secondary targets in the prompt-delay with instructive-feedback condition after a total of 11 training sessions (1.7 hours). Michael imitated and echoed on an average of 18% of trials (range, 0-50%). Next, Michael met the mastery criterion in the prompt-delay condition after a total of 12 training sessions (1.2 hours). Finally, Michael met the mastery criterion in the instructive-feedback condition after a total of 13 training sessions (1.5 hours of instruction time. Michael imitated and echoed on an average of 32% of trials of trials in the instructive-feedback condition (range, 0-75%).

For Michael's second comparison the prompt-delay with instructive-feedback condition required the least mean training time per mastered target (0.3 hours), followed by the prompt-delay condition (0.4 hours), with instructive feedback requiring the most mean training time per mastered target (0.5 hours). These results replicated those of his first comparison. Consistent with his first comparison, Michael's responding during weekly maintenance sessions remained at or near mastery-levels during the 4-week maintenance probes.

During free-play sessions for Michael's first comparison (Figure 2), he engaged in low rates of target actions, non-target actions, target vocalizations, and non-target vocalizations across conditions. During intervention, Michael's rate of appropriate play responses (target and non-target actions and vocalizations) increased in the prompt-delay condition and the prompt-delay with instructive-feedback condition. During intervention in the instructive-feedback condition, Michael's rate of appropriate play responses increased slightly. Post-mastery across conditions, Michael's rate of appropriate play responses decreased to zero (prompt delay and prompt delay with instructive feedback) or near-zero levels (instructive feedback).

During free-play sessions for Michael's second comparison (Figure 3), he engaged in low rates of target and non-target actions and vocalizations in the prompt-delay and prompt-delay with instructive-feedback conditions during baseline. Michael engaged in moderate rates of target and non-target actions and low rates of target and non-target vocalizations in the instructive-feedback condition. During intervention, we observed an increase in target and non-target actions in the prompt-delay and prompt-delay with instructive-feedback conditions. We also observed an increase in Michael's rate of vocalizations in the prompt-delay with instructive-feedback and instructive-feedback conditions. However, following mastery of discrete-trial training, Michael's rate of appropriate play responses remained below clinically acceptable levels, so we implemented video modeling with contingent reinforcement, and we observed an increase in appropriate play responses in two of three conditions (prompt delay and instructive feedback).

Amira engaged in zero-levels of correct responding during baseline across all conditions in both comparisons (Figure 4). During her first comparison (Figure 4, top two panels), Amira met the mastery criterion in the prompt-delay condition first, following five training sessions (0.7 hours of instruction time). Next, Amira met the mastery criterion for the primary targets in the prompt-delay with instructive-feedback condition following a total of six training sessions (1.5 hours). Amira imitated and echoed on an average of 57% of trials (range, 42-67%). After eight training sessions, Amira had not met the mastery criterion for the secondary targets, and we implemented the prompt-delay procedure. Amira met the mastery criterion following six additional training sessions (1 hour). Amira met the mastery criterion in the instructive-feedback condition following eight training sessions (1.4 hours). Amira imitated and echoed on an average of 65% of trial in the instructive-feedback condition (range, 33-100%).

For Amira's first comparison, the prompt-delay procedure required the least mean training time per mastered target (0.2 hours), and the other two conditions both required the same amount of mean training time per mastered target (0.4 hours). Amira responded at or near mastery levels across all weekly maintenance probes, and she engaged in 100% correct responses during all of the 4-week maintenance probes.

In Amira's second comparison (Figure 4, bottom two panels), she achieved the mastery criterion in all conditions following four training sessions (the minimum number of training sessions necessary to meet the mastery criterion). The prompt-delay condition required the least amount of training time (0.6 hours), followed by the instructive-feedback condition (0.6 hours), and prompt delay with instructive feedback required the most training time (0.8 hours). Amira imitated and echoed on an average of 83% in the prompt-delay with instructive-feedback condition (range, 75-92%). She imitated and echoed on an average of 98% in the instructive-feedback condition (range, 92-100%).

For Amira's second comparison, the prompt-delay with instructive-feedback condition required the least mean training time per mastered target (0.1 hours), followed by the instructive-feedback condition (0.2 hours), and the prompt-delay condition required the most mean training time per mastered target (0.3 hours). These results did not replicate what we observed in Amira's first comparison. Consistent with her first comparison, Amira consistently responded at mastery-levels during weekly maintenance probes, and she engaged in 100% correct responses during all of the 4-week maintenance probes.

During free-play sessions for Amira's first comparison (Figure 5), she engaged in moderate rates of target and non-target play actions across conditions during baseline. Amira did not engage in target or non-target vocalizations in the prompt-delay or prompt-delay with instructive feedback conditions. However, she engaged in high rates of vocalizations in the instructive-feedback condition. Following mastery, Amira's rate of target and non-target actions increased in the prompt-delay with instructive-feedback and instructive-feedback conditions and decreased in the prompt-delay condition (Amira mastered the prompt-delay condition before a free-play session was scheduled in the intervention phase). We observed small increases in Amira's rate of vocalizations in the prompt-delay with instructive-feedback and instructive-feedback conditions during intervention. Following mastery, Amira's rate of responding was similar to baseline in the prompt-delay condition. We observed an increase in Amira's rate of target and non-target actions in the prompt-delay with instructive-feedback and instructive-feedback conditions, following mastery.

During free-play sessions for Amira's second comparison (Figure 6), she engaged in moderate rates of target and non-target play actions across conditions during baseline. Amira engaged in zero- (prompt delay and instructive feedback) or near-zero (prompt delay with instructive feedback) levels of vocalizations during baseline. Amira mastered all conditions before free-play sessions were scheduled in the intervention phase. Following mastery, we observed an increase in target and non-target play actions. However, Amira's rate of vocalizations remained low, so we implemented video modeling with contingent reinforcement, and Amira's rate of vocalizations increased to clinically acceptable levels across conditions.

Richard engaged in zero-levels of correct responding during baseline across all conditions in both comparisons (Figure 7). In Richard's first comparison (Figure 7, top two panels), he reached the mastery criterion for the primary and secondary targets in the prompt-delay with instructive-feedback condition following six training sessions (1.2 hours). Richard imitated and echoed on an average of 21% of trials in the prompt-delay with instructive-feedback condition (range, 0-42%). Richard met the mastery criterion in the prompt-delay condition following seven training sessions (1 hour; one additional training session was conducted in the prompt delay condition with Richard before he was unexpectedly ill and absent from the clinic for approximately four weeks). Richard imitated and echoed on an average of 36% of trials in the instructive-feedback condition (range, 0-100%). In the instructive-feedback condition, Richard had not met the mastery criterion following 16 training sessions, so we implemented the prompt-delay procedure for those targets. Richard met the mastery criterion following four additional training sessions (20 sessions total; 3.4 hours).

For Richard's first comparison, the prompt-delay with instructive-feedback condition required the least mean training time per mastered target (0.2 hours), followed by the prompt-delay condition (0.3 hours), and the instructive-feedback condition required the most mean training time per mastered target (1.1 hours). During weekly maintenance sessions, Richard engaged in high, but somewhat variable, levels of correct responding across conditions. Overall, Richard responded at or near mastery-levels across conditions during 4-week maintenance probes.

In Richard's second comparison (Figure 7, bottom two panels), he reached the mastery criterion for the prompt-delay and instructive-feedback conditions, as well as the primary targets in the prompt-delay with instructive-feedback condition following four training sessions (the minimum number of training sessions necessary to meet the mastery criterion). In the instructive-feedback condition, Richard imitated and echoed on 100% of trials. The prompt-delay condition required the least training time (0.4 hours), followed by the instructive-feedback condition (0.5 hours), and the primary targets for the prompt-delay with instructive-feedback condition required 0.7 hours of training time. Upon mastery of the primary targets in the prompt-delay with instructive-feedback condition, Richard's responding to the secondary targets remained below the mastery criterion. Richard imitated and echoed on an average of 25% of trials in the prompt-delay with instructive-feedback condition (range, 17-33%). We implemented the prompt-delay procedure with these targets, and following six training sessions, Richard's responding was still below the mastery criterion. We implemented error correction, and Richard mastered the secondary targets following four additional training sessions (a total of 10 additional training sessions, 1.6 hours).

For Richard's second comparison, the prompt-delay and instructive-feedback conditions both required the least mean training time per mastered target (0.2 hours), and the prompt-delay with instructive-feedback condition required the most mean training time per mastered target (0.6 hours). These results did not replicate what we observed in his first comparison. During weekly maintenance sessions, Richard responded at mastery-levels in the prompt-delay and instructive-feedback conditions, as well as the primary target probes for the prompt-delay with instructive-feedback condition. Richard's responding was more variable for the secondary target probes in the prompt-delay with instructive-feedback condition, but he responded at mastery-level during the 4-week maintenance probe.

During free-play probes for his first comparison (Figure 8), Richard engaged in moderate-to-high rates of target and non-target play actions during baseline and zero-rates of vocalizations across conditions. Following mastery, Richard engaged in zero-rates of play actions and vocalizations across conditions.

During free-play probes for his second comparison (Figure 9), Richard engaged in zero- or low levels of play actions, and zero-levels of vocalizations across conditions during baseline. Following mastery, Richard engaged in zero-levels of play actions and vocalizations across conditions, so we implemented video modeling with contingent reinforcement. After two sessions with video modeling and contingent reinforcement, Richard's rate of play and vocalizations remained at zero across conditions, so we added prompts to the intervention package. During this phase, we observed Richard's rate of play and vocalizations across conditions increase to clinically acceptable levels.

CHAPTER 4: DISCUSSION

The prompt-delay procedure led to mastery across participants and conditions (although error correction was necessary for Michael and Richard). The instructive-feedback procedure alone led to mastery for four of six data sets (prompting and error correction were necessary for Michael and Richard for some sets). When combined with prompt delay, instructive feedback led to mastery for four of six data sets (prompting was necessary for Amira and Richard for some sets). The results of the present study partially replicate Colozzi et al., (2008). For some participants and conditions, secondary targets were acquired just as quickly as primary targets, consistent with Grow et al. (2017) who observed acquisition of all secondary targets. However, for other participants, instructive feedback was insufficient for acquisition, consistent with Colozzi et al. who observed limited acquisition of secondary targets for some participants (e.g., Ned). Consistent with Vladescu and Kodak (2013), prompt delay with instructive feedback was most efficient for four of six data sets.

Despite the overall efficacy of the procedures in discrete-trial-training, generalization to the free-play context without an additional intervention was limited. For Michael, we observed moderate, fleeting improvements in his free play during intervention and following mastery. However, video modeling with contingent reinforcement was necessary to increase his play to clinically acceptable levels. With Amira, we did not observe clinically acceptable behavior change from baseline to post-mastery in her first comparison, with the exception of the prompt-delay with instructive-feedback condition. In her second comparison, we observed clinically significant increases in Amira’s rate of play actions. However, vocalizations remained at near-zero levels, and video modeling was necessary to increase her vocalizations to clinically acceptable levels. With Richard, we did not observe any increase from baseline to post-mastery in either of his comparisons; video modeling, contingent reinforcement, and prompts were necessary to increase his play and vocal behavior to clinically acceptable levels. To summarize, the video modeling intervention package increased all three participants’ rates of play actions and vocalizations, consistent with previous studies (D’Ateno et al., 2003; MacDonald et al., 2005).

The limited generalization of the acquired play skills from the discrete-trial setting to the free-play setting calls into question the benefits of using discrete-trial teaching to teach play skills. We decided to teach play skills in a discrete-trial context because this arrangement facilitates providing multiple exposures to specific, experimenter-selected materials and responses. We hypothesize that the video modeling and reinforcement procedure (with prompting for Richard) increased participants' rates of play quickly upon implementation because the target responses were already in participants' repertoires (due to training in the discrete-trial context). To our knowledge, this is only the second study that evaluated generalization of play skills from a discrete-trial context to a free-play context (Grow et al., 2017 also conducted free-play probes). Although generalization was limited, it is worth noting that we programmed for generalization in several ways (e.g., programming common stimuli, sequential modification; Stokes & Baer 1977). Future researchers should evaluate ways to improve generalization to the free-play context (e.g., implementing indiscriminable contingencies).

It is possible that it would have been more efficient to conduct training in the free-play context from the outset; however, an analysis of this possibility is not feasible given the sequential order of training. Although it is not possible to directly compare our results to those of previous researchers, when we implemented video modeling with reinforcement (Amira and Michael) and prompts (Richard), we observed a more rapid increase in responding than was observed in D'Ateno et al. (2003) and MacDonald et al. (2005), which is likely because of the participants' exposure to discrete-trial training. Future researchers should systematically compare the efficacy and efficiency of conducting training in discrete-trial versus training in more naturalistic settings. For example, future researchers could compare the efficiency of training in the free-play setting from the outset, versus conducting discrete-trial training prior to training in the free-play setting.

Consistent with Colozzi et al. (2008) and Grow et al. (2017), our results lend support for the use of instructive feedback for increasing play skills. Combining prompt delay with instructive feedback required the least mean training time per mastered target for four of six data sets, consistent with Vladescu and Kodak (2013). Although instructive feedback alone, and in combination with prompt delay, was efficacious and efficient, it is worth noting that adding instructive feedback to the prompt-delay procedure increased the instructional time (i.e., participants did not learn additional targets "for free" as described in Grow et al. [2017]). Presenting an additional array of materials, modeling a multi-step sequence, and allowing up to 10 s for the participant to imitate required more response effort from the experimenter and added more time than it seems is typical when instructive feedback is used in language training programs (e.g., when the experimenter tacts an additional picture card, which may take only a few seconds; Vladescu & Kodak, 2013).

Imitative and echoic behavior may lead to acquisition of secondary targets (Nottingham et al., 2015). However, during sessions with instructive feedback, we observed considerable variability in participants' percentage of imitative and echoic behavior (Table 7), and imitative and echoic behavior were not always predictive of participants' acquisition of secondary targets. Future research should continue to evaluate whether overt echoic and imitative behavior are necessary for acquisition of secondary targets.

This study has several limitations and implications for future research. The results for mean training time per mastered target were replicated within-subject for Michael, but not Richard or Amira. Although this efficiency measure was not replicated within-subject, the differences in mean training time per mastered target were relatively minor. Although we attempted to equate the difficulty of targets within and across conditions, it is possible that several factors led some targets to be more difficult to acquire than other targets. Michael appeared fearful of the cash register in the instructive-feedback condition in his first comparison, which could be due to a history of respondent conditioning (e.g., the way Michael attempted to retract his hand quickly after touching the cash register drawer suggests his fingers may have been pinched by a drawer in the past). It was also challenging to equate the difficulty of fine motor movements with different materials, which could explain differences in rates of acquisition between conditions (e.g., is turning on a flashlight more difficult than pushing a specific button on a cash register?). With play skills, there are more dimensions to consider than those described in procedures for a logical analysis (Wolery et al., 2018). More research developing logical analysis procedures for motor and vocal play skills is needed.

For some participants and conditions, errors with secondary targets appeared to be due to problems imitating the model. For example, during secondary target probes in the prompt-delay with instructive-feedback condition, Amira rarely turned off the light in the tool set in her first comparison. This could be because it was unclear that the action was part of the experimenter's model, rather than the experimenter resetting the materials. Similarly, in Richard's instructive-feedback condition in his second comparison, the experimenter modeled placing the dollar bill inside of the wallet, paused, then removed the dollar bill from the wallet to provide Richard the opportunity to imitate. However, during his opportunity to respond, Richard typically pulled the dollar bill in and out of the wallet quickly, which did not meet the operational definition of a correct response. Future researchers could address this limitation by providing a separate set of items for the experimenter. However, making this modification would require the experimenter or clinician to purchase duplicate items, which may be financially prohibitive. Further, arranging and manipulating multiple sets of materials may make these procedures more difficult to implement and may reduce instructional efficiency.

Another notable limitation is that Richard was exposed to an extra teaching session in the prompt-delay condition before he was unexpectedly absent for four weeks. Upon his return, we conducted two 0-s sessions in each condition, and he mastered all primary targets immediately. We made the decision to implement additional 0-s prompt-delay sessions based on clinical judgment, and it is unclear whether the sudden level change in Richard's data is attributable to exposure to the 0-s sessions. Despite this limitation, experimental control is demonstrated in the second comparison in multiple-probe design.

The primary purpose of the present study was to evaluate acquisition and maintenance of play skills in a discrete-trial context. However, when we did not observe clinically acceptable levels of play actions and vocalizations in the free-play context, we implemented a treatment package that included video modeling and token reinforcement (Michael and Amira) and prompts (Richard). It is possible that any of these intervention components could have been efficacious on their own (D'Ateno et al., 2003; MacDonald et al., 2005). However, given the histories of low rates of responding during free-play sessions, we elected to implement video modeling and reinforcement simultaneously to increase the likelihood of rapid treatment effects. We hypothesize that the results we observed when the intervention packages were implemented can be attributed to the training conducted in the discrete-trial context. However, future researchers should evaluate the most optimal intervention(s) for increasing appropriate behavior in the free-play setting.

In the present study, we terminated treatment in the free-play setting on a case-by-case basis based on clinical judgment. For each participant, we aimed to increase play behavior in the free-play setting to clinically acceptable levels. We determined clinical acceptability based on individual participants' chronological and developmental ages, history of learning and performing play skills, and increases in responding relative to baseline. Based on searches of the literature and interviews with developmental psychologists, we were unable to identify an empirically based mastery criterion for free-play sessions. More research is needed to identify goals and mastery criteria for independent free play. For example, future researchers could collect normative data on the play behavior of typically developing children.

Overall, the results of the present study support the use of prompt delay and instructive feedback, separately or in combination, for acquisition and maintenance of play skills in a discrete-trial setting. Our results also support the use of video modeling with contingent reinforcement, following discrete-trial training, for increasing appropriate play in a free-play setting. Based on the results of the present study, clinicians should consider using these procedures to teach play skills. Future researchers should continue to evaluate the most optimal procedures to teach play skills in structured and naturalistic settings.

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Table 1: *Participants' VB-MAPP Scores by Skill Domain*

Participant	Total Score	Skill Domain											
		Mand	Tact	LR	VP/MTS	Play	Social	IM	Echoic	Vocal	IV	Group	Ling.
Michael	80.5/170	9/15	8/15	9.5/15	11/15	9/15	2.5/15*	9.5/10	7/10	5/5	2/10	3/10*	3/10
Amira	116/170	8.5/15	9.5/15	11.5/15	13.5/15	15/15	6.5/15*	10/10	10/10	5/5	4/10	6/10*	5/10
Richard	42/170	2/15	6/15	2/15	8.5/15	4/15	1.5/15*	3/10	9/10	5/5	0/10	0/10*	1/10

Note. The reading, writing, and math skill domains are not depicted in the table. LR = listener responding, VP/MTS = visual-perceptual/match-to-sample, IM = imitation, IV = intraverbal, and Ling. = linguistic structure. Asterisks indicate that some skills were not able to be assessed due to the COVID-19 pandemic.

Table 2: *Materials for Each Set of Play Materials*

Set	Materials	Number of Materials
Kitchen	Egg, plate, fork, cup, sink, towel, pot, vegetables, brush, soap, pan, bacon, steak, salt, knife	16
Camping	Bug, net, jar, fire, roasting stick, marshmallow, pan, portable stove, plate, hot dog, graham cracker, s’more half, flashlight, magnifying glass, duffel bag, canteen	16
Birthday	Three cake pieces, cake decoration, candle, jar of sprinkles, wrapped gift, bow, plate, ice cream, ice cream scoop, ice cream container, birthday hat, cake server, piñata, stick	16
Tools	Work bench, screw, screwdriver, manual saw, two wood pieces, toolbox, safety goggles, electric saw, phone, two bolts, light, clamp, hammer, hook	16
Vet	Kennel, scale, cat, dog, stethoscope, X-ray, blanket, medicine bottle, brush, scissors, syringe, veterinarian’s bag, bandage, thermometer	14
Store	Two food boxes, two food cans, shopping basket, shopping list, cash register, debit card, wallet, two dollar bills, two coins, grocery bag	14

Table 3: *Listener Discrimination Pre-Assessment and Pre-Training Targets*

Part of Speech	Targets
Nouns	Hot dog, s'more, phone, gift, wood, stove, meat, taco, cake, scale, cup, fire, soup, shot
Verbs	Turn on, listen, bang, pack, catching, pay, put on, washing, cutting, buying, cooking, drink, hit, eating, close, screw, shaking, spinning, scoop, looking, brush, open

Table 4: *Imitation Pre-Assessment Targets*

Participant	Targets
Michael and Amira	(1) Stack two blocks, (2) shake blocks
	(1) Twist block on table, (2) place block in bucket
	(1) Cut play food with knife, (2) re-fasten Velcro
	(1) Hit table with mallet, (2) bring mallet to mouth
	(1) Remove lid from shape sorter, (2) place lid on shape sorter
	(1) Shake shape sorter, (2) place shape sorter on head
	(1) Bring block to ear, (2) place block on card
	(1) Open and close scissors, (2) raise scissors above head
	(1) Push button on book, (2) swipe plastic button on table
	(1) Rub card between hands, (2) put card on table
Richard	(1) Place block in cup, (2) dump block from cup into bucket
	(1) Open shape sorter, (2) remove block
	(1) Cut play food with knife, (2) re-fasten Velcro
	(1) Hit table with mallet, (2) bring mallet to mouth
	(1) Remove lid from shape sorter, (2) place lid on shape sorter
	(1) Shake shape sorter, (2) feed baby
	(1) Push buttons on phone, (2) bring phone to ear
	(1) Tap scissors on table, (2) open and close scissors
	(1) Trace line with plastic button, (2) stack blocks
	(1) Rub card between hands, (2) put card on table

Table 5: *Targets for each Participant by Condition*

Participant	Condition	Set	Targets: Actions	Targets: Vocalizations
Michael	PD C1	Tools	(1) Put screw in hole, (2) put screw driver in screw	*Screw*
			(1) Put bolts into tool box, (2) put phone to ear	*Phone*
			(1) Put on goggles, (2) bring saw down onto wood	*Cutting*
	PD + IF C1 Prim.	Vet	(1) Take cat out of kennel, (2) place on scale	*Scale*
			(1) Brush dog (2) cut nails	*Brush*
			(1) Put on glasses (2) hold up X-ray	*Looking*
	PD + IF C1 2nd		(1) Put cat on blanket, (2) medicine to mouth	*Drink*
			(1) Put on stethoscope, (2) stethoscope on dog's chest	*Listen*
			(1) Take syringe out of bag, (2) plunge syringe	*Shot*
	IF C1	Store	(1) Put coin in register, (2) close register	*Close*
			(1) Open register, (2) put cash in wallet	*Open*
			(1) Put soup can in basket, (2) put basket on arm	*Soup*
	PD C2	Camping	(1) Put bug in net, (2) dump into container	*Catching*
			(1) Hold marshmallow over fire, eat marshmallow	*Fire*
			(1) Hot dog in pan, (2) hot dog on plate	*Hot dog*
	PD + IF C2 Prim.	Birthday	(1) Put decoration on cake, (2) put candle on cake	*Put on*
			(1) Scoop up piece of cake, (2) put on plate	*Cake*
			(1) Put on hat, (2) hit piñata with stick	*Hit*
	PD + IF C2 2nd		(1) Scoop ice cream, (2) put ice cream on plate	*Scoop*
			(1) Shake sprinkles over cake, (2) cut cake with server	*Shaking*
			(1) Shake gift box, (2) put bow on gift	*Gift*
	IF C2	Kitchen	(1) Pour soap over sink, (2) scrub plate with brush	*Washing*
			(1) Turn knob on stove, (2) shake bacon in pan	*Stove*
			(1) Shake salt over steak, (2) cut with knife	*Meat*

Amira	PD C1	Camping	(1) Put bug in net, (2) dump into jar, (3) lift jar up and look	*Catching the bug*
			(1) Put marshmallow on stick, (2) hold marshmallow over fire, (3) eat marshmallow	*Cooking on the fire*
			(1) Turn on portable stove, (2) put hot dog in pan, (3) put hot dog on plate	*I want hot dog*
	PD + IF C1 Prim.	Tools	(1) Put screw in hole, (2) put screw driver in screw, (3) twist screw driver	*Put screwdriver in*
			(1) Put bolts into container, (2) put phone to ear, (3) put phone back on table	*Answer the phone*
			(1) Put on goggles, (2) bring saw down onto wood, (3) pull wood apart	*Cutting with the saw*
	PD + IF C1 2nd		(1) Cut wood apart with saw, (2) put wood in tool box, (3) pick up tool box and shake	*Pack up the wood*
			(1) Turn on light, (2) turn clamp, (3) turn off light	*Turn on the light*
			(1) Bang table with hammer, (2) put hook in work bench, (3) hang hammer up	*Bang with the hammer*
	IF C1	Kitchen	(1) Pour soap over sink, (2) scrub plate with brush, (3) place plate in drying rack	*Washing off the plate*
			(1) Turn knob on stove, (2) shake bacon in pan, (3) place bacon on plate	*The stove is hot*
			(1) Shake salt over steak, (2) cut with knife, (3) bring fork to mouth	*The meat tastes good*
	PD C2	Store	(1) Push buttons on register, (2) put pineapple can in bag, (3) put bag on arm	*Here is your food*
			(1) Take card out of wallet, (2) swipe, (2) put card back in wallet	*Paying with my card*
			(1) Pick up list and look, (2) put taco box in cart, (3) roll cart	*Buy the taco*
	PD + IF C2 Prim.	Vet	(1) Put screw in hole, (2) put screwdriver in screw, (3) twist screwdriver	*Put screwdriver in*
			(1) Put bolts into container, (2) put phone to ear, (3) put phone back on table	*Answer the phone*

			(1) Put on goggles, (2) bring saw down onto wood, (3) pull wood apart	*Cutting with the saw*
	PD + IF C2 2nd		(1) Cut wood apart with manual saw, (2) put wood in tool box, (3) pick up tool box and shake	*Pack up the wood*
			(1) Turn on light, (2) turn clamp, (3) turn off light	*Turn on the light*
			(1) Bang table with hammer, (2) put hook in work bench, (3) hang hammer up	*Bang with the hammer*
	IF C2	Birthday	(1) Scoop ice cream, (2) put ice cream on plate, (3) put cake on plate	*Scoop the ice cream*
			(1) Shake sprinkles over cake, (2) put on candle, (3) cut cake	*Cake looks so yummy*
			(1) Shake box, (2) put on bow, (3) put hat on head	*It is my birthday*
Richard	PD C1	Kitchen	(1) Put egg on plate, (2) bring fork to mouth	*Eating*
			(1) Dry cup with towel, (2) put cup in drying rack	*Cup*
			(1) Put veggies in pot, (2) put lid on pot	*Cooking*
	PD + IF C1 Prim.	Camping	(1) Put bug in net, (2) dump into container	*Catching*
			(1) Hold marshmallow over fire, eat marshmallow	*Fire*
			(1) Put hot dog in pan, (2) put hot dog on plate	*Hot dog*
	PD + IF C1 2nd		(1) Stack marshmallow on top of s'more, (2), put graham cracker on top	*S'more*
			(1) Turn on light, (2) hold magnifying glass over bugs	*Turn on*
			(1) Put canteen in bag, (2) put binoculars in bag	*Pack*
	IF C1	Tools	(1) Cut wood apart with saw, (2) put wood in tool box	*Wood*
			(1) Turn on light, (2) turn clamp	*Spinning*
			(1) Bang table with hammer, (2) hang hammer up	*Bang*
	PD C2	Birthday	(1) Put decoration on cake, (2) put candle on cake	*Put on*
			(1) Scoop up piece, (2) put on plate	*Cake*
			(1) Put hat on head, (2) hit piñata	*Hit*
	PD + IF C2 Prim.	Store	(1) Push buttons on register, (2) put food in bag	*Buying*
			(1) Take debit card out of wallet, (2) swipe	*Pay*

		(1) Pick up grocery list and look, (2) put taco box in cart	*Taco*
PD + IF C2 2nd		(1) Put coin in register, (2) close register	*Close*
		(1) Open register, (2) put cash in wallet	*Open*
		(1) Put soup can in basket, (2) put basket on arm	*Soup*
IF C2	Vet	(1) Take cat out of kennel, (2) put on scale	*Scale*
		(1) Brush dog (2) cut nails	*Brush*
		(1) Put on glasses (2) hold up X-ray	*Looking*

Table 6*: Efficiency Data across Participants and Conditions*

	Training Sessions			Training Duration (hours)			Mean Training Time per Mastered Target (hours)		
	Participant			Participant			Participant		
Condition	Michael	Amira	Richard	Michael	Amira	Richard	Michael	Amira	Richard
PD C1	17	5	7	2.4	0.7	1.0	0.8	0.2	0.3
IF C1	35†*	8	20*	4.2†*	1.4	3.4*	2.1†*	0.4	1.1*
PD + IF C1 Prim.	12	6	6	2.2	1.5	1.2	0.5	0.4*	0.2
PD + IF C1 2nd	19	6*	0	1.0	1.0*	0	N/A	N/A	N/A
PD C2	12	4	4	1.2	0.5	0.4	0.4	0.3	0.2
IF C2	13	4	4	1.5	0.6	0.5	0.5	0.2	0.2
PD + IF C2 Prim.	11	4	4	1.7	0.8	0.7	0.3	0.1	0.6*
PD + IF C2 2nd	0	0	10*	0	0	1.6*	N/A	N/A	N/A

Note: Data for the secondary targets in the prompt-delay with instructive-feedback condition indicate additional training sessions that were conducted following mastery of the primary targets (i.e., when secondary targets were not yet acquired); Asterisks indicate that the original training condition was not efficacious and the prompt-delay procedure was used to train secondary targets; The dagger indicates only two of three targets were acquired; N/A is listed under mean training time per mastered target for PD + IF 2nd because secondary targets are included in the calculation for the condition; For Richard, an additional training session was conducted in the prompt-condition for his first comparison before he was unexpectedly absent for one month; C1 = first comparison; C2 = second comparison; PD = prompt delay; IF = instructive feedback; PD + IF = prompt delay with instructive feedback; Prim. = primary targets; 2nd = secondary targets

Table 7: *Echoic and Imitative Behavior in Conditions with Instructive Feedback*

	Mean Percentage of Trials with Imitative and Echoic Behavior		
	Participant		
Condition	Michael	Amira	Richard
IF C1	0%	65%	36%
PD + IF C1	4%	57%	21%
IF C2	32%	98%	100%
PD + IF C2	18%	83%	25%

Note: IF = instructive feedback; PD + IF = prompt delay with instructive feedback; C1 = comparison 1; C2 = comparison 2

Table 8: *Maintenance Data across Conditions for Michael*

	Percentage of Independent Correct Responses			
Condition	1-week	2-week	3-week	4-week
PD C1	100%	100%	100%	92%
IF C1	100%	88%	-	88%
PD + IF C1 Prim.	66%	83%	83%	83%
PD + IF C1 2nd	100%	100%	92%	92%
PD C2	92%	100%	100%	100%
IF C2	100%	100%	100%	83%
PD + IF C2 Prim.	75%	92%	100%	100%
PD + IF C2 2nd	75%	92%	67%	83%

Note: Dashes indicate that the session was not conducted (e.g., due to scheduling conflicts or participant absence); C1 = comparison 1; C2 = comparison 2; PD = prompt delay; IF = instructive feedback; PD + IF = prompt delay with instructive feedback

Table 9: *Maintenance Data across Conditions for Amira*

	Percentage of Independent Correct Responses			
Condition	1-week	2-week	3-week	4-week
PD C1	92%	100%	100%	100%
IF C1	100%	92%	100%	100%
PD + IF C1 Prim.	-	83%	100%	100%
PD + IF C1 2nd	100%	100%	-	100%
PD C2	100%	100%	100%	100%
IF C2	100%	100%	100%	100%
PD + IF C2 Prim.	92%	92%	100%	100%
PD + IF C2 2nd	100%	92%	100%	100%

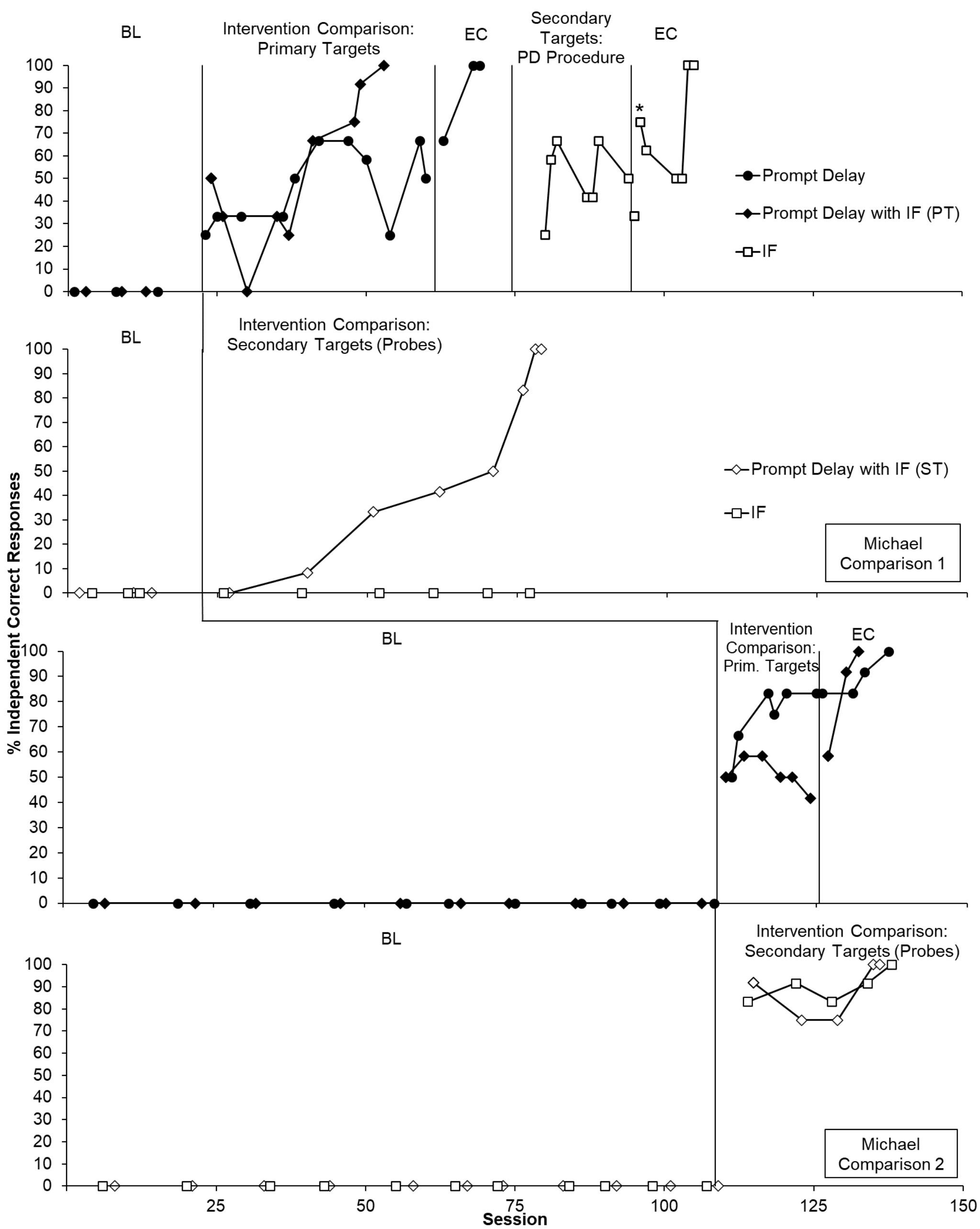
Note: Dashes indicate that the session was not conducted (e.g., due to scheduling conflicts or participant absence); C1 = comparison 1; C2 = comparison 2; PD = prompt delay; IF = instructive feedback; PD + IF = prompt delay with instructive feedback

Table 10: *Maintenance Data across Conditions for Richard*

	Percentage of Independent Correct Responses			
Condition	1-week	2-week	3-week	4-week
PD C1	92%	83%	100%	83%
IF C1	100%	100%	92%	100%
PD + IF C1 Prim.	83%	58%	92%	100%
PD + IF C1 2nd	100%	83%	100%	100%
PD C2	100%	100%	100%	92%
IF C2	100%	100%	100%	92%
PD + IF C2 Prim.	100%	100%	100%	100%
PD + IF C2 2nd	83%	83%	75%	92%

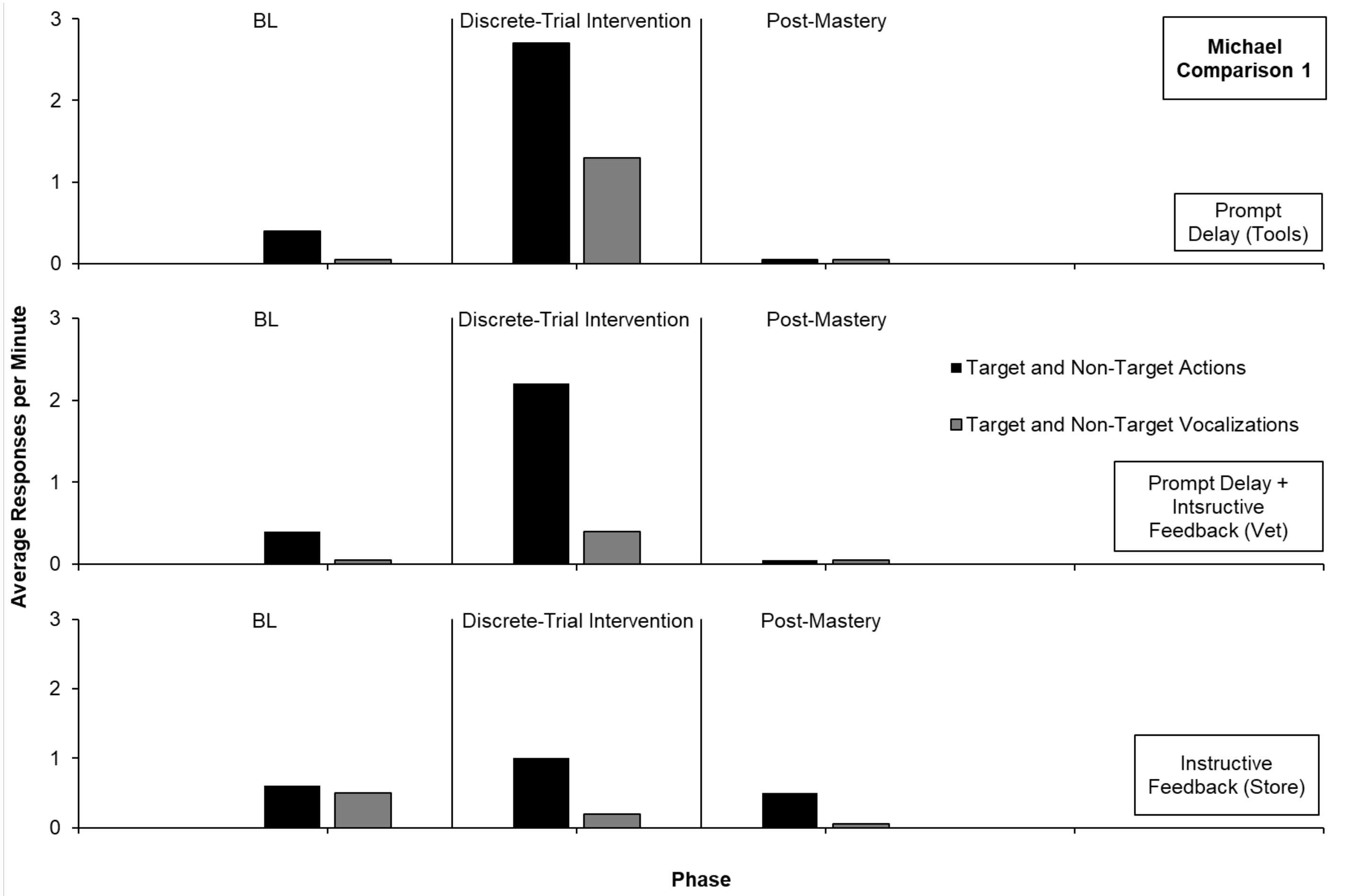
Note: C1 = comparison 1; C2 = comparison 2; PD = prompt delay; IF = instructive feedback; PD + IF = prompt delay with instructive feedback

Figure 1: *Discrete-Trial Instruction Data for Michael*



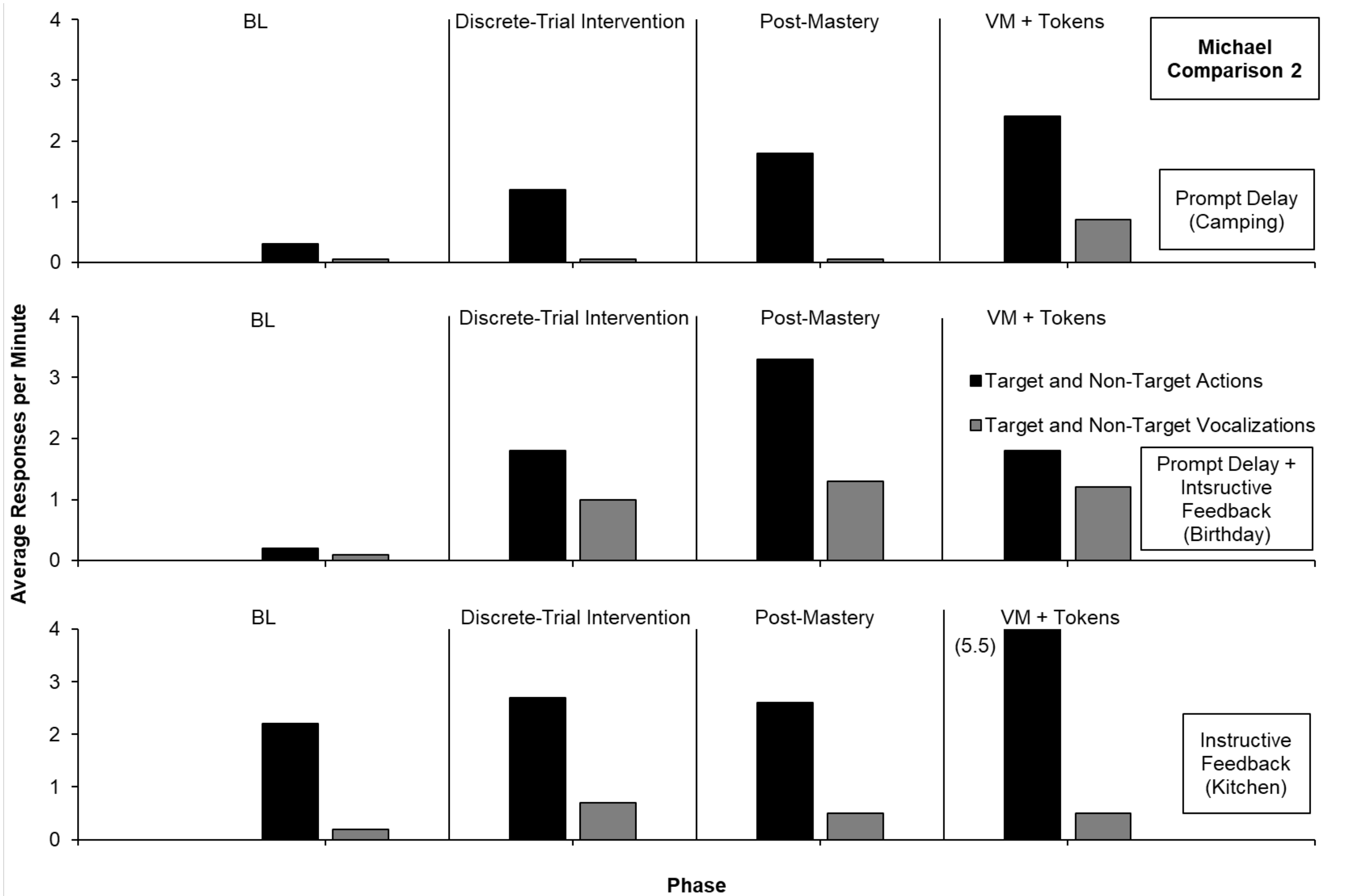
Note. The asterisk (top panel) indicates when one target was removed from Michael's IF condition; BL = baseline; PD = prompt delay; IF = instructive feedback; EC = error correction; prim. = primary; PT = primary targets; ST = secondary targets

Figure 2: *Summarized Free-Play Data for Michael's First Comparison*



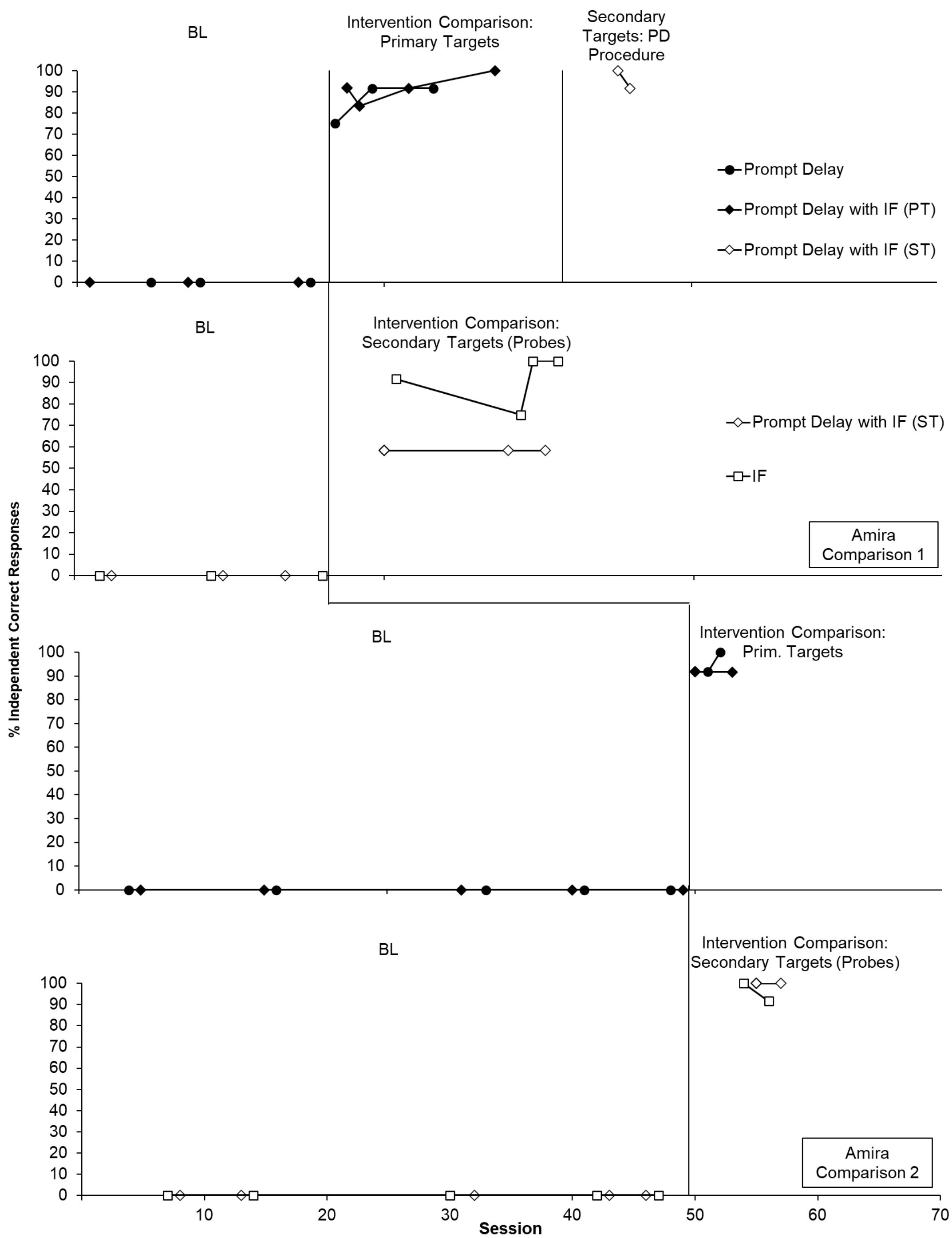
Note: BL = baseline

Figure 3: *Summarized Free-Play Data for Michael's Second Comparison*



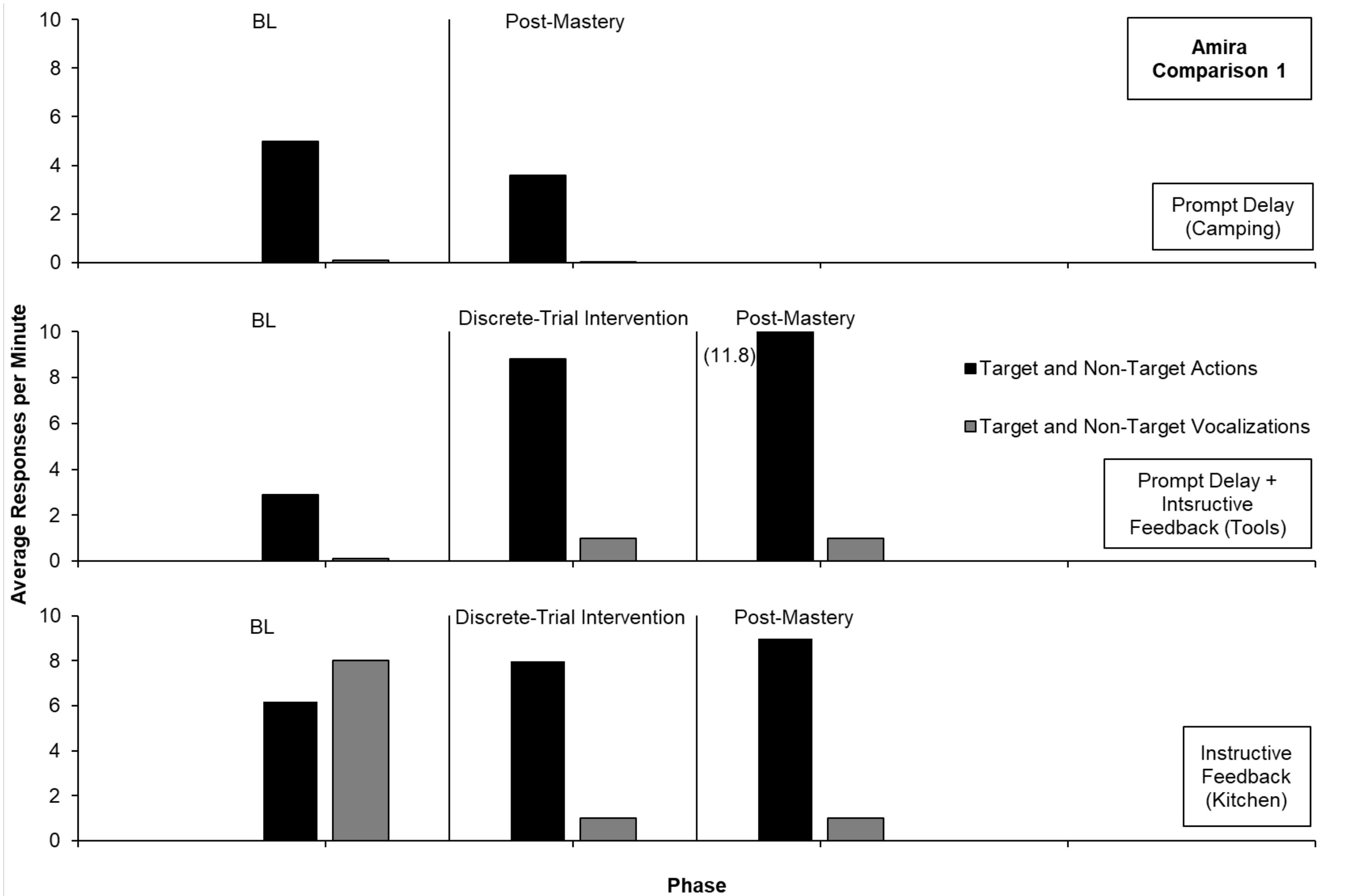
Note: During the video-modeling phase in the instructive-feedback condition, Michael engaged in an average of 5.5 target and non-target actions per min, exceeding *y*-axis maximum. BL = baseline; VM = video modeling

Figure 4: *Discrete-Trial Instruction Data for Amira*



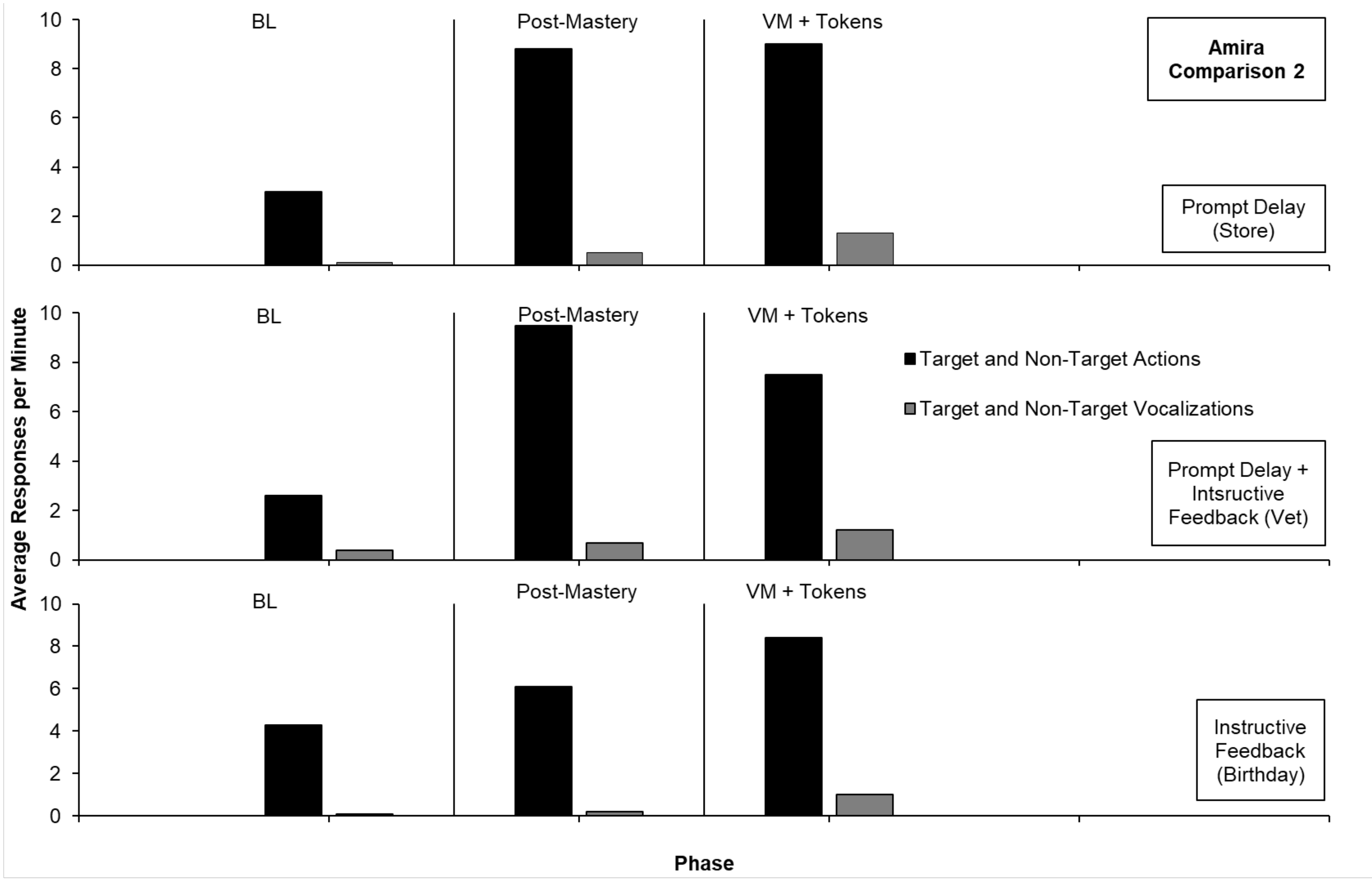
Note: BL = baseline; PD = prompt delay; IF = instructive feedback; prim. = primary; PT = primary targets; ST = secondary targets

Figure 5: *Summarized Free-Play Data for Amira's First Comparison*



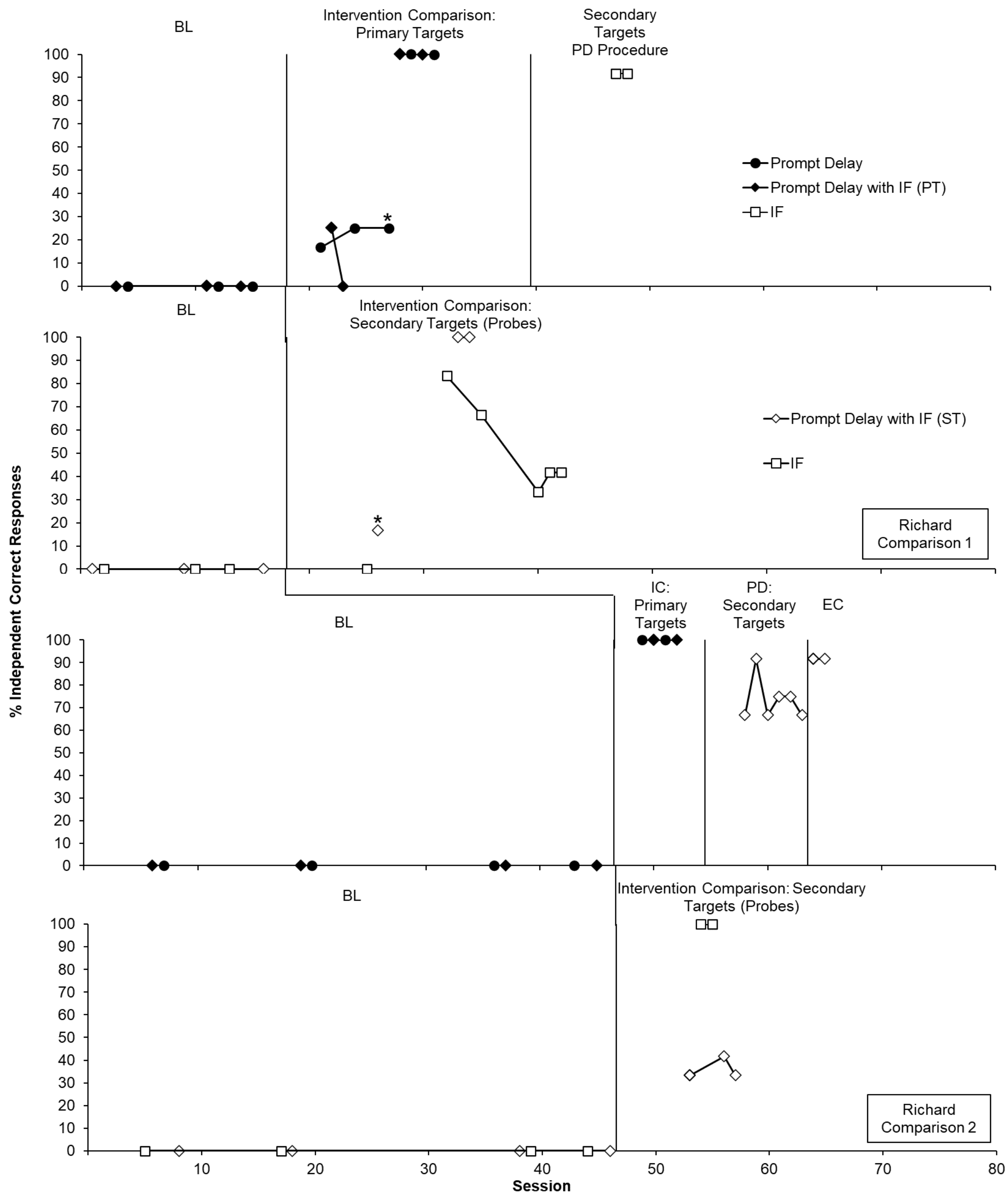
Note: During the post-mastery phase in the prompt-delay with instructive-feedback condition, Amira engaged in an average of 11.8 actions per minute, exceeding the *y*-axis maximum; BL = baseline

Figure 6: *Summarized Free-Play Data for Amira's Second Comparison*



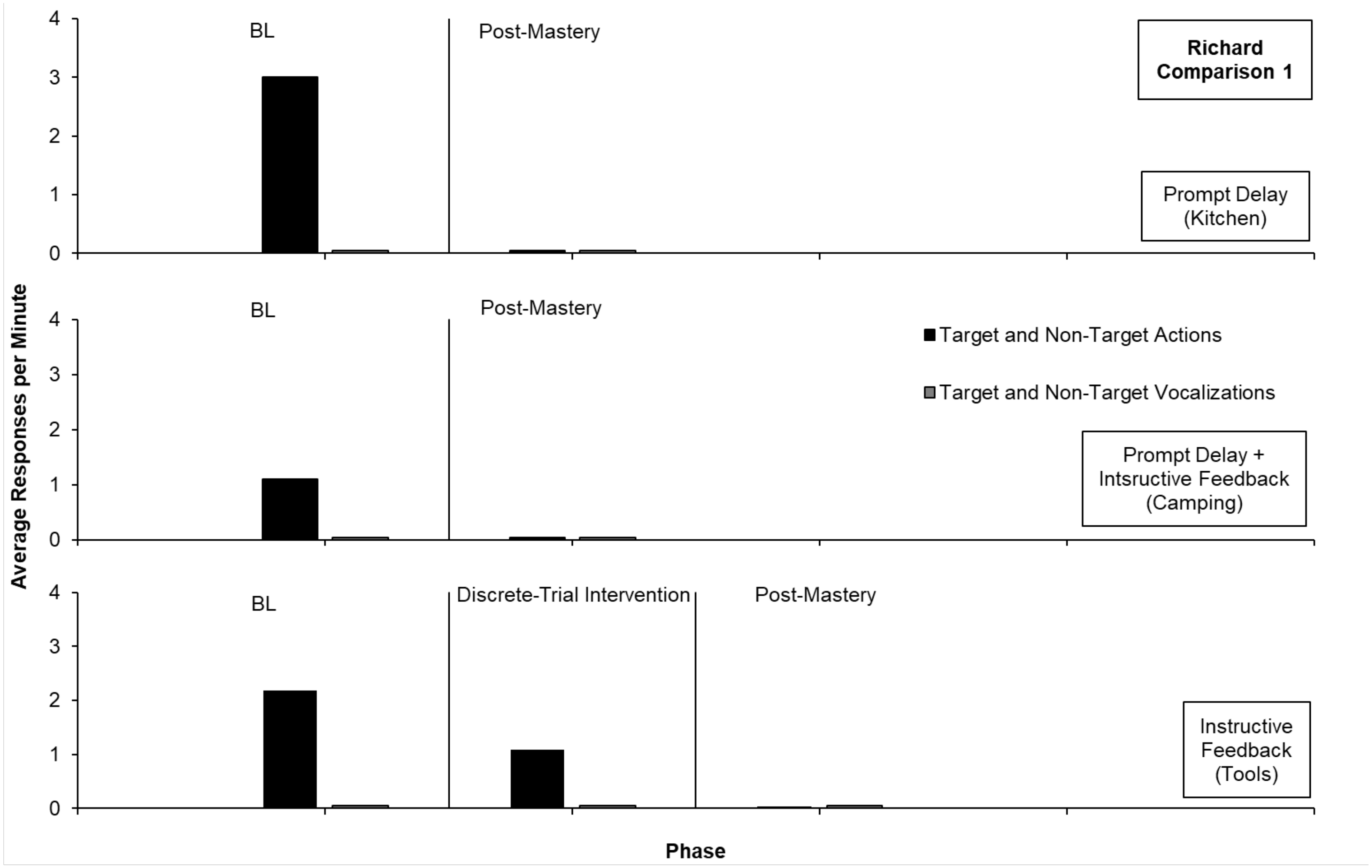
Note: BL = baseline; VM = video modeling

Figure 7: *Discrete-Trial Instruction Data for Richard*



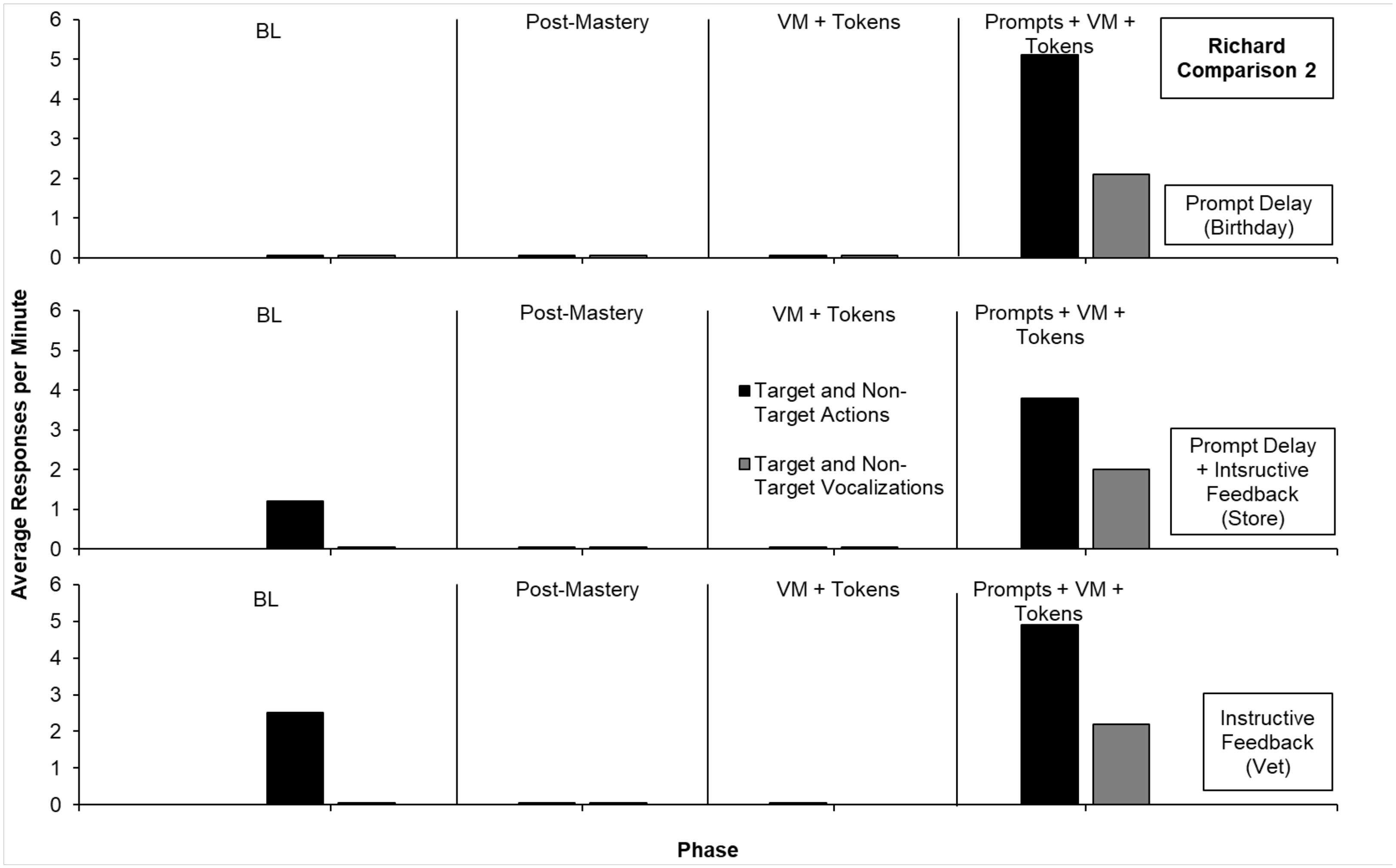
Note: The asterisks indicate the last sessions conducted before Richard was unexpectedly absent from the clinic for approximately four weeks, an additional 0-s session was conducted in each condition upon his return; BL = baseline, PD = prompt delay; IF = instructive feedback; IC = intervention comparison; EC = error correction

Figure 8: *Summarized Free-Play Data for Richard's First Comparison*



Note: BL = baseline

Figure 9: *Summarized Free-Play Data for Richard's Second Comparison*



Note: BL = baseline; VM = video modeling

Appendix A: Procedural Integrity Measures

Baseline: Discrete-Trial Instruction Sessions	
Component	**Definitions**
Present Materials	+ (correct): The experimenter places the materials specified for the trial on the table in front of the participant; the experimenter does not omit any materials OR present any materials not specified - (incorrect): The experimenter omits materials or presents additional materials
Ensure Attending	+ (correct): The experimenter ensures the child scans the entire area in which materials are present (the child may independently attend OR the experimenter may prompt attending) - (incorrect): The child does not scan the entire area in which materials are present and the experimenter does not prompt attending
Response Interval	+ (correct): The experimenter allows up to 5 s (+/- 2 s) for the child to respond; if the participant initiates a response within 5 s, the experimenter allows up to 10 s (+/- 2 s) for the child to complete the response; the experimenter removes the materials within 2 s of a correct response or error - (incorrect): The experimenter allows less than 3 s or more than 7 s for the child to respond; the experimenter does not remove the materials within 2 s of a correct response or error; if the child initiates a response within 5 s, the experimenter allows less than 8 s or more than 12 s for the child to complete the response
Prompt Delivery	+ (correct): The experimenter does not deliver any model or physical prompts following an error or no response - (incorrect): The experimenter delivers a model or physical prompt following an error or no response; the experimenter delivers the incorrect prompt level N/A (not applicable): A correct response occurs (therefore no prompts were necessary)
Reinforcement Delivery	+ (correct): The experimenter delivers praise and a token within 2 s of a correct response - (incorrect): The experimenter does not deliver praise and a token within 2 s of a correct response (reinforcement delivery is too late OR omitted altogether) N/A (not applicable): A correct response does not occur (therefore reinforcement should not be delivered)

0-s Prompt Delay: Discrete-Trial Instruction Sessions (PD and PD + IF Condition)	
Component	**Definitions**

Present Materials	+ (correct): The experimenter places the materials specified for the trial on the table in front of the participant; the experimenter does not omit any materials OR present any materials not specified - (incorrect): The experimenter omits materials or presents additional materials
Ensure Attending	+ (correct): The experimenter ensures the child scans the entire area in which materials are present (the child may independently attend OR the experimenter may prompt attending) - (incorrect): The child does not scan the entire area in which materials are present and the experimenter does not prompt attending
Response Interval	+ (correct): The experimenter allows up to 5 s (+/- 2 s) for the child to respond to the model prompt; if the child initiates a response within 5 s, the experimenter allows up to 10 s (+/- 2 s) for the child to complete the response - (incorrect): The experimenter allows less than 3 s or more than 7 s for the child to respond to the model prompt; if the child initiates a response within 5 s, the experimenter allows less than 8 s or more than 12 s for the child to complete the response
Prompt Delivery	+ (correct): The experimenter provides a model prompt (Amira) or physical prompt (Michael and Richard) within 2 s of ensuring attending; the experimenter provides a physical prompt within 2 s of an error to the model prompt or within 5 s (+/- 2 s) of providing the model prompt if a response does not occur (Amira); the experimenter models the target vocalization every 5 s until the child echoes or the model has been presented 10 times (all participants) - (incorrect): The experimenter delivers a model prompt too late; the experimenter omits the model or physical prompt; the experimenter does not model the target vocalization every 5 s until the child echoes or the model has been presented 10 times
Secondary Target (conditions with IF only)	+ (correct): The experimenter models a secondary target within 5 s (+/- 2 s); the experimenter allows the child up to 5 s to imitate; if the child initiates a response within 5 s, the experimenter allows up to 10 s (+/- 2 s) for the child to complete the response; the experimenter does not provide reinforcement or interact with the child within 5 s if the child imitates - (incorrect): The experimenter does not model a secondary target within 5 s (+/- 2 s); the experimenter does not allow the child up to 5 s to imitate; the experimenter provides reinforcement or interacts with the child within 5 s of the child imitating; if the child initiates a response within 5 s, the experimenter allows less than 8 s or more than 12 s for the child to complete the response
Reinforcement Delivery	+ (correct): The experimenter delivers praise and a token within 2 s of a correct prompted response

	- (incorrect): The experimenter does not deliver praise and a token within 2 s of a correct response following a correct prompted response (reinforcement delivery is too late OR omitted altogether)

5-s Prompt Delay: Discrete-Trial Instruction Sessions (PD and PD + IF Conditions)	
Component	**Definitions**
Present Materials	+ (correct): The experimenter places the materials specified for the trial on the table in front of the participant; the experimenter does not omit any materials OR present any materials not specified - (incorrect): The experimenter omits materials or presents additional materials
Ensure Attending	+ (correct): The experimenter ensures the child scans the entire area in which materials are present (the child may independently attend OR the experimenter may prompt attending) - (incorrect): The child does not scan the entire area in which materials are present and the experimenter does not prompt attending
Response Interval	+ (correct): The experimenter allows up to 5 s (+/- 2 s) for the child to respond independently; if the child initiates a response within 5 s, the experimenter allows up to 10 s for them to complete the response - (incorrect): The experimenter allows less than 3 s or more than 7 s for the child to respond independently; if the child initiates a response within 5 s, the experimenter allows less than 8 s or more than 12 s for the child to complete the response
Prompt Delivery	+ (correct): The experimenter provides a model prompt (Amira) within 2 s of an error or within 5 s (+/- 2 s) of ensuring attending if a response does not occur; the experimenter provides a physical prompt (Michael and Richard) within 2 s of an error or within 5 s (+/- 2 s) of ensuring attending if a response does not occur; the experimenter provides a physical prompt within 2 s of an error to the model prompt (Amira) or within 5 s (+/- 2 s) of providing the model prompt if a response does not occur; the experimenter models the target vocalization every 5 s until the child echoes or the model has been presented 10 times (all participants) - (incorrect): The experimenter delivers a model or physical prompt too early or too late; the experimenter omits one or more prompts; the experimenter uses the incorrect prompt level; the experimenter does not model the target vocalization every 5 s until the child echoes or the model has been presented 10 times N/A (not applicable): An independent correct response occurs, so no prompts are necessary
Secondary Target (conditions with IF only)	+ (correct): The experimenter models a secondary target within 5 s (+/- 2 s); the experimenter allows the child up to 5 s to imitate; the experimenter does not provide reinforcement or interact with the child within 5 s if the child imitates

	<u>- (incorrect):</u> The experimenter does not model a secondary target within 5 s (+/- 2 s); the experimenter does not allow the child up to 5 s to imitate; the experimenter provides reinforcement or interacts with the child within 5 s of the child imitating
Reinforcement Delivery	<u>+ (correct):</u> The experimenter delivers praise and a token within 2 s of an independent correct response or a correct response to the model prompt (Amira) or physical prompt (Michael and Richard) when non-differential reinforcement is in place; the experimenter delivers praise only following prompted responses when differential reinforcement is in place <u>- (incorrect):</u> The experimenter does not deliver praise and a token within 2 s of an independent correct response or a correct prompted response when non-differential reinforcement is in place (reinforcement delivery is too late OR omitted altogether); the experimenter delivers reinforcement for prompted responses when differential reinforcement is in place

Training Sessions: Instructive Feedback Only	
Component	**Definitions**
Present Materials	<u>+ (correct)</u>: The experimenter places the materials specified for the trial on the table in front of the participant; the experimenter does not omit any materials OR present any materials not specified <u>- (incorrect):</u> The experimenter omits materials or presents additional materials
Ensure Attending	<u>+ (correct):</u> The experimenter ensures the child scans the entire area in which materials are present (the child may independently attend OR the experimenter may prompt attending) <u>- (incorrect):</u> The child does not scan the entire area in which materials are present and the experimenter does not prompt attending
Secondary Target	<u>+ (correct):</u> The experimenter models a secondary target within 5 s (+/- 2 s); the experimenter allows the child up to 5 s to initiate a response; if the child initiates a response within 5 s, the experimenter allows up to 10 s for the child to complete the response; the experimenter ends the trial if the child does not respond within 5 s or within 2 s of an error; the experimenter does not provide reinforcement or interact with the child within 5 s if the child imitates the secondary target <u>- (incorrect):</u> The experimenter does not model a secondary target within 5 s (+/- 2 s); the experimenter does not allow the child up to 5 s to imitate; the experimenter does not allow the correct response interval (as described above) for the child to imitate the secondary target; the experimenter provides reinforcement or interacts with the child within 5 s of the child imitating
Reinforcement Delivery	<u>+ (correct):</u> The experimenter delivers praise and a token on a schedule yoked to the preceding prompt delay and prompt delay + IF sessions (+/- 1 reinforcement delivery per session)

	- (incorrect): The experimenter delivers praise and a token too often (two or more trials) or too seldom (two or fewer trials) than the schedule yoked to the mean of the preceding prompt-delay and prompt-delay with instructive-feedback sessions

Free-Play Probes	
Component	**Definitions**
Present Materials	+ (correct): The experimenter presents the materials all of the materials for the condition - (incorrect): The experimenter omits materials or presents additional materials not specified
Ensure Attending	+ (correct): The experimenter ensures the child scans the entire area in which materials are present (the child may independently attend OR the experimenter may prompt attending) - (incorrect): The child does not scan the entire area in which materials are present and the experimenter does not prompt attending
Withdraw Attention within 10 s	+ (correct): The experimenter sits down, appears to be busy by looking at a clipboard, and does not interact with the participant within 10 seconds (+/- 2 s) of ensuring attending and providing the instruction for the remainder of the session - (incorrect): The experimenter takes longer than 12 s to sit down or interacts with the participant following 12 s after providing the instruction
Respond to Mands for Attention	+ (correct): Following the first mand for attention, the experimenter says "Not right now, let's talk about that later. Please play with your toys;" Following subsequent mands for attention, the experimenter says, "I'm almost done, please play for a few more minutes" - (incorrect): The experimenter says anything other than the above statements in response to participant mands for attention N/A (not applicable): No mands for attention occur

Appendix B: Additional Analyses of Michael's Free-Play Data

Table B1

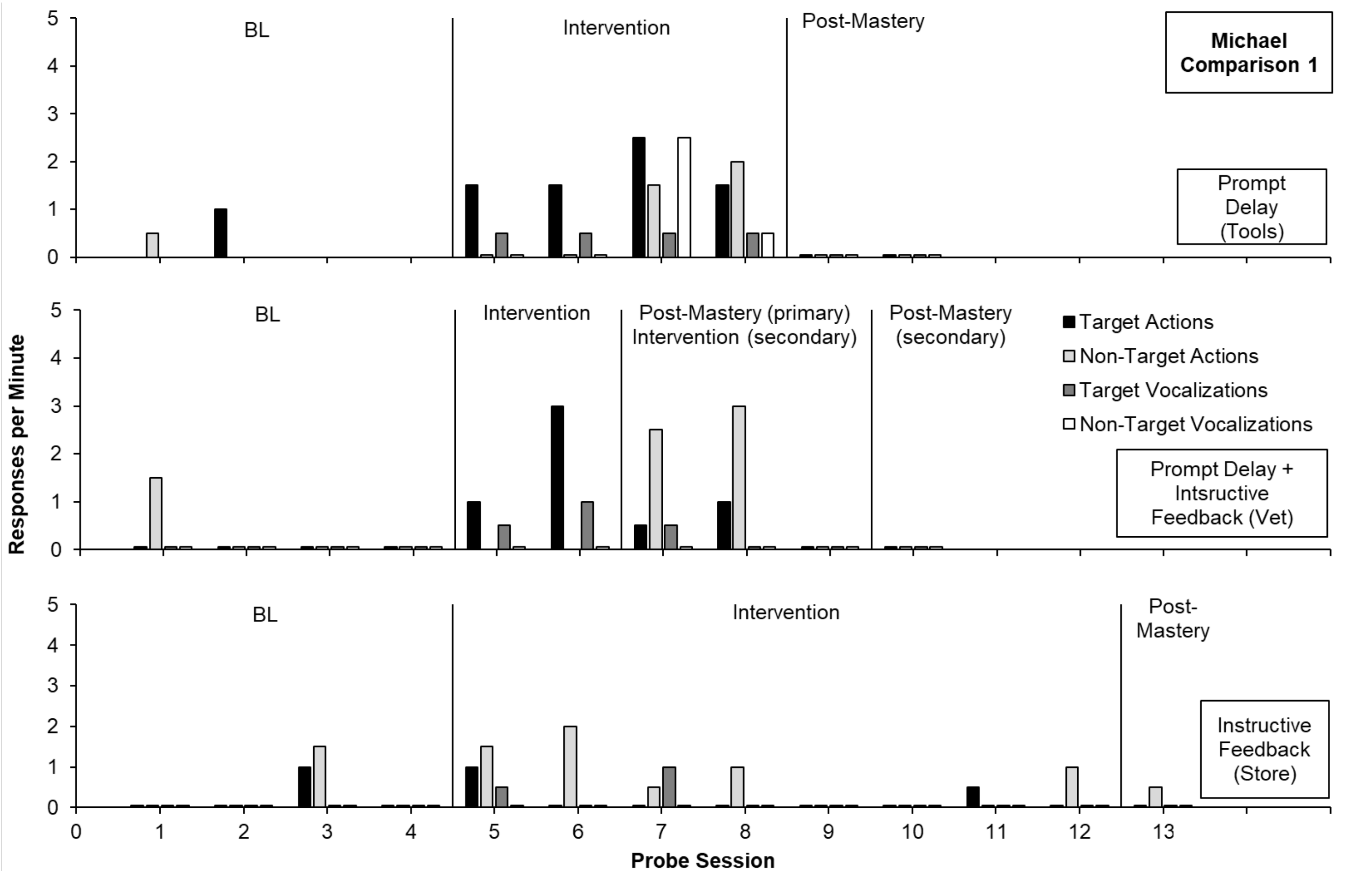
Phase-by-Phase Free Play Summary for Michael

	Phase															
	Baseline				Intervention				Post-Mastery				Video Modeling			
	Responses per Min				Responses per Min				Responses per Min				Responses per Min			
Condition	TA	NTA	TV	NTV	TA	NTA	TV	NTV	TA	NTA	TV	NTV	TA	NTA	TV	NTV
PD C1	0.3	0.1	0.0	0.0	1.8	0.9	0.5	0.8	0.0	0.0	0.0	0.0	-	-	-	-
IF C1	0.2	0.4	0.0	0.0	0.2	0.8	0.2	0	0.0	0.5	0.0	0.0	-	-	-	-
PD + IF C1	0.0	0.4	0.0	0.0	1.1	1.1	0.4	0	0.0	0.0	0.0	0.0	-	-	-	-
PD C2	0.2	0.1	0.0	0.0	0.5	0.7	0.0	0	0.0	1.8	0.0	0.0	0.7	1.7	0.5	0.2
IF C2	0.0	2.2	0.0	0.2	1.7	1.0	0.7	0	0.8	1.8	0.5	0.0	0.5	6.2	0.3	0.2
PD + IF C2	0.1	0.1	0.0	0.1	1.8	0.0	0.5	0	3.0	0.3	1.3	0.0	1.5	0.3	1.2	0.0

Note: When primary targets were mastered before secondary targets (PD + IF C1), data for the post-mastery (primary), intervention (secondary) phase are included during the *intervention* phase in this table; TA = target actions; NTA = non-target actions; TV = target vocalizations; NTV = non-target vocalizations.

Figure B1

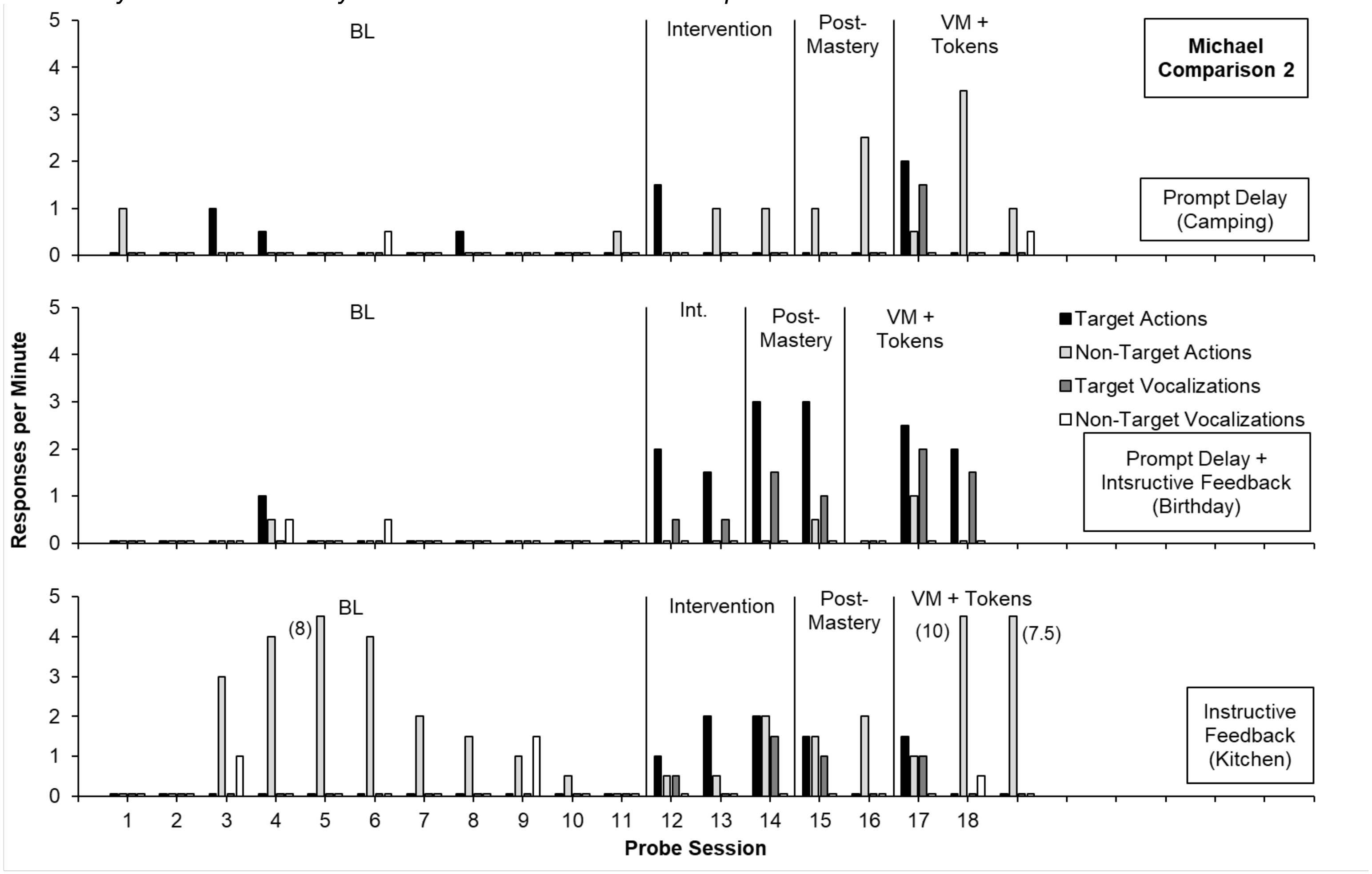
Session-by-Session Free-Play Data for Michael's First Comparison



Note: BL = baseline

Figure B2

Session-by-Session Free-Play Data for Michael's Second Comparison



Note: For probe sessions 5, 18, and 19 in the instructive-feedback condition, Michael engaged in non-target actions at a rate greater than the maximum *y* axis values, actual values are shown in parenthesis next to the bar for those sessions; BL = baseline; VM = video modeling.

Appendix C: Additional Analyses of Amira's Free-Play Data

Table C1

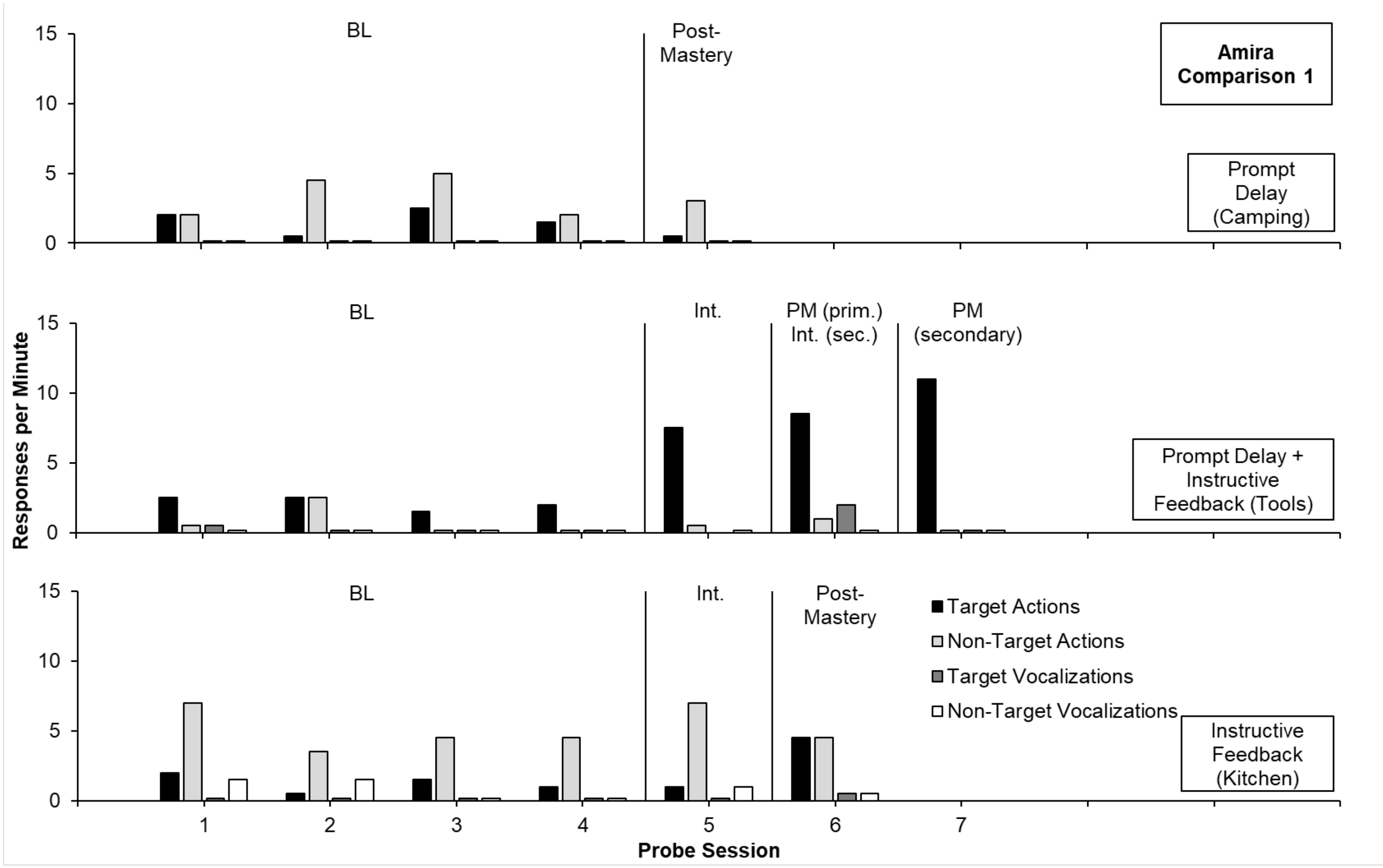
Phase-by-Phase Free Play Summary for Amira

	Phase															
	Baseline				Intervention				Post-Mastery				Video Modeling			
	Responses per Min				Responses per Min				Responses per Min				Responses per Min			
Condition	TA	NTA	TV	NTV	TA	NTA	TV	NTV	TA	NTA	TV	NTV	TA	NTA	TV	NTV
PD C1	1.6	3.4	0.0	0.1	-	-	-	-	0.5	3.1	0.0	0.0	-	-	-	-
IF C1	1.3	4.9	0.0	0.8	1.0	7.0	0.0	1.0	4.5	4.5	0.5	0.5	-	-	-	-
PD + IF C1	2.1	0.8	0.1	0.0	8.0	0.8	1.0	0.0	11.0	0.8	1.0	0.0	-	-	-	-
PD C2	0.6	2.4	0.0	0.1	-	-	-	-	4.5	4.3	0.5	0.0	4.7	4.3	1.0	0.3
IF C2	2.6	1.7	0.0	0.1	-	-	-	-	4.8	1.3	0.0	0.2	5.7	2.7	0.7	0.3
PD + IF C2	1.0	1.6	0.0	0.4	-	-	-	-	8.2	1.3	0.2	0.5	6.2	1.3	1.0	0.2

Note: When primary targets were mastered before secondary targets (PD + IF C1), data for the post-mastery (primary), intervention (secondary) phase are included during the *intervention* phase in this table; TA = target actions; NTA = non-target actions; TV = target vocalizations; NTV = non-target vocalizations.

Figure C1

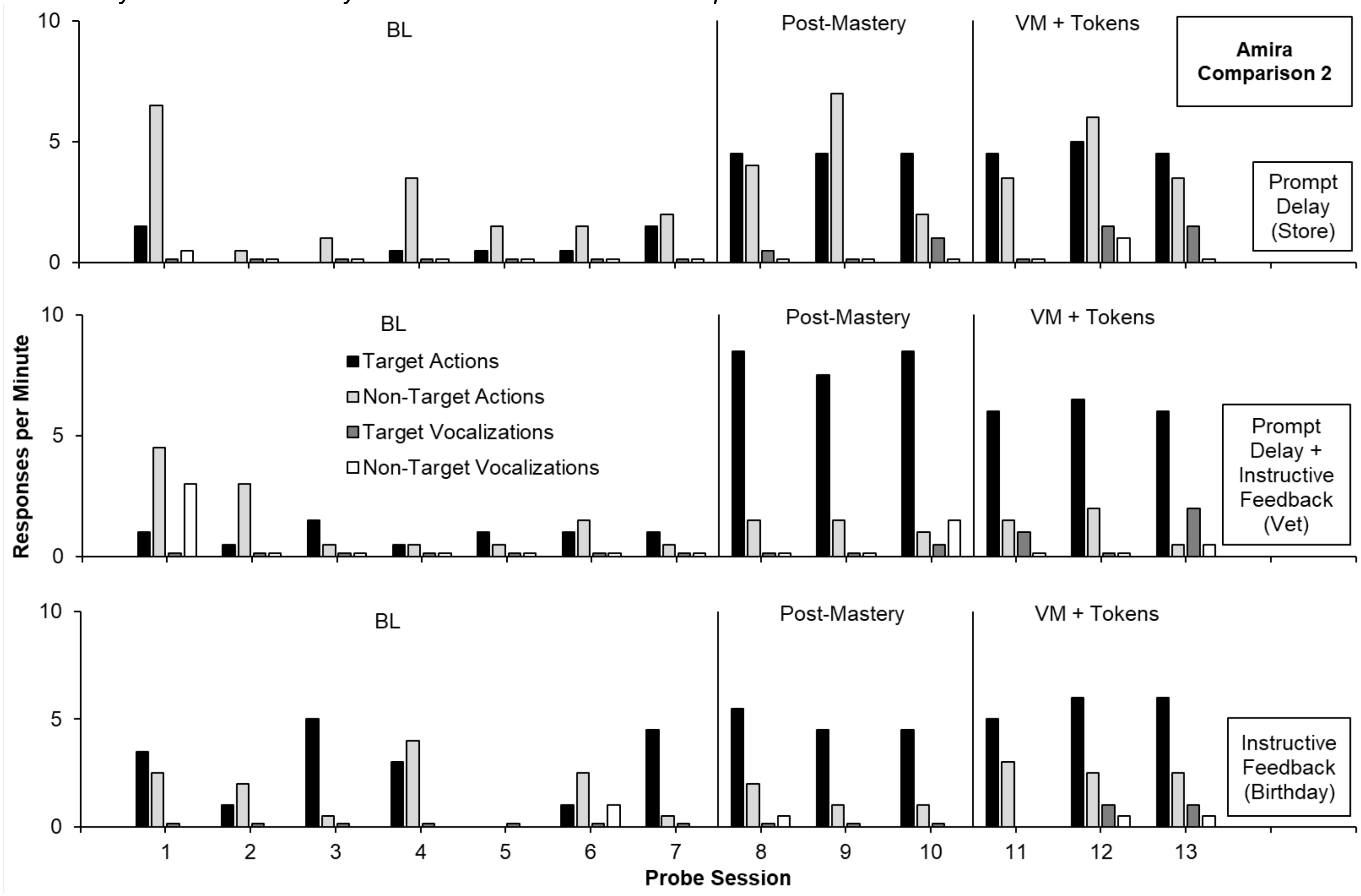
Session-by-Session Free-Play Data for Amira's First Comparison



Note: BL = baseline; Int. = intervention; PM = post-mastery; prim. = primary; sec. = secondary

Figure 6

Session-by-Session Free-Play Data for Amira's Second Comparison



Note: BL = baseline; VM = video modeling

Appendix D: Additional Analyses of Richard's Free-Play Data

Table D1

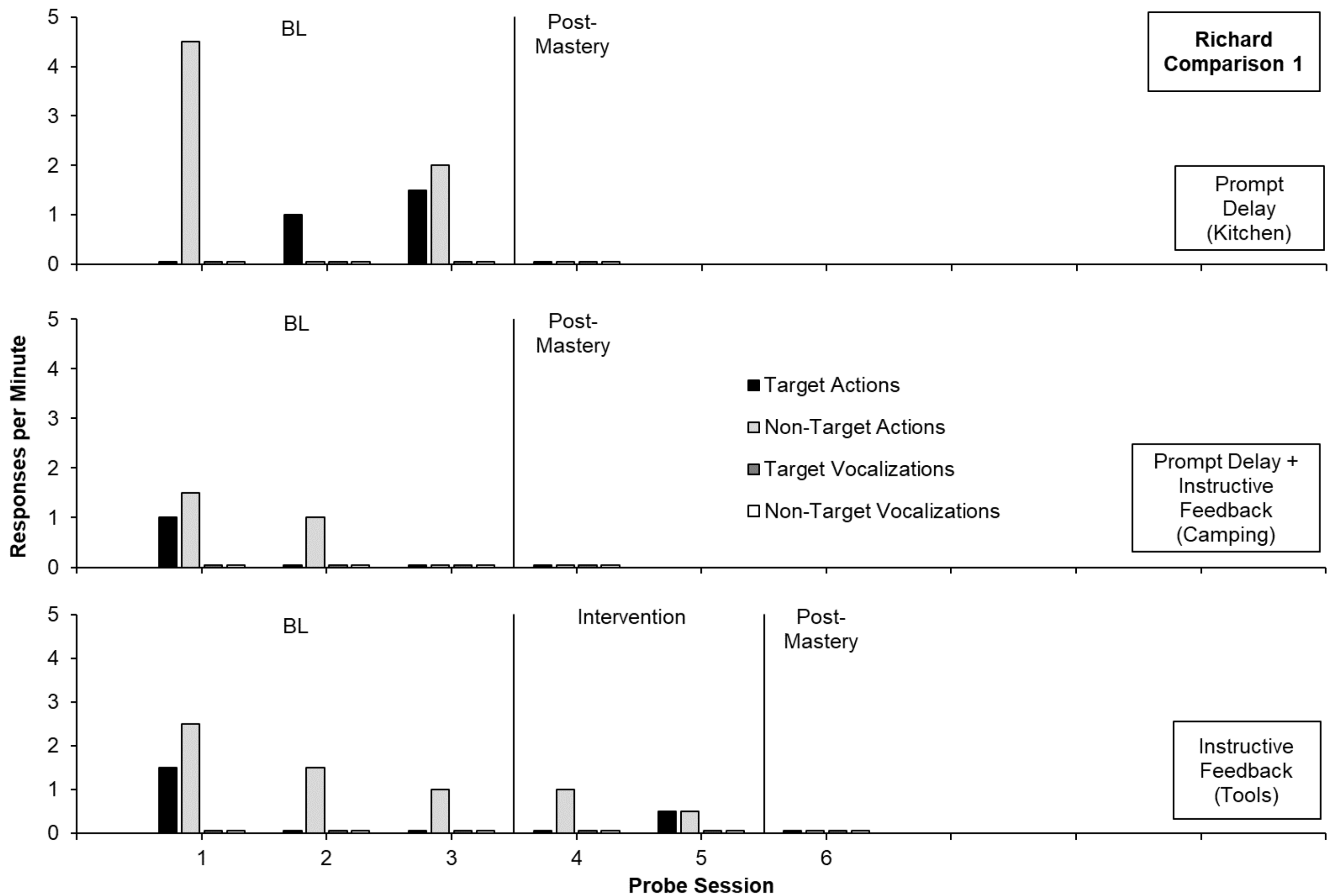
Phase-by-Phase Free Play Summary for Richard

	Phase															
	Baseline				Intervention				Post-Mastery				Video Modeling			
	Responses per Min				Responses per Min				Responses per Min				Responses per Min			
Condition	TA	NTA	TV	NTV	TA	NTA	TV	NTV	TA	NTA	TV	NTV	TA	NTA	TV	NTV
PD C1	0.8	2.2	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-
IF C1	0.5	1.7	0.0	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-
PD + IF C1	0.3	0.8	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0	-	-	-	-
PD C2	0.0	0.0	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0	1.8	1.8	0.4	1.1
IF C2	0.0	2.5	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0	1.6	1.9	0.5	1.1
PD + IF C2	0.8	0.4	0.0	0.0	-	-	-	-	0.0	0.0	0.0	0.0	2.4	0.4	0.7	0.7

Note: When primary targets were mastered before secondary targets (PD + IF C2), data for the post-mastery (primary), intervention (secondary) phase are included during the *intervention* phase in this table; Data for the video modeling + tokens and prompts + video modeling + tokens phases are combined, summarized under the *video modeling* phase in this table; TA = target actions; NTA = non-target actions; TV = target vocalizations; NTV = non-target vocalizations.

Figure D1

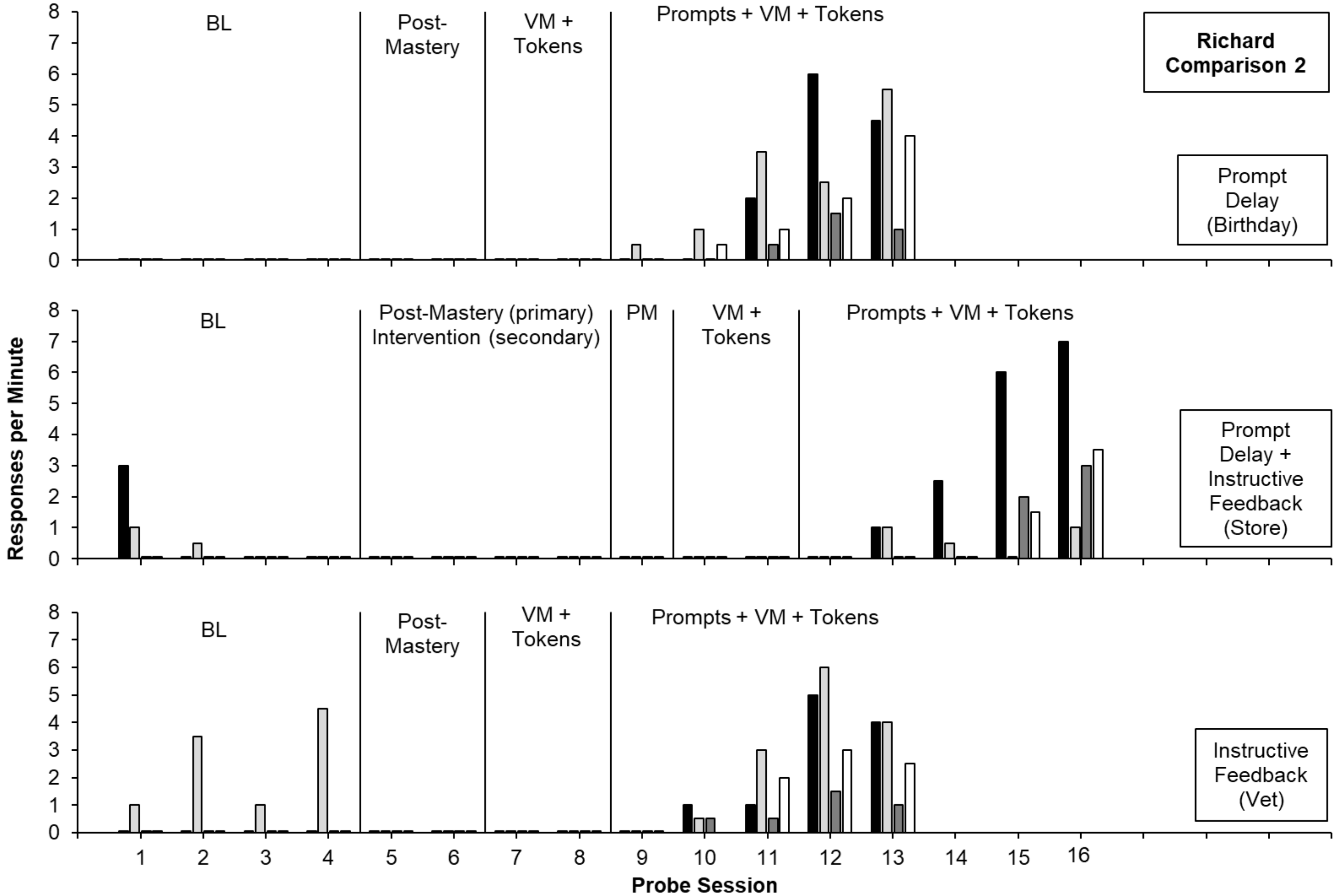
Session-by-Session Free-Play Data for Richard's First Comparison



Note: BL = baseline

Figure D2

Session-by-Session Free-Play Data for Richard's Second Comparison



Note: BL = baseline; VM = video modeling