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A Comparison of Imitation Training Using Concurrent Versus Delayed Prompting

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The ability to imitate can facilitate the learning of a variety of skills. However, children with autism spectrum disorder (ASD) often lack this ability. Valentino, LeBlanc, and Conde (2018) demonstrated that the use of a second therapist to eliminate the delay between the imitative model and the response opportunity effectively established imitative responding exhibited by 1 subject. The present study replicated and extended this finding by separately examining the effects of the second therapist and the delay. Three participants with ASD were exposed to 3 conditions: a 1-therapist, delayed-prompt condition; a 2-therapist, delayed-prompt condition; and a 2-therapist, concurrent-prompt condition. Differentiated responding across conditions occurred in 3 of 6 sets. With respect to determining the most efficient prompting condition, this study yielded mixed results across participants and sets. The condition that most closely resembled the standard instructional arrangement (1-therapist, delayed-prompt condition) was found to be most efficient only 17% of the time. Directions for future research on concurrent prompting during imitation training and the clinical implications of our findings, taken together with those of Valentino et al., are discussed.

Keywords: autism, concurrent prompt, delayed prompt, imitation, second therapist

In typically developing children, imitative behavior usually emerges around a child's first birthday (Learmonth, Lamberth, & Rovee-Collier, 2004). Evidence exists (e.g., Williams, Whiten, & Singh, 2004) that children with autism spectrum disorder (ASD) show deficits in

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imitative behavior when compared to their typically developing peers. Generalized imitation (i.e., the ability to reproduce novel actions without prior training) plays a critical role in learning (Bandura, 1977) and the development of social behavior (e.g., Klinger & Romeo, 1992) and thus is an essential skill for children to develop (Vivanti et al., 2014). Generalized imitation is frequently characterized as a behavioral cusp (Rosales-Ruiz & Baer, 1997) and a "learning to learn" skill (Cornford, 2002) because of the far-reaching effects of imitation on future learning.

Given the importance of imitation and the deficits exhibited by children with ASD, many applied behavior analytic (ABA) programs explicitly target imitation (Maurice, Green, & Luce, 1996; Sundberg, 2008). This focus has led to the development of a large body of empirical evidence demonstrating that discrete-trial teaching is an effective approach to establishing imitative behavior for children with ASD (Baer, Peterson, & Sherman, 1967; DeQuinzio, Townsend, Sturmey, & Poulson, 2007; Garcia, Baer, & Firestone, 1971; Lovaas, Berberich, Perloff, & Schaeffer, 1966; Lovaas, Freitas, Nelson, & Whalen, 1967; Metz, 1965; Young, Krantz, McClannahan, & Poulson, 1994). However, the current literature lacks studies on how to best optimize child learning in the context of an arrangement for discrete-trial imitation training. Ledford and Wolery (2011) conducted a review of research on imitation training for children with disabilities. Their analysis indicated that there are few evidence-based recommendations about instructional procedures for imitation training, and more research is needed in this area so that evidence-based guidelines for imitation training can be established.

The discrete-trial arrangement commonly used in clinical practice utilizes a single therapist presenting learning trials to a child. At the beginning of each learning trial, the therapist delivers a discriminative stimulus (S^D) to the child (vocal instruction to "do this" + model) and waits for the child to respond or prompts the child to perform the target action. In the standard arrangement, the therapist's model is usually discontinued prior to the delivery of a physical prompt. In fact, when the target response involves both arms (e.g., clapping), the model has to be discontinued because it is impossible for the therapist to simultaneously model the target response and prompt the child. In other words, there is an inherent delay between the model and a physical prompt. The presence of a second therapist, whose only role is to block error attempts and prompt as needed, might mitigate the difficulties of the standard arrangement by allowing the primary therapist to continue the model until the child completes the response. In addition, even if the model was discontinued prior to the prompt, the use of an unobtrusive second prompter may help maintain the salience of the model and enhance stimulus control by the relevant features of the teaching arrangement, thereby facilitating the transfer of control from the extraneous prompt to the intended S^D.

Recently, Valentino, LeBlanc, and Conde (2018) used a preassessment to inform the development of individualized instructional strategies for children struggling to acquire gross motor imitative responses. During the preassessment, they evaluated each participant's attending and delayed imitation skills. The results of the preassessment indicated that one participant displayed deficits in delayed imitation. To address their participant's deficit in delayed imitation, Valentino et al. designed an intervention that eliminated the delay between the therapist's model and physical prompts. A second therapist was used to prompt the response, allowing the primary therapist to present the model continuously throughout the response interval. For that participant, the second-prompter condition produced faster acquisition of imitative responses than other conditions. These findings provided preliminary evidence that the use of a second prompter during imitation training might be beneficial for some children with ASD. However, in their evaluation of the second-prompter intervention, Valentino et al. did not separate the effects of prompting in the presence of the model from the effects of using a second therapist during training. Therefore, the isolated effects of concurrent prompting (i.e., prompting in the presence of the model) on the acquisition of imitative responses by children with ASD remain unknown. The purpose of the current study was to replicate the finding of Valentino et al. and to extend their findings by comparing the effects of these two types of prompting (concurrent and delayed) on rates of acquisition of gross motor imitative responses while controlling for the effects of a second therapist.

Method

Participants

Three children diagnosed with autism spectrum disorder (ASD) participated in this study. Prior to the study, all three participants scored a zero on the motor imitation section of the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP): Level 1 (Sundberg, 2008). Joey was a 3-year-old boy who attended a public preschool program for children with developmental disabilities. Joey sometimes produced one-word utterances, but he rarely emitted vocal speech when prompted by adults. He engaged in high rates of motor stereotypy and occasionally engaged in problem behavior such as flopping, chin-pressing, and tantrums. Jackson was a 4-year-old boy who attended a university-based clinic for children with ASD. Jackson sometimes emitted intraverbal responses (e.g., “ready, set, [go]”) and could greet others with prompting but otherwise produced mostly unintelligible speech sounds. He occasionally engaged in problem behavior such as flopping, scratching, pinching, and tantrums. Romeo was a 7-year-old boy who attended a private applied behavior analysis school for children with ASD. He did not emit vocal speech and used a picture-based system to request preferred objects and activities. He engaged in high rates of vocal and motor stereotypy and occasionally engaged in problem behavior such as flopping, elopement, and tantrums. Prior to our study, Joey and Jackson had not received ABA services or imitation training. Romeo had received 3 years of ABA services, including imitation training.

Experimental Design, Measurement, and Procedural Fidelity

We used a concurrent multiple-baseline design across sets with an embedded adapted alternating-treatments comparison (Sindelar, Rosenberg, & Wilson, 1985) to evaluate the effects of three variations of model presentation and prompting on the acquisition of gross motor responses. Our primary dependent variable was *correct responses* during independent trials, expressed as the percentage of independent trials presented during each session. Observers recorded *correct responses* when the participant completed the same physical response that the therapist modeled, at least one time, within 5 s of the S^D, and in the absence of prompting. We calculated the percentage of correct responses during independent trials for each session by dividing the number of independent trials with correct responses by the total number of independent trials and multiplying the result by 100. Observers recorded *incorrect responses* when the participant did not complete the same physical response that the therapist modeled within 5 s of the S^D, attempted to engage in a different physical response (including stereotypy), or failed to respond.

A second observer independently collected data during at least 40% of sessions for each participant across all phases. We calculated interobserver agreement (IOA) for correct responses across all independent trials using the trial-by-trial agreement method by dividing the number of independent trials with agreements within a given session by the number of agreements plus disagreements and multiplying by 100. We defined an exact agreement for each independent trial as both observers scoring a “correct” or both observers scoring an “incorrect” for that trial. Mean agreement for Joey was 100% for baseline sessions, 99% (range, 82–100%) for training sessions, 100% for maintenance sessions, and 98% (range, 92–100%) for interspersed-trial sessions. Mean agreement for Jackson was 99% (range, 90–100%) for baseline sessions, 99% (range, 91–100%) for training sessions, 100% for maintenance sessions, and 100% for interspersed-trial sessions. Mean agreement for Romeo was 97% (range, 80–100%) for baseline sessions, 97% (range, 80–100%) for training sessions, 99% (range, 75–100%) for maintenance sessions, and 100% for interspersed-trial sessions.

Observers collected data on therapist behavior during all phases of the study. For each trial, observers scored if the therapist established eye contact with the participant prior to the S^D, presented the correct prompt (if programmed), and delivered the correct consequence. Procedural fidelity scores were calculated by dividing the number of correct responses by the sum of correct and incorrect responses and multiplying the result by 100 to yield a percentage. We collected data on procedural fidelity during 82% of sessions for Joey, 77% of sessions for Jackson, and 87% of sessions for Romeo; procedural fidelity was 99% for all three participants.

Preexperimental Procedures

Preference assessment. With each participant, we conducted a preference assessment using multiple stimuli without replacement (DeLeon & Iwata, 1996) with 5–10 items to identify highly preferred edible or leisure items for use during training, maintenance, and interspersed-trial sessions. We offered a choice of the top-three items from the preference assessment at the start of each session.

Target identification. Prior to baseline, a single therapist conducted brief imitation sessions with each participant to select target responses. During these sessions, we assessed gross motor movements outlined in early intervention curriculums (e.g., Maurice et al., 1996) or commonly used in clinical practice. The therapist presented three independent trials of each potential response. If the participant responded incorrectly, the therapist moved on to the next trial. If the participant responded correctly, the therapist delivered praise. Sessions continued until we identified six target responses to which the participant never responded correctly.

Target assignment. We selected six gross motor imitation targets for each participant. We attempted to match the targets by the body part and physical effort required to complete the responses. We assigned three targets to Set A and three targets to Set B. We randomly assigned each of the three targets in each set to one of the three experimental conditions described next.

General Procedure

We conducted Joey and Romeo's sessions in empty classrooms; we conducted Jackson's sessions in a common area of the clinic. Participants and therapists sat in small chairs facing each other. During two-therapist sessions, a second therapist sat directly behind the participant in a small chair or on the floor. With the exception of the interspersed-trial phase, we presented trials in a massed trial teaching (MTT) format. We selected MTT for three reasons. First, recent research suggests that MTT may result in more rapid acquisition than interspersed trials (IT; e.g., Rapp & Gunby, 2016). Second, it is possible that early learners may benefit from more exposure to each target in acquisition, such as may be provided by MTT. Finally, MTT allowed us to simplify the teaching procedures somewhat to allow for the therapist to implement the within-session prompt-fading procedures with high fidelity. However, it should be noted that early research on IT often found benefits to IT, particularly for individuals who engage in problem behavior in the presence of demands (e.g., Charlop, Kurtz, & Milstein, 1992; Dunlap & Koegel, 1980). During *independent trials*, the therapist established eye contact, delivered the S^D ("Do this" + 3-s model), and gave the participant 5 s to respond. The therapist did not deliver any prompts during independent trials, and we scored responding as correct or incorrect. During *prompted trials*, the therapist established eye contact and delivered the S^D ("Do this" + 3-s model), and then the primary or second therapist delivered a full physical, elbow, or shoulder prompt to the participant immediately (0-s delay). The (primary or second) therapist held the specified prompt in place for 5 s to allow the participant the opportunity to complete the response. For example, if the therapist was delivering a shoulder prompt for touching toes, the therapist placed her hands on the back of the participant's shoulders and directed the participant's arms toward his own feet (bending at the waist) for 5 s. For the target response "stomp feet," the prompt sequence started at the ankle (full physical), then moved to the knee, and finally to a light thigh prompt. There were occasions in which participants responded correctly prior to the delivery of a programmed prompt (i.e., he "beat" the prompt). This outcome occurred a few times with Joey. In those cases, the therapist delivered the reinforcer, interrupted the programmed prompt sequence, and began conducting independent trials. If the participant responded incorrectly for two consecutive trials during these independent trials, the therapist reintroduced the programmed prompt sequence at the point at which the therapist had left off. Throughout the study, error correction always consisted of full physical guidance regardless of the trial type (prompted or independent).

Baseline. Baseline sessions consisted of 10 independent trials. During each trial, the therapist established eye contact, delivered the S^D

("Do this" + 3-s model), and gave the participant 5 s to respond. If the participant responded correctly, the therapist delivered praise. If the participant responded incorrectly, the therapist moved to the next trial. A second therapist sat behind the participant during all trials for targets assigned to two-person conditions.

Training. Our training procedures depart from those described by Valentino et al. (2018) in that we used most-to-least prompting (MTL) rather than least-to-most prompting (LTM). We used MTL prompt fading because it has been found to be effective at establishing new behavior with young children with ASD (Cengher et al., 2016) and is associated with fewer learner errors when compared with LTM (Libby, Weiss, Bancroft, & Ahearn, 2008). Training consisted of up to three phases: the 6:4 prompt phase, the 3:7 prompt phase, and the independent phase. The ratios (6:4 and 3:7) refer to the ratio of prompted to independent trials during those prompt phases. Training for each target was always introduced at the 6:4 prompt phase. In the 6:4 prompt phase, sessions consisted of one initial probe trial (explained in more detail later in the article), followed by two full physically prompted trials, followed by two elbow-prompted trials, followed by two shoulder-prompted trials, and then four independent trials (1 initial probe trial + 10 teaching trials in total). In the 3:7 prompt phase, sessions consisted of one initial probe trial, followed by one full physically prompted trial, followed by one elbow-prompted trial, followed by one shoulder-prompted trial, and then seven independent trials (1 initial probe trial + 10 teaching trials in total). In the independent phase, sessions consisted of 10 independent trials.

During training, if the participant responded correctly during a prompted trial, the therapist delivered the reinforcer. If the participant responded incorrectly during a prompted trial, the therapist provided error correction (full physical guidance) and delivered the reinforcer. During training, if the participant responded correctly during an independent trial, the therapist delivered the reinforcer. If the participant responded incorrectly during an independent trial, the therapist implemented error correction (full physical guidance) and did not deliver the reinforcer.

During the 6:4 and 3:7 prompt phases, we conducted an initial probe trial (cold probe) prior to the first trial of the session. Although MTL prompting has been demonstrated to produce fewer learner errors than other prompting schemes (Fentress & Lerman, 2012), the development of prompt dependence is always a risk when using prompts. The purpose of the initial probe trial was to mitigate this risk by determining whether the participant needed the programmed prompts prior to a given session. During initial probe trials, the therapist established eye contact, delivered the S^D ("Do this" + 3-s model), and gave the participant 5 s to respond. If the participant responded incorrectly, the therapist provided no error correction and conducted the session at the current training phase (with programmed prompts). In other words, if the participant responded incorrectly, the therapist conducted the predetermined number of prompted trials and the predetermined number of independent trials (e.g., 6 prompted trials and 4 independent trials during the 6:4 prompt phase). If the participant responded correctly, the therapist delivered the reinforcer and began the session with independent trials rather than the programmed prompts outlined by the current prompt phase. Independent trials continued as long as the participant continued to respond correctly until 10 independent trials were conducted (session ended) or two consecutive errors occurred, whichever came first. If at any point in the session the participant responded incorrectly for two consecutive trials, the therapist reverted to the programmed prompt sequence relevant to that phase of training. Sessions were capped at 10 trials even if the programmed prompt sequence was not completed.

One-therapist, delayed-prompt condition. A single therapist implemented all of the session procedures (S^D presentation, prompts, error correction, and reinforcement delivery).

Two-therapist, delayed-prompt condition. A second therapist was seated behind the participant in a small chair or on the floor and assisted the therapist with session procedures. The primary therapist presented the S^D and delivered praise and reinforcement. The second therapist delivered prompts and error correction. The purpose of this condition was to isolate the effects of a second prompter without concurrent prompting.

Two-therapist, concurrent-prompt condition. Session procedures were identical to the two-therapist, delayed-prompt condition, with one exception. After the therapist presented the S^D, the therapist continued to model the target response until the participant responded correctly or until the end of an error correction. In other words, the model continued throughout the participant's opportunity to respond. Therefore, the model could last up to 8 s (3-s S^D model + 5-s window to respond).

Maintenance. Maintenance sessions consisted of four independent trials of a mastered target response. If the participant responded correctly, the therapist delivered the reinforcer. If the participant responded incorrectly, the therapist implemented error correction (full physical guidance) and did not deliver the reinforcer.

Interspersed trials. Interspersed-trial sessions consisted of 12 independent trials of all targets (2 trials of each mastered target). We randomized trials prior to sessions. The therapist delivered the reinforcer following correct responses but did not provide error correction following incorrect responses.

The mastery criterion for all phases was 90% correct responding on independent trials for two consecutive sessions across days. Upon meeting the mastery criterion, the participant moved from the 6:4 prompt phase to the 3:7 prompt phase. The terminal mastery criteria (to move a target from training to maintenance) were 90% correct responding on independent trials for two consecutive sessions and correct responses to the initial probe trials in both sessions. Participants could meet the terminal mastery criteria in any of the training phases. We conducted maintenance sessions for mastered targets regularly to promote skill retention. If correct responding decreased to 0% for five consecutive sessions in any phase, we returned the participant to the previous phase (this only occurred for one participant, Romeo). If a participant mastered targets in one condition (that condition was effective) and an overall increasing trend was not present in the remaining condition(s), we moved the targets that were not mastered to the most effective condition for that participant. Romeo was the only participant for whom this was necessary.

Results

All figures display the participant's percentage of correct responding on independent trials for Set A (top three panels) and Set B (bottom three panels). Participant performance on initial probe trials is not included in percentage of correct responding. Instead, filled data points indicate correct responding on the initial probe trial during a given session. Figure 1 depicts Joey's results. Joey did not emit any correct responses for any of the six targets during baseline. Joey met the terminal mastery criteria for the target in the one-therapist, delayed-prompt condition (tap legs) in Set A after four sessions in the 6:4 prompt-training phase. We then introduced training in Set B. Joey met the mastery criteria for the 6:4 prompt phase for the other two Set A targets (hands on cheeks and touch elbow), and those targets moved to the 3:7 prompt phase after five and seven sessions, respectively. Although we moved these two targets to the 3:7 prompt phase, Joey never experienced the 3:7 prompt phase because he always responded correctly on the initial probe trial. Joey met the terminal mastery criteria for these two targets in the 3:7 prompt phase. For Set B, Joey met the terminal mastery criteria for all three targets within four training sessions. After we moved all six targets to maintenance, we introduced interspersed trials. Correct responding remained high during interspersed trials across conditions for all six targets.

Figure 2 displays Jackson's results. Jackson did not emit any correct responses for the Set A targets during baseline. The target in the one-therapist, delayed-prompt condition (hands on cheeks) was the first target to reach mastery in the 6:4 prompt phase. Correct responding increased slowly throughout the 3:7 prompt phase and eventually reached the terminal mastery criteria in the independent phase. The target in the two-therapist, delayed-prompt condition (tap legs) required 19 sessions in the 6:4 prompt phase before finally moving to the 3:7 prompt phase and reaching terminal mastery criteria. We observed variable responding for the target in the two-therapist, concurrent-prompt condition (clap hands) during the 6:4 prompt phase until the terminal mastery criteria were met at Session 68. Jackson's responding during baseline for Set B targets was low and stable for the targets in the two-therapist, delayed-prompt and two-therapist, concurrent-prompt conditions. We observed some correct responding for the target in the one-therapist, delayed-prompt condition (tap head) prior to the introduction of training. Terminal mastery criteria were met for

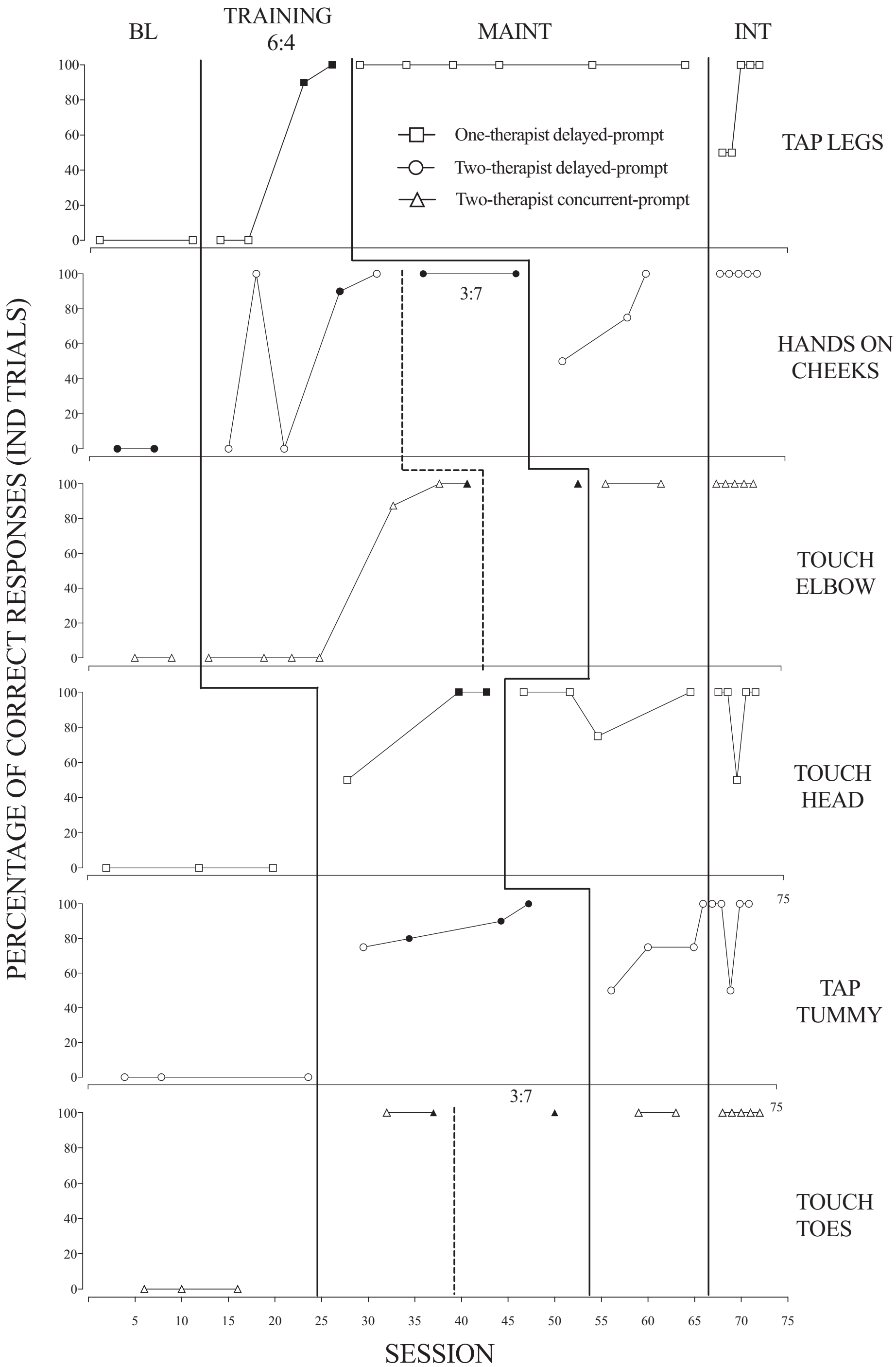

Figure 1. Joey's percentage of correct responding on independent trials for Set A (top three panels) and Set B (bottom three panels). Filled data points represent sessions in which Joey responded correctly on the initial probe trial. BL = baseline; MAINT = maintenance; INT = interspersed trials.

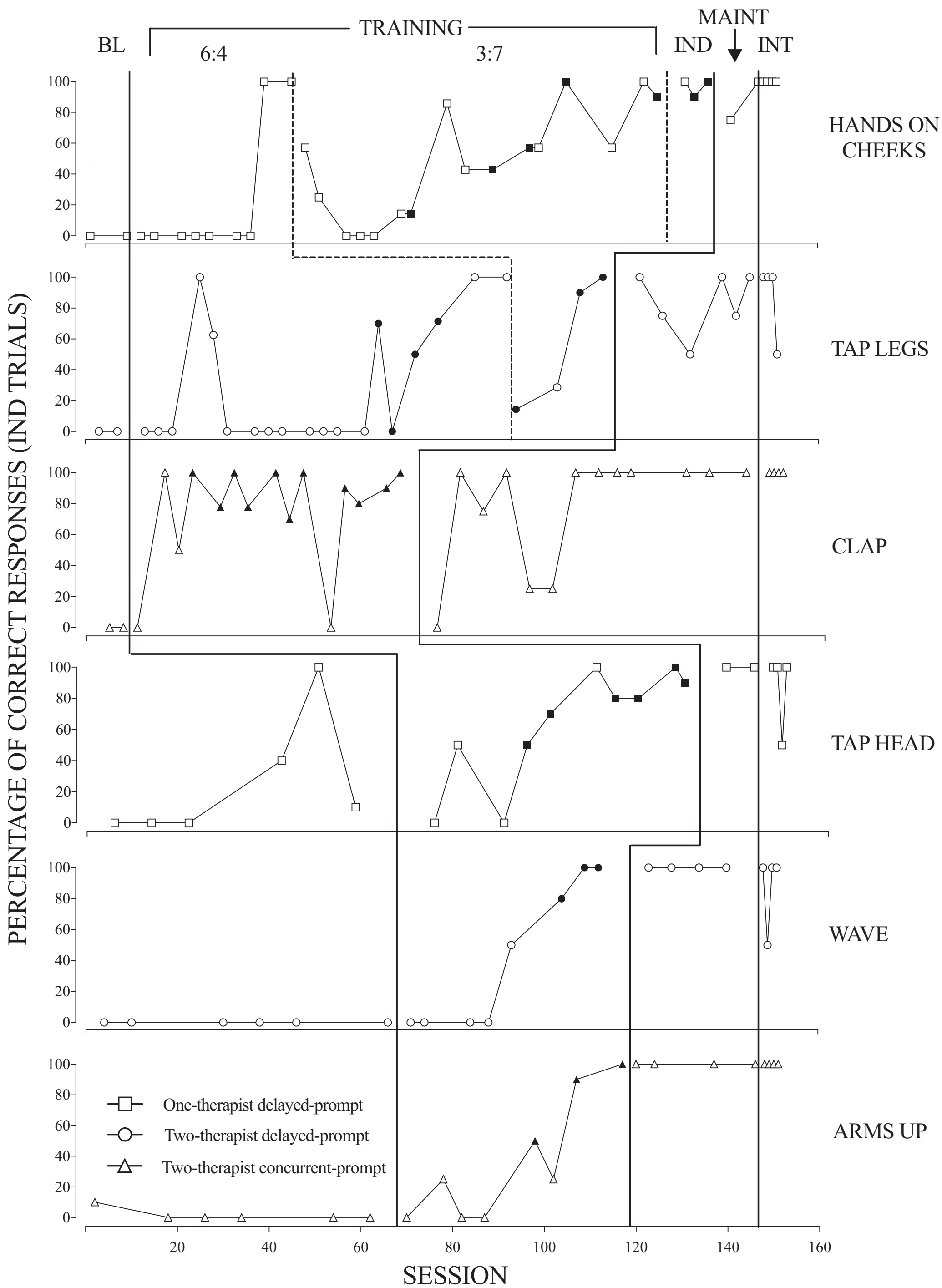

Figure 2. Jackson's percentage of correct responding on independent trials for Set A (top three panels) and Set B (bottom three panels). Filled data points represent sessions in which Jackson responded correctly on the initial probe trial. BL = baseline; IND = independent phase; MAINT = maintenance; INT = interspersed trials.

all three Set B targets during the 6:4 prompt phase. Terminal mastery criteria were met in 10, 6, and 7 sessions in the one-therapist, delayed-prompt; two-therapist, delayed-prompt; and two-therapist, concurrent-prompt conditions, respectively. We observed high levels of correct responding for all targets during the interspersed-trial phase.

Figure 3 displays Romeo's results. Romeo engaged in low to zero levels of correct responding during baseline across all six targets. After we introduced the 6:4 prompt phase with Set A, Romeo began emitting correct responses for the target in the two-therapist, delayed-prompt condition (touch head) and met mastery after eight training sessions. However, we observed some responding prior to the S^D during Sessions 37 and 39, suggesting that this response may have been under the control of unintended features of the training environment, rather than the model. As a precaution, we conducted additional sessions before moving this target to maintenance at Session 65. The emergence of correct responding in Set B was associated with a decrease in correct responding in the maintenance phase for the touch-head response. This decrease suggested that the response of touching the head was indeed likely under faulty stimulus control (Halle & Holt, 1991). After five sessions with zero correct responses, we reinstituted the 3:7 prompt phase and subsequently the 6:4 prompt phase. Eventually, Romeo met the terminal mastery criteria (for the second time) for the touch-head response in the second 3:7 prompt phase at Session 227. Correct responding for the target in the two-therapist, concurrent-prompt condition (stomp feet) was met in the 6:4 prompt phase after 32 sessions. We did not observe correct responding for the target in the one-therapist, delayed-prompt condition (wave) until this target was switched to a more effective condition (described later in the article). We observed low to zero levels of correct responding during baseline for Set B targets. We introduced the 6:4 prompt phase to Set B at Session 61. Romeo quickly met mastery criteria for the targets in the two-therapist, concurrent-prompt condition (touch toes) and the two-therapist, delayed-prompt condition (clap) in the 6:4 prompt phase and subsequently met the terminal mastery criteria for those targets in the 3:7 prompt phase.

After Romeo met the terminal mastery criteria for the touch-head response in Session 237, the only targets still in training were the two targets in the one-therapist, delayed-prompt condition (wave and arms up). Additionally, Romeo was not making sufficient progress on these two targets. We conducted 36 sessions of the wave with zero instances of a correct response. To increase the likelihood of acquisition, we switched the targets from the one-therapist, delayed-prompt condition to the two-therapist, concurrent-prompt condition. We selected the concurrent-prompt condition rather than the delayed-prompt condition because we suspected that the delay in the one-therapist, delayed-prompt condition may have contributed to the lack of acquisition. Following this switch, correct responding for both targets increased, and both targets met terminal mastery within five and four sessions, respectively. We observed high levels of correct responding for all six targets during the maintenance and interspersed-trial phases.

Table 1 summarizes the number of sessions needed to reach mastery for each participant across the three conditions as well as which condition was most efficient (fewest sessions to mastery) for each set. If the difference between the two conditions requiring the fewest number of sessions was minimal, we considered the conditions equivalent with respect to efficiency. We defined a minimal difference as fewer than 50% additional sessions needed for mastery. In other words, if the target in Condition A was mastered in 10 sessions and the target in Condition B was mastered in fewer than 15 sessions (10 sessions + 5 sessions [50% of 10 sessions]), Conditions A and B were considered equivalent. We observed differentiated responding across conditions in three of six sets. For one of the three sets, the two-therapist, concurrent-prompt condition was most efficient. For one of the three sets, the two-therapist, delayed-prompt condition was most efficient, and for the remaining set (Joey, Set A), the one-therapist, delayed-prompt condition was most efficient. It is interesting to note that very few training sessions were necessary in any of the conditions for Joey. That is, in Joey's case, it seems that all conditions were more or less equal. However, for the remaining two participants, the differences between the conditions were more marked. For Jackson (Set A), the two-therapist,

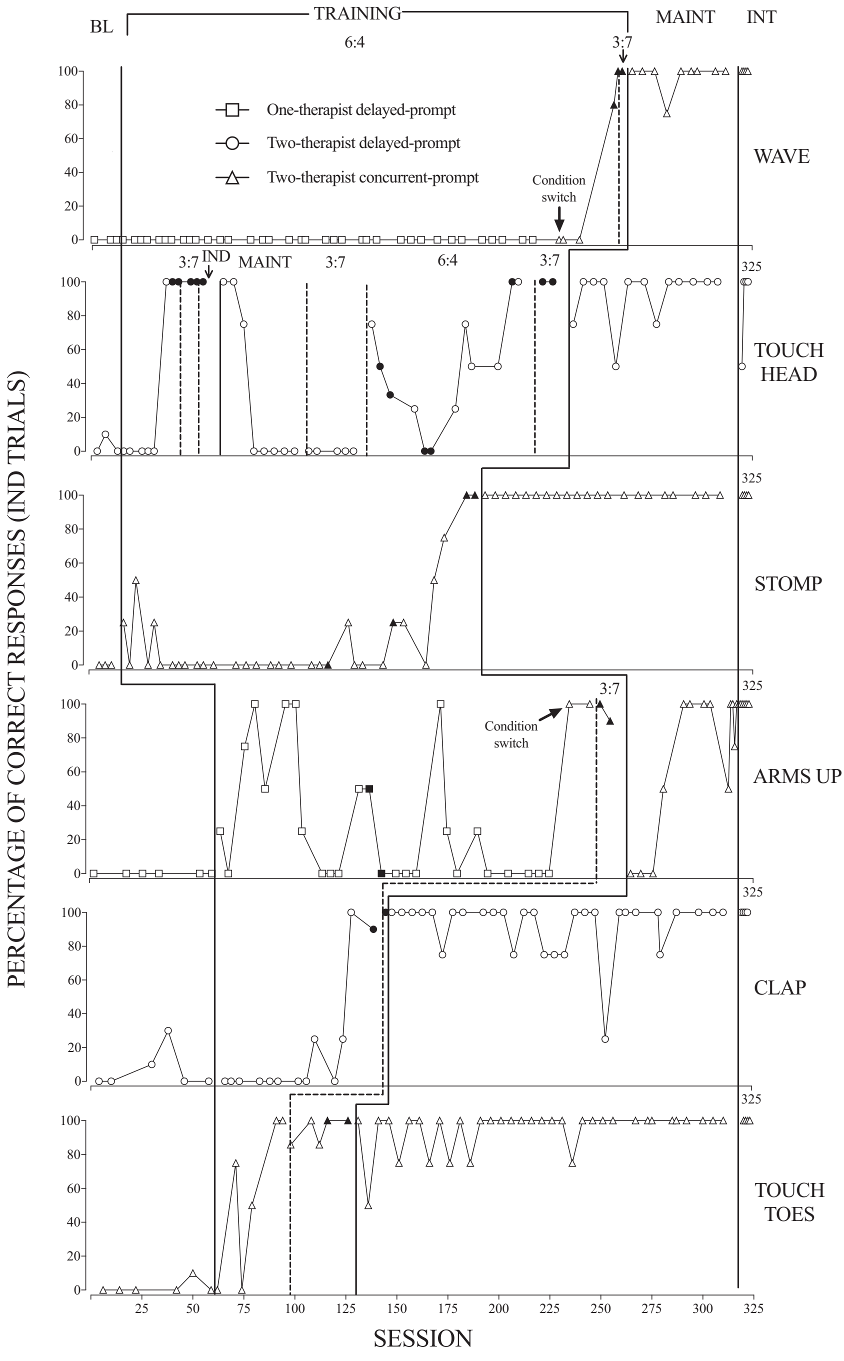

Figure 3. Romeo's percentage of correct responding on independent trials for Set A (top three panels) and Set B (bottom three panels). Filled data points represent sessions in which Romeo responded correctly on the initial probe trial. The switch from the one-therapist, delayed-prompt condition to the two-therapist, concurrent-prompt condition for "wave" and "arms up" is reflected by the change in symbol. BL = baseline; IND = independent phase; MAINT = maintenance; INT = interspersed trials.

Table 1
Number of Training Sessions to Terminal Mastery Criteria

Participant	Set	One therapist, delayed prompt	Two therapists, delayed prompt	Two therapists, concurrent prompt	Most efficient
Joey	A	4	7	8	One therapist, delayed prompt
	B	3	4	3	Equivalent
Jackson	A	28	23	15	Two therapists, concurrent prompt
	B	10	8	8	Equivalent
Romeo	A	[a]	8	32	Two therapists, delayed prompt
	B	[a]	14	11	Equivalent

[a] Targets mastered after being switched to the two-therapist, concurrent-prompt condition.

concurrent prompt condition was more efficient than the other two conditions. For Romeo, the two-therapist, delayed-prompt condition was most efficient for Set A. Generally speaking, the two-therapist conditions were more efficient than the one-therapist condition for Romeo. In addition, for Romeo, correct responding did not emerge for either of the targets assigned to the one-therapist, delayed-prompt condition until those targets were switched to the two-therapist, concurrent-prompt condition.

Discussion

Overall, this evaluation produced mixed results across participants and sets. Despite these mixed findings, we observed some interesting differences between the conditions that are worthy of consideration. First, we found the condition that most closely resembles the standard clinical training arrangement (one-therapist, delayed-prompt condition) to be most efficient for only one of the six (17%) sets. We found the two-therapist conditions to be superior to the one-therapist condition for two of six sets (34%). These findings represent a partial replication of those of Valentino et al. (2018), who found that a two-therapist arrangement was superior to a one-therapist arrangement for one subject during imitation training. Second, we extended the findings of Valentino et al. by separating the effects of concurrent prompt delivery from the effects of a second prompter during imitation training. The two-therapist, concurrent-prompt condition produced more rapid acquisition in one set, and the two-therapist, delayed-prompt condition produced more rapid acquisition in one set. As a result of these mixed findings, the influence of the second therapist (alone) and the influence of concurrent prompting (alone) on the acquisition of imitation remain unclear. Additional research is needed before we can draw conclusions about the isolated effects of concurrent prompting.

There are a number of implications to consider in light of our findings. Similar to Valentino et al. (2018), we used a second therapist to facilitate the use of concurrent prompting; the second therapist delivered prompts while positioned behind the participant. Several prior studies have incorporated prompting from behind into training procedures aimed at establishing new skills (e.g., Krantz & McClannahan, 1998; MacDuff, Krantz, & McClannahan, 1993). In the case of imitation training, two-therapist training arrangements might offer some distinct advantages relative to the standard, one-therapist training arrangement. In a one-therapist training arrangement, a single therapist is responsible for completing all components of the trial (S^D presentation, prompting, error correction, and consequence). In the early stages of imitation training, prompting is almost always necessary to produce new participant responses. That means that the therapist must first model the target response and then quickly prompt the participant to engage in the same response. Generally, the therapist's model and prompt occur in very close temporal proximity to each other. Let us consider how a participant might experience a learning trial during the early stages of imitation training. First, the therapist engages in a number of motor responses (including touching the participant), and then the therapist delivers a reinforcer. It is possible that it might be difficult for some children to discriminate what portion of the antecedent stimulus is the model and what portion is the prompt. Difficulty discriminating between these two components of the antecedent stimulus could produce two potential outcomes. One possible outcome is that the child might begin exhibiting the target response and then attempt to prompt the therapist. A more probable outcome is that the child might begin waiting for the therapist to prompt him or her. The therapist touching (prompting) the child is not a programmed part of the reinforcement contingency. However, when a single therapist delivers a model in close temporal proximity to a prompt, there might be an increased risk of the development of problematic stimulus control. Romeo's results provide a potential example of such faulty stimulus control in the present study and highlight the potential benefits of the second prompter for some individuals.

Although two-therapist training arrangements may not completely mitigate the risk of faulty stimulus control, it might be helpful during the early stages of imitation training to separate the source of the S^D and reinforcement from the source of prompting. A two-therapist arrangement might allow therapists to fade prompts by decreasing their proximity to the child; this would not be possible in a one-therapist arrangement. It is also possible that a two-therapist arrangement may result in learning trials that appear "cleaner" from the perspective of the child. In some settings, strategic planning might be necessary to ensure two therapists are available for imitation training sessions. In the case of home-based therapy, parents might be able to assist therapists during early imitation-training sessions. If the assistance of a second therapist is not feasible, there are a few other teaching strategies that could facilitate the use of concurrent prompting. First, simple, one-handed imitative responses could be targeted during the initial stages of training. This approach would allow therapists to prompt the child while continuing to present the model. Future research could compare the effects of a one-therapist, concurrent-prompting arrangement to a two-therapist, concurrent-prompting arrangement on the acquisition of one-handed imitative responses. Second, some researchers have used mirrors during imitation training (Du & Greer, 2014; Miller, Rodriguez, & Rourke, 2015). A mirror could facilitate the use of concurrent prompting for one-handed responses; however, for some children, the presence of a mirror might evoke responses that interfere with training (i.e., touching the mirror, making faces). Future researchers could investigate the effects of concurrent prompting using a mirror on imitation acquisition as well as the frequency of competing responses during training. Finally, there is promising research on the use of video models during imitation training (Cardon & Wilcox, 2011; McDowell, Gutierrez, & Bennett, 2015). A substantial body of research indicates that video modeling can be an effective intervention for teaching new skills to children with ASD (see Delano, 2007 for a review). Additionally, some evidence suggests that children with ASD may demonstrate increased visual attention to video stimuli relative to live stimuli (Cardon & Azuma, 2012a). Similarly, peer modeling (e.g., Sweeney, Barton, & Ledford, 2018) might provide another alternative to the second-prompter arrangement that could have additional benefits for individuals with ASD who also may need interventions to support appropriate joint attention and other social repertoires.

There is a growing body of research on the use of preassessments to inform the selection or development of individualized instructional strategies (e.g., Schnell et al., 2019). Both participants in the Valentino et al. (2018) study had previously acquired a number of imitative responses with objects but were struggling to learn gross motor imitation under standard clinical instructional arrangements. Their prerequisite skills assessment was designed to identify a specific remediation strategy for each participant. One of our participants, Romeo, had also received imitation training using well-established instructional strategies but had not acquired gross motor or object imitation prior to our study. It is interesting that the two-therapist conditions produced the most pronounced effects for Romeo relative to our other two participants. For Romeo, the two-therapist conditions were the most efficient conditions for Sets A and B. Furthermore, Romeo did not acquire either target in the standard, one-therapist, delayed-prompt condition until we switched those targets to the two-therapist, concurrent-prompt condition. More research on the utility of concurrent prompting during imitation training is needed, but the results of our study and those of Valentino et al. suggest that it might be a promising remediation strategy for some children.

As we stated previously, one notable difference between our participants and those in the

Valentino et al. (2018) study is that our participants did not exhibit any imitation skills prior to our study. The participants in their study already exhibited some object imitation but were unable to imitate gross motor movements. In their preassessment, Valentino et al. evaluated two skills (attending and delayed imitation) with and without objects. That is, the authors used object imitation as the basis for comparison during the assessment. An interesting avenue for future researchers could be to investigate strategies for assessing prerequisite skills for imitation when participants do not exhibit any imitative behavior. The development of such an assessment would be a valuable clinical tool. Future researchers could also explore other skills pertinent to the acquisition of imitative responses, such as specific motor difficulties (e.g., crossing the midline or insufficient muscle strength).

One limitation of our study is that we did not conduct probes of novel responses. Given that the purpose of imitation training is to establish generalized imitation, the inclusion of novel stimulus probes would have strengthened our study. Future researchers investigating imitation-training procedures may want to consider embedding novel stimulus probes throughout training or including a generalization phase at the end of training similar to Valentino et al. (2018). Another consideration for future researchers is the use of massed trials (MTs) during the initial stages of imitation training. One advantage of using MTs rather than ITs is that it might be easier for the therapist to keep track of prompt fading for individual target responses. One disadvantage is that MTs may increase the risk of the development of faulty stimulus control. Two ways to mitigate this risk to some degree are to teach multiple targets concurrently and to include a requirement of a correct response during an initial probe trial in the mastery criteria. As noted by Rapp and Gunby (2016), there is conflicting evidence regarding the relative benefits of MT and IT for teaching in general. Furthermore, none of the studies comparing MT and IT includes imitation as one of the targets. Thus, more research is needed comparing IT and MT before best-practice recommendations can be made. Future researchers may want to explore questions about massed versus interspersed trials, serial versus concurrent training, and set size on acquisition in the context of imitation training. Another potential limitation of this study was that although we tried to counterbalance target difficulty across conditions, we cannot be certain that these targets were perfectly equal in difficulty. However, this limitation is not specific to our study and is a general limitation of studies aimed at comparing effective treatment strategies for teaching new skills. Additionally, in our attempts to equate the difficulty between targets, we only compared the effects of these conditions on gross motor imitation training. Future research could investigate the effects of these conditions on different subtypes of imitation, including fine motor or object motor imitation.

On a related note, although we attempted to equate difficulty across targets, we did so by matching the body part and physical effort required to complete the responses. We did not take into account other parameters that might affect target acquisition for this population. For example, it is possible that gross motor movements that are more discrete (i.e., connect to a physical stimulus and/or have a clear start and finish; e.g., touch foot) may be easier for some individuals to acquire than less discrete responses (i.e., do not connect to a physical stimulus and/or do not have a clear start and finish; e.g., wave). It is also possible that discrimination errors are more likely to occur with targets that use the same body parts. Future research could address this limitation by limiting targets to discrete responding with different body parts or by increasing the number of comparison sets.

As Valentino and colleagues (2018) noted, one inherent drawback of comparing imitation-training procedures using single-subject experimental designs is the possibility of multiple-treatment interference. When comparing multiple-treatment conditions aimed at establishing responses that could become members of a generalized operant class, it may be challenging (if not impossible) to limit carryover effects. Valentino et al. suggested embedding an alternating-treatments comparison in a multiple-baseline approach across participants to provide an additional demonstration of experimental control. We accomplished a similar effect by using a multiple baseline across sets, lending some additional support to our demonstration of experimental control despite the inherent difficulty of this type of comparison. It should be noted, however, that when using a multiple baseline across sets for a skill like imitation, it might be harder to detect an effect in the later sets. In other words, if differential effects are observed in the first set, the differences between the conditions in subsequent sets may be less pronounced. All three of our participants showed a savings effect across sets (Wacker, Berg, Berrie, & Swatta, 1985), such that the second set of targets was acquired in fewer sessions than the first set. Although this was a positive clinical outcome for our participants, it does speak to the limitations of treatment-comparison studies involving "learning to learn" skills (such as imitation).

We replicated and extended the findings of Valentino et al. (2018) by separating the effects of concurrent prompting from the effects of a second therapist. The results of our study were mixed across participants and sets; however, the standard instructional arrangement (one therapist, delayed prompt) was rarely the most efficient (17%, 1 out of 6 sets). The two-therapist conditions were superior to the one-therapist condition 33% of the time (2 out of 6 sets), and the one-therapist and two-therapist conditions were equally efficient 50% of the time (3 out of 6 sets). More specifically, our data indicate that for 2 of 3 participants, there was little difference between the one- and two-therapist conditions. This might lead some to conclude that the second therapist is not beneficial from a cost–benefit perspective. However, our data suggest that the two-therapist conditions were particularly effective for the participant who required the most training overall. Taken together, our results and those of Valentino et al. suggest that the use of concurrent prompting during gross motor imitation training might be a useful strategy for some children with ASD, especially those who exhibit specific deficits in delayed imitation. Although the use of two therapists may require more resources, it might be necessary to establish imitative responding in some children. Thus, additional research is needed to identify participant characteristics that may predict for whom the second prompter and concurrent model might be beneficial. Generally, more research on the utility of concurrent prompting during imitation training with additional participants would lend support to these preliminary findings.

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