Using Progressive Time Delay to Increase Levels of Peer Imitation During Play with Preschoolers with Disabilities

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Abstract

Research suggests peer imitation can be taught using systematic procedures and can be embedded into ongoing play contexts with preschool age children. However, additional research is needed to test procedures that may increase levels of peer imitation with toddlers with disabilities and in generalized contexts. We used a multiple probe across participants research design to evaluate the effectiveness of progressive time delay (PTD), to teach peer imitation to preschoolers with disabilities during a play activity with a peer. We also examined the efficacy of PTD in a generalized context (i.e., new peers, implementer, and materials). Visual analysis indicated a functional relation between PTD and unprompted peer imitation; however, generalization was variable across participants. Our results support previous research indicating PTD is effective in teaching children with disabilities to imitate their peers.

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Imitation, watching and copying the action of another, is an important developmental milestone, as it enables children to access new and varied learning opportunities (Najdowski, Gould, Lanagan, & Bishop, 2014). Watching and imitating others is a primary mechanism for learning. This process, known as observational learning (Bandura, 1977), occurs when children observe other(s) perform a behavior (i.e., skill, task) and then emit the behavior without explicit instruction (Sweeney, Barton, & Ledford, 2019). However, children with disabilities—particularly those with autism spectrum disorder (ASD)—oftentimes have deficits or delays in imitation (Rogers, Hepburn, Stackhouse, & Wehner, 2003). These children may be unlikely to learn efficiently from adult or peer imitation without direct and systematic instruction (Ledford & Wolery, 2011). Imitation is important for learning in both direct instructional contexts and in typical settings in which observational learning might take place. Further, several researchers have shown correlations between imitation and language and play development for children with disabilities (Stone, Ousley, & Littleford, 1997; Thurm, Lord, Lee, & Newschaffer, 2007). Adequate peer imitation is especially advantageous for children with disabilities in inclusive classroom settings, where children have multiple and varied opportunities to imitate competent peers engaging in age and context-appropriate behaviors (Bricker, 1978; Strain, Schwartz, & Barton, 2011). Thus, targeted interventions that effectively and efficiently teach imitation are needed as peer imitation might be particularly important for attaining positive outcomes and providing children with ongoing learning opportunities across environments.

Researchers have identified several effective direct teaching (e.g., prompting and reinforcement) and naturalistic (e.g., contingent imitation) strategies for increasing imitation of

adults by children with disabilities (Gazdag & Warren, 2000; Hwang & Hughes, 1995; Hwang & Hughes, 2000; Ingersoll & Schreibman, 2006). Although naturalistic strategies are important procedures for adults to use during child-directed activities, peers may be unlikely to systematically use naturalistic strategies with other children without specific prompting and reinforcement. Ledford and Wolery (2011) identified four types of strategies used by researchers to teach imitation. Two of these four types of strategies were used to teach peer imitation (rather than adult imitation) and both involve direct teaching procedures. One strategy, discrete trial training, included the use of peer models with adult prompting and reinforcement during short instructional activities. The second strategy included the use of peer models alongside adult prompting and reinforcement in the context of typical activities (referred to by Ledford & Wolery as *classroom-based interventions*). These classroom-based interventions all included use of a responses prompting procedure, such as progressive time delay (PTD). PTD is a single-prompt strategy (Ledford, Lane, & Barton, 2019) that includes both the provision of adult supports (prompts) and reinforcement for correct responding (contingent reinforcement). When PTD is used, the delay between the discriminative stimulus (e.g., task direction plus peer model) and adult prompt (e.g., physical prompt to imitate the peer) are systematically increased or decreased based on the child's responses. For example, the pre-prompt interval might increase by 3 s such that there are sessions with 0, 3, and then 6 s delays (Sweeney, Barton, & Ledford, 2018). The response interval also can be decreased if the child is not responding after a longer interval. PTD has a long history as an effective and efficient procedure for teaching new skills to children with disabilities (Walker, 2008; Wolery & Gast, 1984).

Since the Ledford and Wolery review, several additional studies have assessed the use of prompting procedures to teach peer imitation in the context of classroom activities (Barton &

Ledford, 2018; Sweeney, Barton, & Ledford, 2019). These contemporary studies indicate children with disabilities can be taught to imitate their peers in the context of classroom activities, such as sculpting play and follow-the-leader activities. Importantly, they also showed that removal of reinforcement contingencies resulted in decreased levels of peer imitation while systematic thinning of reinforcement resulted in maintained imitation. This suggests that even when children have been systematically taught to imitate their peers, generalization of these behaviors to new contexts may depend on typically-occurring or contrived reinforcement opportunities. Identifying conditions under which peer imitation maintains in typical contexts is a critically important area of future research.

Although generalization to different contexts has not been assessed in any peer imitation study, generalized imitation of adults by children has been examined. For example, Ingersoll, Lewis, and Kroman (2007) used a naturalistic imitation intervention called Reciprocal Imitation Training (RIT) to teach imitation to five children with ASD. When implementing RIT, the adult uses contingent imitation, linguistic mapping, physical prompting, and contingent reinforcement, while following the child's lead within a play context. All five children increased their imitation of gestures and generalized across implementers, settings, and materials. Similarly, Walton and Ingersoll (2012) taught siblings of children with ASD to use RIT to increase imitation skills in their younger siblings with ASD. Imitation results were variable across children; three of the four children increased overall levels of imitation. Two of these three children generalized imitation across materials and settings, and one generalized across implementers. Likewise, Ingersoll and Gergans (2007) taught mothers of children with ASD to use RIT to teach gesture and object imitation. Mothers learned to use RIT with fidelity, and children increased their imitation skills. Although there were few generalization sessions, all three children demonstrated evidence of

generalizing imitation to their homes. The results of these studies suggest generalized imitation is possible when using naturalistic procedures and adult or older sibling implementers; however, information about the extent to which this occurs in classroom settings with peers is needed.

In addition to the lack of generalization measurement, previous studies assessing peer imitation included older preschool-aged children—of 14 included children across four studies, most were 4-5 years old (n = 9), some were 3 years old (n = 4), and only one was 2 years old. Because observational learning opportunities in early childhood classrooms depend on the ability to effectively use peer opportunities, and because typically-developing toddlers imitate peers at high rates (Bandura, 1977; Nadel, Guerini, Peze, & Rivet, 1999; Nadel, & Peze, 1993), it would be ideal to teach peer imitation to younger children. Thus, additional research is needed to examine whether classroom-based peer imitation interventions are similarly effective for toddlers, and whether it results in generalized imitation in non-instructional contexts.

To address these gaps, we examined the following research questions in the context of a single case study: (1) Does the use of PTD increase levels of peer imitation in young children with disabilities during intervention sessions?, (2) Do increases maintain in contexts without prompting?, (3) Does the use of PTD result in associated changes in the level of peer imitation in a generalized context?, (4) Do teachers find the procedures and goals of the intervention to be acceptable and important?, and (5) Are naïve raters more likely to report that children imitate peers at an appropriate rate after intervention than prior to intervention?

Method

Participants

After obtaining IRB approval, children enrolled in an inclusive, university-based early childhood education program in the southeastern United States were recruited for participation.

Six children with disabilities were consented for this study; however, one child did not meet inclusion criteria (i.e., was not imitative of adults and did not meet criterion d below), and one child did not participate due to scheduling constraints (i.e., this child had multiple therapists working with him throughout the day and limited time to participate in additional instruction). The children who participated in the study met the following inclusion criteria: (a) were between the ages of 24 and 48 months; (b) had greater than 80% attendance for the previous month; (c) were eligible for special education services through an Individualized Education Plan (IEP) or an Individualized Family Service Plan (IFSP) or scored in the at-risk range for social delays range on the Ages & Stages Questionnaire: Social Emotional 2nd edition (ASQ:SE-2; Squires & Bricker, 2016); (d) scored at or above 75% on the Motor Imitation Scale (MIS; Appendix C; Stone, Ousley, & Littleford, 1997) with an adult model; (e) scored below 75% on the MIS with a peer model; (f) demonstrated delays in peer imitation based on teacher report; (g) and performed fewer than five unprompted peer imitations during two 10 min sessions as measured by direct observation in the child's classroom. The ASQ:SE-2 is a parent or caregiver completed social emotional screening tool; normative studies with over 14,000 children demonstrated strong validity, reliability, sensitivity, and specificity, which support the ability of the ASQ:SE-2 to discriminate children with social emotional delays from children with typical social emotional development. The ASQ:SE-2 was administered for Patrick and completed by his classroom teacher. The MIS was developed to assess motor imitation skills in young children with autism. It consists of 8 motor and 8 object imitation tasks; previous studies have shown excellent test-retest and inter-rater reliability and strong validity for the MIS (McDuffie et al., 2007). The MIS was completed by the primary implementer for all participants. Similar to previous studies

designed to assess peer imitation, children were selected who were likely to benefit from the study because they imitated adults but not children (Sweeney et al., 2019; Venn et al., 1993).

Dina was a 44-month-old White, Non-Hispanic female with cerebral palsy and an IEP. Based on teacher report, she often played with puzzles and small people figures and typically engaged in solitary play, with some instances of parallel play (Parten, 1932). Dina used vocalizations, gestures, and an augmentative and alternative communication (AAC) device (i.e., Dynavox^{TM} or iPad) to communicate. Her pre-intervention adult and peer MIS scores were 75% and 56.3%, respectively.

Patrick was a 34-month-old Asian male who received speech and language therapy but did not have an IFSP. He obtained a score of 155 on the ASQ:SE-2, which was above the cut-off score of 105 and indicated that he should be referred for follow-up testing and was at risk for social delays. Based on teacher report, he often played with puzzles and toy food in the dramatic play center in his classroom during free play. Patrick used verbalizations, multiple word phrases, and gestures to communicate. His pre-intervention adult and peer MIS scores were 93.8% and 59.4%, respectively.

Cyndi was a 32-month-old White, Non-Hispanic female with developmental delays and an IFSP. Based on teacher report, she often played with the toy grocery cart in the dramatic play center in her classroom during free play and occasionally played near peers in other centers. Cyndi's communication repertoire was limited, and she primarily used gestures to communicate. Her pre-intervention adult and peer MIS scores were 84.4% and 71.9%, respectively.

Justin was a 28-month-old Black male with Down Syndrome and an IFSP. Based on teacher report, he enjoyed singing, musical instruments, and reading books, but spent most of center time engaged in solitary play with noise making toys. His teacher also reported that he

often inappropriately threw toys. Justin used gestures and some vocalizations to communicate, but his vocalizations were limited. His pre-intervention adult and peer MIS scores were 87.5% and 28.1%, respectively.

Researchers recruited 18 peers from the same classroom as the peers. To be considered for participation in the study, peers met the following criteria: (a) were between the ages of 24 and 72 months, (b) had greater than 80% attendance for the previous month, (c) had a score at or above 75% on the MIS with adult and peer models, and (d) regularly complied with adult requests based on teacher report. Depending on the number of students that were consented, 2-3 peers were randomly assigned to instructional or generalization sessions to ensure that at least one peer would be available in the event of an absence. The implementers included two female (one White; one White-Native American) special education graduate students; both also were working towards certification in behavior analysis.

Setting and Materials

All sessions for Patrick and Cyndi occurred in their preschool classroom. Dina's sessions occurred in a resource room across from her classroom, during a daily play group that occurred during her classroom's scheduled nap time for students who did not regularly nap. For Justin, the intervention primarily occurred in his classroom, but on occasion occurred in separate rooms outside of his classroom per teacher request. Materials for all sessions included developmentally appropriate play materials similar to toys found across the participants' classrooms such as Play-Doh™, kitchen utensils, people and animal figures, vehicles, blocks, and construction tools. Materials were regularly rotated to promote engagement and reduce the likelihood of satiation. A variety of tangible, social, and edible reinforcers also were used across all conditions, including stickers, high-fives, and fruit snacks. Preferences and reinforcers were identified using a multiple

stimulus without replacement preference assessment (MSWO; Daly et al. 2009) or paired stimulus preference assessment (PS; Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992) and reinforcer assessments prior to the start of the study for all participants. All generalization sessions occurred in each child's classroom when typical activities (e.g., other center time activities) were taking place. Materials for generalization sessions included also included developmentally appropriate toys similar to those found in classrooms—none of which were used during instructional sessions (Flarp™, garden tools, people figures). A Canon Vixia digital video camera was used to record all sessions, and data were coded using ProCoder for Digital Video (ProcoderDV; Tapp 2003).

Response Definitions and Measurement Systems

The primary dependent variable was the frequency of unprompted peer imitation (UPI) behaviors emitted by the participants. Peer imitation was defined as the participant completing the same action as the peer using the same object(s). UPI behaviors met the following requirements: (a) lasted for at least 1 s; (b) began after the onset and within 6 s of the offset of the peer's action (i.e., UPI could occur before offset of peer behavior); (c) combined with the participant looking at the peer at least once during the imitated action (Sweeney, Barton, & Ledford, 2018); and (d) occurred independent of implementer prompts. Prompted peer imitation (PPI) behaviors included the same criteria with the exception that they occurred within 6 s of the offset of an implementer-delivered prompt. A new imitation behavior began 3 s after the offset of the previous occurrence. Unprompted errors (UPE) occurred when the child engaged in a play behavior that was not imitative of the peer after the attentional cue, but prior to the prompt. Prompted errors (PE) occurred when the child engaged in a play behavior that was not imitative of the peer, resisted the prompt, or did not respond within the response interval following the

teacher prompt. Across all conditions, sessions were 10 min in duration. Timed-event recording (i.e., counts with associated time stamps) was used to count the frequency of peer imitation exhibited by the participants during study sessions (Ledford, Lane, & Gast, 2018).

Experimental Design

A multiple probe design across participants single case research design was used (Gast, Lloyd, & Ledford, 2018). Condition changes were made when UPI data were stable and at a level higher than the baseline condition. Visual analysis was used to identify functional relations via examination of trend, level, and variability across and within conditions, as well as the consistency, proportion of overlap, and immediacy of change across conditions. Experimental control was established with three different demonstrations of effect (across participants) at three different points in time at intervention onset and not when the intervention was introduced in previous tiers (Horner et al., 2005). We used a concurrent multiple probe design with Dina, Patrick, and Cyndi, and started a nonconcurrent fourth baseline with Justin after commencing intervention with Cyndi. Sessions occurred once per day during intervention and maintenance conditions and intermittently but at least once per week during baseline and generalization conditions. During all sessions, the participant and peer sat across from each other at the same child-sized table, with the researcher seated next to the participant. During all sessions, the implementer narrated each child's play behaviors and provided the participant with an attentional cue and task direction (e.g., "Cyndi look at Bradley. Do what Bradley is doing.") approximately once per minute. However, variations in the number of trials delivered occurred across sessions and conditions based on the children's play and engagement behaviors, the children's response to the attentional cue, and the length of the trial delay; the implementer delivered a minimum of 5 trials per session across conditions.

Procedures

Baseline. Peers were randomly selected for each session from the pool of available, consented peers using a random number generator. Prior to beginning the session, the implementer placed the toys in an array on the table with identical toys in front of each child and reviewed the contingency (e.g., “We are going to play at the table for 10 min, and you will get a sticker for staying at the table.”). The implementer then started the timer and said, “Let’s play.” The implementer provided verbal praise for staying at the table about once per minute. The implementer did not provide prompts or behavior specific praise for peer imitation in baseline.

Intervention. Intervention sessions were identical to baseline sessions, with the addition of the use of PTD to evoke peer imitation. The attending cue and task direction were followed by a controlling prompt (i.e., full physical prompt), which was initially delivered on a 0-s delay. Consistent with baseline, the implementer delivered trials about once per min (minimum of 5 per session). After three sessions at 0-s prompts with stable PPI, the implementer increased the delay interval to 3-s and after several additional sessions with stable PPI the implementer increased the delay interval to 6-s (i.e., terminal delay). Increases in delay durations were made contingent on continued correct responding (PPI or UPI) in a manner consistent with PTD procedures (Ledford, Lane, & Barton, 2019; Wolery et al., 1992). The implementer provided behavior-specific praise and reinforcement to the participant after each correct response (PPI and UPI responses). The intervention condition continued until the child met mastery criterion, which was at least three consecutive sessions with stable levels of UPI higher than PPI.

Generalization. During generalization sessions, the duration, instructional arrangement, and task directions were identical to baseline. However, the materials, peers, and implementer were different from the baseline and intervention sessions. Generalization sessions occurred

intermittently during all conditions no less than at least one hour before or after baseline or instructional sessions. We made a minor adaptation to Cyndi's final generalization sessions which is described in the instructional adaptations.

Maintenance. Procedures during the maintenance condition were identical to the baseline condition procedures, with the exception of contingent reinforcement for UPI responses. At least three maintenance sessions occurred for each participant, after the participant met mastery criterion during the intervention condition.

Instructional adaptations. Individual adaptations were made for each participant to increase engagement and facilitate improved responding. For Dina and Cyndi, differential reinforcement for unprompted rather than prompted peer imitation was initiated to reduce the likelihood of prompt dependency at session 9 and 16, respectively. Along with this change, implementers used token boards, wherein Dina and Cyndi could earn 5 min of access to a preferred tangible item (i.e., video clip on a tablet) if they received a predetermined number of tokens for UPI responses. The controlling prompt was changed from a full physical prompt (i.e., hand-over-hand) to a gestural prompt for Cyndi and Patrick at session 11 and session 27, respectively, as they both resisted hand-over-hand prompts. However, for Patrick, at session 36, full physical prompts were reintroduced following several sessions including a large proportion of prompted errors. Additionally, Patrick's reinforcer was changed at session 38, as it was hypothesized that the previously-used item was no longer functioning as a reinforcer. Based on low levels of responding, we added reinforcement for UPIs for Cyndi for the final five generalization sessions.

Interobserver Agreement

Interobserver agreement (IOA) data were collected for 38.5% of all sessions across all participants, dependent variables, and conditions. Two reliability coders—one doctoral student and one master student in special education and applied behavior analysis—were trained by the primary implementer to code all dependent variables. The first author reviewed the definitions with the coders, and they simultaneously coded non-study videos for UPI behaviors. Then they independently coded non-study videos for UPI behaviors until 90% agreement was reached between coders. IOA was estimated using a point-by-point agreement method with a 3-s agreement time-window by dividing all agreements by agreements plus disagreements and multiplying by 100 (Ledford, Lane, & Gast, 2018). Average IOA across all conditions was 84% for Dina, 87% for Patrick, 91% for Cyndi, and 86% for Justin. Detailed IOA results are listed in Table 1. IOA data were graphed alongside the primary data to monitor, detect, and minimize systematic observer bias; no systematic bias was detected in the graphed data.

Procedural Fidelity

We operationalized procedures across all experimental conditions: baseline, intervention, generalization, and maintenance sessions (Barton, Meadan-Kaplansky, & Ledford, 2018). We measured procedural fidelity during 41% of sessions across all experimental conditions and participants. Detailed procedural fidelity results are included in Table 1. Procedural fidelity data were analyzed separately for each condition, each participant, and across the study using a direct systematic observational recording system using a data collection form developed for this study. We completed the procedural fidelity data collection form using video recordings. The number of correct procedural and instructional steps (including instructional adaptations as appropriate) was divided by the total number of procedural and instructional steps observed and multiplied by 100 to yield the percentage of correct implementation. The measurement procedures allowed the

implementer to record adherence to study procedures and differentiation across baseline, intervention, generalization, and maintenance conditions.

Social Validity

To evaluate acceptance of the target goal and prompting procedures, we provided a questionnaire to 10 teachers from the university-based preschool where the study was conducted. The teachers rated each item using a Likert-scale. To evaluate the social validity of outcomes, seven graduate students enrolled in a Special Education program who were naïve to the purpose and outcomes of the current study viewed randomly-selected videos from baseline, maintenance, and generalization sessions and rated the appropriateness of peer imitation behaviors using Likert-scale.

Results

Unprompted Peer Imitation

Dina. During baseline, Dina emitted zero UPI for three consecutive sessions. Upon introduction of the intervention, UPI were variable with an increase in level that stabilized at about four by the 20th session (*range* = 0-6). Although there was considerable overlap with the baseline condition during the first half of the intervention condition, there were no overlapping data for the final 17 sessions. Her data were stable and at a level higher than baseline after 39 intervention sessions. During maintenance, the intervention was withdrawn, and UPI remained near intervention levels (*range* = 2-6).

Patrick. For Patrick, baseline UPI were low and stable at 0 to 2 imitations during baseline, and remained at this level when the intervention was introduced for Dina. When intervention commenced for him, Patrick's level of UPI remained unchanged; however, UPI immediately increased to seven when the prompting delay reached the terminal delay. UPI

remained stable for five sessions, but during the 12th intervention session his level of UPI decreased and variability increased. When we changed the reinforcer, his UPI immediately increased. Overall, his data were stable and at a level higher than baseline after 33 intervention sessions. During maintenance, the level and variability of UPI were similar to intervention (*range* = 7-14).

Cyndi. During baseline for Cyndi, UPI were low and variable (*range* = 0-4) and remained low and stable while the intervention was implemented for Dina and Patrick. During intervention, her level of UPI immediately increased, demonstrating an increasing trend with slight variability (*range* = 1-9). Data stabilized above 5 UPI after 12 intervention sessions; here data were stable and at a level higher than baseline after 16 intervention sessions. During maintenance, UPI remained high, with some overlap with the intervention condition.

Justin. During baseline, Justin's level of UPI was low and stable (*range* = 0-2). During intervention, UPI imitations immediately increased, with a stable increasing trend. Data stabilized at a level of about five imitations after 18 sessions. His data were stable and at a level higher than baseline after 19 intervention sessions. During maintenance, imitations remained high, at a level similar to intervention (*range* = 4-8).

Summary. A functional relation was demonstrated between PTD and UPI with consistent and replicated behavior change across Dina, Patrick, and Cyndi. Unprompted (open circles) and prompted (closed circles) peer imitation data for all participants are displayed in Figure 1. Consistent with previous studies using PTD, increases in PPI were immediate whereas increases in UPI were gradual across all participants. Given baseline data for Justin were not collected prior to intervention commencing with the previous three participants, interpretations of his data are limited.

Generalized UPI

UPI responses (open triangles) during generalization sessions are displayed in Figure 2. For Dina, UPI during baseline generalization sessions were low and stable. Imitations increased during intervention, but remained at a low and stable level for throughout intervention and maintenance (*range* = 0-3). Patrick's UPI during generalization sessions were at zero during baseline conditions, but increased during intervention (range = 0-5) with some variability. However, UPI did not reach levels observed during the final intervention sessions (range = 7-16). Cyndi demonstrated one or fewer UPI during baseline generalization sessions. During intervention, her levels of UPI had considerable variability and overlap with the baseline condition. For the final five generalization sessions during the maintenance conditions, procedures were modified such that Cyndi received reinforcement for unprompted imitations. This resulted in an immediate increase in level of UPI followed by a decreasing trend and no UPIs during the final two sessions (range = 0-5). Thus, this adaptation did not have a demonstrable effect on the stability of UPI for her during generalization. Justin's UPI responses were low and stable across all generalization sessions across all conditions. In sum, a functional relation was not evident between PTD during treatment sessions and UPI during generalization sessions due to limited data during baseline conditions for one participant and lack of consistent behavior change across participants.

Prompted and Unprompted Errors

The means and ranges for UPE and PE are provided in Table 2. As expected, there were no prompted errors during baseline, maintenance, or generalization sessions across children when the implementer is not providing prompts. Likewise, UPE were higher during baseline, maintenance, or generalization sessions than intervention sessions across children. Mean UPE

and PE were similar for Dina, Patrick, and Justin during the intervention condition; whereas Cyndi's mean UPE and PE were slightly higher during intervention.

Social Validity

The teachers (n=10) rated three items on the social validity questionnaire using a Likert-scale of 1 (not at all important) to 5 (very important). On average, the teachers reported the following: (a) that it is 'always important' for preschoolers to imitate (*M* = 4.6, range = 4-5), (b) that it is 'always important' for preschoolers to know how to imitate peers (*M* = 4.6, range = 4-5), and (c) that it is 'very acceptable' to utilize PTD to teach a new skill (*M* = 4.6, range = 4-5). The graduate students (n=7) rated four videos using a Likert-scale of 1 (strongly disagree) to 5 (strongly agree). On average, the graduate students reported the following: (a) the participant *was not appropriately* imitating their peer during baseline sessions (*M* = 1.5, range = 1-2), (b) the participant *was appropriately* imitating their peer during maintenance sessions (*M* = 4.6, range = 4-5), and (c) the participant *was not appropriately* imitating their peer during baseline (*M* = 2.6, range = 1-3) or maintenance (*M* = 2.3, range = 2-3) generalizations sessions.

Discussion

A multiple probe across participants design was used to evaluate the effectiveness of PTD, including contingent reinforcement, for teaching peer imitation during a play activity with a peer. The intervention yielded a functional relation in the primary instructional context, which maintained when prompting was removed but reinforcement continued. Overall, the results of this study support the use of PTD to increase the levels of peer imitation during play activities with young children with disabilities and their peers. Although some behavior change occurred in generalized contexts, levels of imitation did not reach levels similar to those demonstrated during intervention. Our results expand on previous research indicating that PTD is effective in

teaching peer imitation (e.g., Sweeney et al., 2018; Venn et al., 1993) and highlight the need for additional research examining generalized peer imitation.

Sweeney and colleagues (2018) suggested levels of imitation will maintain after mastery criterion is met when reinforcement is provided, which was support by the results of the current study. Also, Barton and Ledford (2018) found that peer imitation may be contextually bound to settings in which peer imitation is explicitly taught and reinforced. In the current study, children emitted low levels of peer imitation during generalization sessions in which contingent reinforcement was absent, yet stable, high levels of imitation during maintenance sessions in which contingent reinforcement was present. Although not directly tested in our study, Barton and Ledford (2018) found that peer imitation performance was dependent on reinforcement contingencies. Future replications should examine schedules of reinforcement for UPI that might be both effective and feasible in early childhood contexts. Future research also should test more robust interventions that lead to generalized and sustained changes in peer imitation in young children. Additional replications are needed to examine the relation between generalized peer imitation, observational learning, and other meaningful outcomes for young children.

Our results also extend current research because we included toddlers who were younger than children in previous research. Although we documented behavior change, the children in our study required more sessions to reach mastery criterion and did not achieve the same levels of UPI as documented by Sweeney and colleagues (2018) or Barton and Ledford (2018). Additional replications are needed to examine effective practices for increasing peer imitation with young children, particularly those under the age of four. Further, in our study, the toddlers used some peer imitation during the pre-study peer MIS (scores ranged from 28.1% to 71.9%). Likewise, the children in the current study were imitative of adults, but not peers, which is

similar to previous research. Additional replications also are needed with toddlers who have little to no peer imitation prior to intervention and with children who are non-imitative of adults and peers. Relatedly, we closely monitored and changed reinforcers mid-study, which highlights the importance of using of ongoing preference and reinforcer assessments for children. Future researchers might consider the use of frequent pre-session preference assessments rather than pre-intervention assessments.

For three of four participants, sessions occurred while typical classroom activities were ongoing (in the classroom or during a regularly-scheduled play group), which suggests the procedures are feasible during typical classroom activities and ecologically congruent with typical classroom practices. Researchers should continue to examine peer imitation interventions with authentic end users (e.g., caregivers, teachers) and toddlers to develop a comprehensive understanding of effective and efficient practices to support peer imitation as early as possible.

Limitations

Several limitations should be considered when interpreting results. First, the tangible stimuli provided contingent on UPI did not maintain their reinforcing value as the study progressed. We had to make changes to the reinforcers which likely delayed learning. Second, reinforcement was provided for PPI and UPI, which might have contributed to the variability throughout the study. Future replications might systematically examine procedures for thinning reinforcement for PPI and differential reinforcement for UPI. Third, the environment in which Patrick's sessions took place varied; some of his sessions occurred in the classroom while typical classroom activities such as free play were taking place, some sessions occurred in the classroom when the other children were not present, and a few sessions took place in a separate classroom. This variability was due to scheduling changes in his classroom and could have contributed to

the variability in his data, although no discernable patterns were identified. Fourth, insufficient generalization data were collected which limits conclusions about functional relations. Finally, future studies should examine generalization in a typical free play context by target children as a primary outcome and the average rate of peer imitation emitted by typically developing children to inform what is meaningful and socially significant across contexts.

Conclusion

Replications are critical for developing a comprehensive understanding of the assets and limitations of tested interventions (Horner et al., 2005). Our study replicates previous research on peer imitation and provides an important contribution regarding the effects of a systematic peer imitation intervention on UPI with toddlers, which maintained as prompts were faded and reinforcement continued. However, our findings also suggested a more robust peer imitation intervention might be needed to produce generalized and sustained UPI. Our study extended knowledge and uncovered limitations that need to be examined through systematic replications to continue to build a comprehensive understanding of evidence-based practices for teaching peer imitation. Also, additional replications of peer imitation interventions implemented by intended end users (e.g., classroom teachers) in authentic settings (e.g., preschool classrooms) are critically needed.

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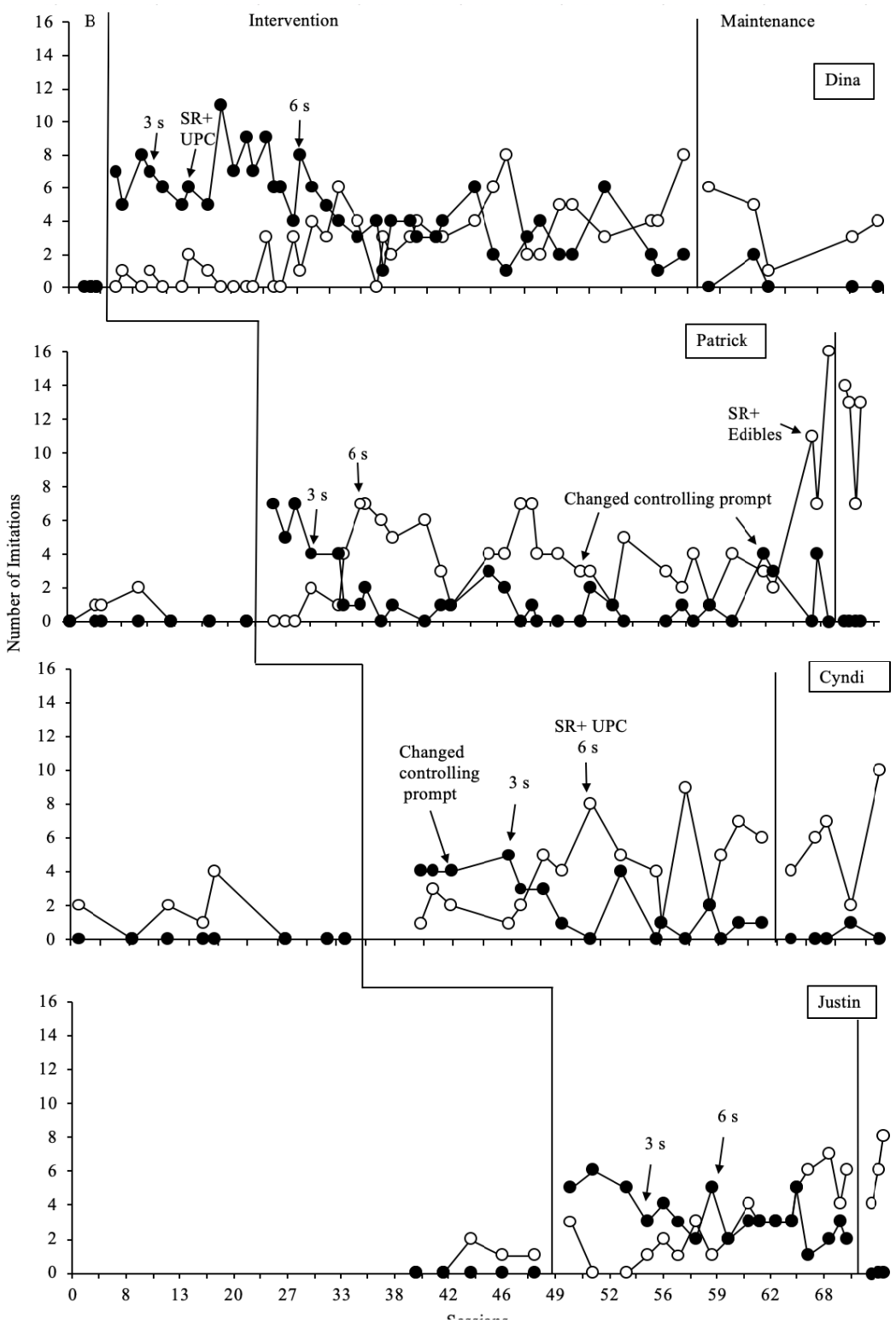

Figure 1. Results for unprompted and prompted correct peer imitation responses for all participants. Open circles represent frequency of unprompted peer imitations. Closed circles represent frequency of prompted peer imitations. B = Baseline. 3 s = indicates when prompt delays were extended from 0 s to 3 s. 6 s = indicates when prompt delays were extended from 3 s to 6 s.

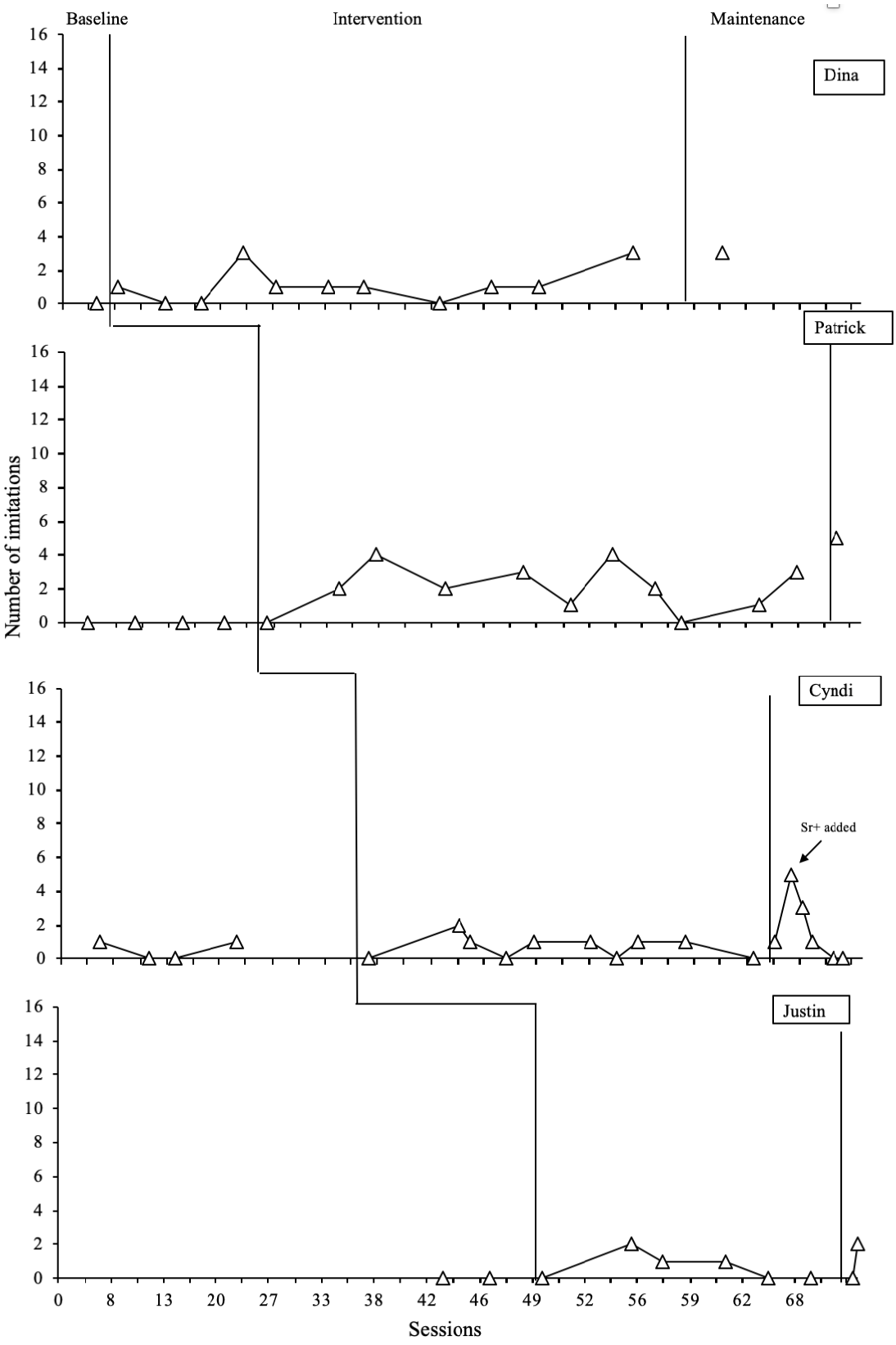

Figure 2. Results for unprompted correct peer imitation responses for all participants during generalization sessions. Open triangles represent frequency of unprompted peer imitation.

Table 1

Interobserver Agreement and Procedural Fidelity Data

	Children	Baseline *M* (range)	Intervention *M* (range)	Maintenance *M* (range)	Generalization *M* (range)	Overall *M*
Interobserver Agreement	Dina	91.5% (85.7-90)	83.2% (50-100)	81.3% (62.5-100)	82.4% (66.7-90)	83.9%
	Patrick	90.4% (72.7-100)	84.9% (62.5-100)	96.9% (93.8-100)	85.5% (80-88.9)	87.1%
	Cyndi	92.1% (87.5-100)	82.6% (72.7-88.2)	100%	98.2% (87.5-100)	91.2%
	Justin	92.9% (85.7-100)	82.3% (62.5-100)	83.3% (77.7-88.9)	88.9% (66.7-100)	86.3%
	Overall *M*	91.7%	82.8%	90.4%	88.8%	87.2%
Procedural Fidelity	Dina	100%	96.4% (88.9-100)	97.6% (95.2-100)	97.9% (94.4-100)	96.9%
	Patrick	96.9% (95.8-100)	93.3% (83.3-100)	100%	99% (94.4-100)	95.9%
	Cyndi	97.8% (93.6-98.5)	96.8% (93.5-100)	100%	98.4% (95.8-100)	97.8%
	Justin	91.1% (80.6-100)	93.5% (69.4-100)	100%	95.4% (88.9-100)	93.4%
	Overall *M*	96.45%	95%	99.3%	97.7%	96.2%

Table 2

Unprompted Errors and Prompted Errors Across Conditions

	Baseline *M* (range)		Intervention *M* (range)		Maintenance *M* (range)		Generalization *M* (range)	
	UPE	PE	UPE	PE	UPE	PE	UPE	PE
Dina	8.3 (6-11)	0	0.44 (0-3)	0.18 (0-1)	3.40 (1-6)	0	6.23 (3-10)	0
Patrick	7.0 (6-9)	0	0.31 (0-2)	0.64 (0-4)	1.75 (1-3)	0	4.81 (2-8)	0
Cyndi	7.38 (6-10)	0	1.38 (0-5)	3.13 (0-6)	4.40 (2-7)	0	6.40 (3-9)	0
Justin	3.75 (2-5)	0	0.47 (0-5)	0.16 (0-1)	3.00 (2-5)	0	4.25 (2-6)	0