Journal of Early Intervention
2022, Vol. 44(3) 268–288

DOI: 10.1177/10538151211052004
journals.sagepub.com/home/jei
SAGE

The Effects of Progressive Time Delay to Teach Social Problem-Solving to Preschoolers

Jarrah Korba[1], Mary Louise Hemmeter[1], Adrienne K. Golden[1], and Kate Nuhring[1]

Abstract

A multiple probe design across participants was used to evaluate the effectiveness of progressive time delay (PTD) during small group instruction to teach social problem-solving to preschoolers and to assess generalization to novel contexts. PTD was used to teach children to both name and use a variety of problem-solving solutions. Target participants, all of whom exhibited challenging behavior or were at risk for social skill deficits, were paired with a typically developing peer for small group instructional sessions. During sessions, children were presented with scenarios involving simple social problems and were asked, "What could you do?" After naming an appropriate solution, participants were prompted to use the solution. Results indicate the use of PTD during small group instruction was effective for teaching social problem-solving to preschoolers, generalized to novel contexts and maintained following the withdrawal of the intervention. Limitations, areas for future research, and implications for practice are discussed.

Keywords

social problem-solving, progressive time delay, small group instruction, early childhood education, social-emotional development

Social-emotional development during the early childhood years is related to children's later relationships, academic success, and overall quality of life (Strain & Timm, 2001; Whitted, 2011). Social problem-solving, a core social-emotional skill, is a cognitive-behavioral process in which a child works to identify or create effective solutions for social problems encountered in everyday life (D'Zurilla et al., 2004). The ability to solve social problems creates increased opportunities for children to form peer relationships. Problem-solving is correlated with conflict resolution and empathy, which are important aspects of social-emotional development (Bernard-Opitz et al., 2001).

There is growing concern about the number of children who exhibit challenging behavior and/or have deficits in social-emotional development in preschool settings (Holtz et al., 2015). Children who engage in challenging behavior often have fewer positive interactions with peers,

[1]Vanderbilt University, Nashville, TN, USA

Corresponding Author:
Jarrah Korba, Department of Special Education, Vanderbilt University, 110 Magnolia Circle, Nashville, TN 37212, USA.
Email: jarrahkorba1@gmail.com

because peers may avoid interactions that could result in challenging behavior (Joseph & Strain, 2010). Children with social skill deficits often use inappropriate solutions, like challenging behavior or social withdrawal, to attempt to resolve social conflicts (Bernard-Opitz et al., 2001). This leads to social skill deficits that may result in lower peer acceptance rates, later expulsion from school, dropping out of school, and juvenile criminality (Parker & Asher, 1987). Because difficulties in social problem-solving are more difficult to resolve as children get older (Joseph & Strain, 2010), there is a need to intervene early to prevent future problems.

There is a limited number of studies that focused specifically on teaching social problem-solving skills to preschool children using designs that allow an evaluation of the problem-solving intervention separate from other aspects of the curriculum or intervention. These studies have used single-case designs. Hune and Nelson (2002) conducted a study in which children displaying high levels of aggressive behavior, aged 3 to 4 years old, were taught problem-solving steps in a small group setting using direct instruction. While the data indicated improvements in children's prosocial behaviors and aggressive behaviors, the study used a series of A-B designs which precluded the demonstration of a function relation. Hune and Nelson recommended future studies include a plan for generalization of the skills to ongoing classroom activities, as some of the participants' aggressive behaviors were higher in generalization contexts when compared with intervention contexts. Vandelaar (2017) conducted a study using progressive time delay (PTD; J. Ledford et al., 2019) to teach preschoolers with social skills deficits, including a participant diagnosed with autism and a participant diagnosed with down syndrome, to name solutions to common social problems. The results indicated children learned to name the solutions; however, additional intervention was required for the children to use the solutions in the generalization setting.

While research on social problem-solving in young children provides initial evidence that young children can be taught problem-solving skills, the findings are limited in a number of important ways. First, in one study (Hune & Nelson, 2002), the description of the independent variable was limited, and there was no evidence the intervention had been implemented with fidelity. Furthermore, the design did not allow for the demonstration of a functional relation. Second, generalization has not consistently been measured and when it was measured, there was limited evidence that the intervention resulted in generalized outcomes (Hune & Nelson, 2002; Vandelaar, 2017). Given the critical need for children to solve social problems in their everyday interactions with peers, it is important that these interventions result in the generalized use of the problem-solving skills.

Small group instruction offers one context for teaching social problem-solving skills. Small group instruction has been effective for teaching young children to read sight words, engage in social interactions, and answer questions, and these skills have generalized to novel contexts (J. R. Ledford et al., 2012; J. R. Ledford & Wolery, 2013). Small group direct instruction involves teaching more than one student at a time and may lead to an increase in opportunities for social interactions and learning. In a review of 47 studies, J. R. Ledford and colleagues (2012) found that the use of prompting procedures during small group direct instruction was not only effective for acquisition of new skills, but also for generalization and maintenance of behaviors taught during small group direct instruction. In addition, children consistently learned skills taught to their peers (J. R. Ledford et al., 2012). J. R. Ledford and Wolery (2013) conducted a study that showed the use of PTD with preschoolers in a small group setting to be effective for teaching children to expressively name words and colors. The intervention was designed to include peers, and generalization was demonstrated as target children were observed sharing with different peers in different settings (J. R. Ledford & Wolery, 2013). No research has been conducted on the use of small group direct instruction to teach social problem-solving skills to preschool-aged children. While some curriculum studies include small group problem-solving activities, it is not possible to isolate the effects of those activities from the effects of other aspects of the curriculum.

Small group instruction is effective when it involves the use of systematic instructional strategies. One instructional strategy that has been used to teach social skills (e.g., peer imitation, social problem-solving) to preschool-age children is PTD (Francis et al., 2020; Sweeney et al., 2018; Vandelaar, 2017). PTD is a systematic prompting procedure that is efficient and effective for teaching discrete skills (J. Ledford et al., 2019). PTD utilizes prompts to relay information about how to correctly perform the target behavior. PTD uses a trial sequence, in which the stimulus is presented and a task direction is given followed by a delay, beginning with 0 s and increasing following correct responding. The controlling prompt is delivered after the delay interval if the student does not provide a correct response. The steps for PTD include gaining the child's attention, delivering the task direction, waiting for the child to respond, delivering the controlling prompt, and giving a consequence (J. R. Ledford et al., 2016). Reinforcement is provided after the child's correct response to increase the likelihood the behavior will happen again in the future. In addition to Vandelaar's (2017) study which used PTD to teach social problem-solving skills, PTD has been used in several studies to teach peer imitation to preschoolers with disabilities within a small group play context (Francis et al., 2020; Sweeney et al., 2018; Venn et al., 1993). PTD trials, delivered by researchers (Francis et al., 2020; Sweeney et al., 2018) or teachers (Venn et al., 1993) were embedded into play activities with small groups of children. Data from these studies indicate PTD is an effective and efficient procedure for teaching social skills to preschool-age children.

There is a need for research on teaching children to use problem-solving solutions and to generalize those solutions to ongoing classroom activities where children are interacting with their peers. The purpose of the current study was to evaluate the effectiveness of PTD during small group direct instruction to teach social problem-solving skills and to assess generalization to novel contexts. The research questions were as follows:

Research Question 1: Does the use of PTD during small group instruction increase the number of correctly named problem-solving solutions for preschoolers with social skill deficits?
Research Question 2: Does the use of PTD during small group instruction increase the number of correctly used problem-solving solutions for preschoolers with social skill deficits?
Research Question 3: Do the problem-solving skills taught using PTD during small group instruction generalize to novel contexts?
Research Question 4: Do ratings of participants' social problem-solving skills, provided by naive raters, differ between pre- and postintervention conditions?

Method

Participants and Implementers

After the study was approved by the University's Institutional Review Board, subjects were recruited from an inclusive early childhood program. Four target participants and six confederates between the ages of 37 and 55 months were included in the study. Each target participant was paired with one typically developing confederate during each small group instruction session. To avoid missing sessions due to absences, confederate-target participant pairs rotated throughout the study with all confederates working with all target participants at least once. See Table 1 for demographic information about target participants and the confederates. To be included in this study, target participants had to (a) score above average on the problem behavior domain and/or below average on the social skills domain of the Social Skills Improvement System Rating Scale (SSIS; Gresham & Elliott, 2008); (b) be able to repeat a verbal model; (c) be able to sit and attend for at least 15 min; (d) produce verbal communication; (e) independently move around the classroom; and (f) follow verbal directions. The exclusion criteria for target participants were that they

Table 1. Target Participants' and Confederates' Demographics.

Demographics	Age	Gender	Race	Diagnosis
Jason[a]	46 months	Male	Caucasian	At-risk for developmental delay
Seth[a]	46 months	Male	Caucasian	No diagnosis
Wade[a]	42 months	Male	Caucasian	No diagnosis
Ella[a]	37 months	Female	Caucasian	No diagnosis
Ryder	48 months	Male	Caucasian	No diagnosis
Penny	55 months	Female	Caucasian	No diagnosis
Chad	53 months	Male	Caucasian	No diagnosis
Allie	55 months	Female	Caucasian	No diagnosis
Winston	40 months	Male	Caucasian	No diagnosis
Rose	39 months	Female	Caucasian	No diagnosis

[a]Target participant.

(a) had two or more positive two-word utterances with a peer during center time during a 15-min observation; and (b) had two or more absences per month in the 3 months prior to when they were recruited. With the exception of the SSIS, all inclusion and exclusion criteria for target participants were measured and verified using teacher report and/or direct observation. The Mullen Scales of Early Learning (Mullen, 1995) were administered to all participants to provide descriptive information on their developmental levels at the beginning of the study. See Table S1 in Supplemental Materials for the results of the Mullen Scales of Early Learning.

The primary researcher, first author, was a master's student studying early childhood special education and applied behavior analysis and conducted the majority (i.e., 84.1%) of study sessions. Two additional implementers, a doctoral student and a master's student, both studying early childhood special education, conducted 2.3% and 13.6% of the sessions, respectively. All implementers were trained on study protocols and procedural fidelity by the first author.

Settings

The study was conducted in an inclusive university-based preschool in a southeastern state. The researchers conducted baseline, intervention, and maintenance sessions during center time in a play center for one participant (i.e., Seth) and in a play center in an empty classroom for the other three participants. These locations were selected based on teacher preference. The small group setting included the researcher, the target participant, and one confederate at a child-sized table. Generalization sessions were conducted by the researcher during center time, with the target participants and confederates playing in classroom centers (e.g., block center, art table, library).

Materials

Each target participant had their own set of scenario cards that were individualized based on teacher report. See Figure 1 for example scenario cards. During intervention sessions, laminated solution cards were available (see Figure 2). A handheld video camera and tripod were used to record sessions, and data were collected on a data collection sheet.

Response Definitions and Measurement Systems

There were two dependent variables: (a) naming problem-solving solutions and (b) using problem-solving solutions. The primary dependent variable was naming problem-solving solutions

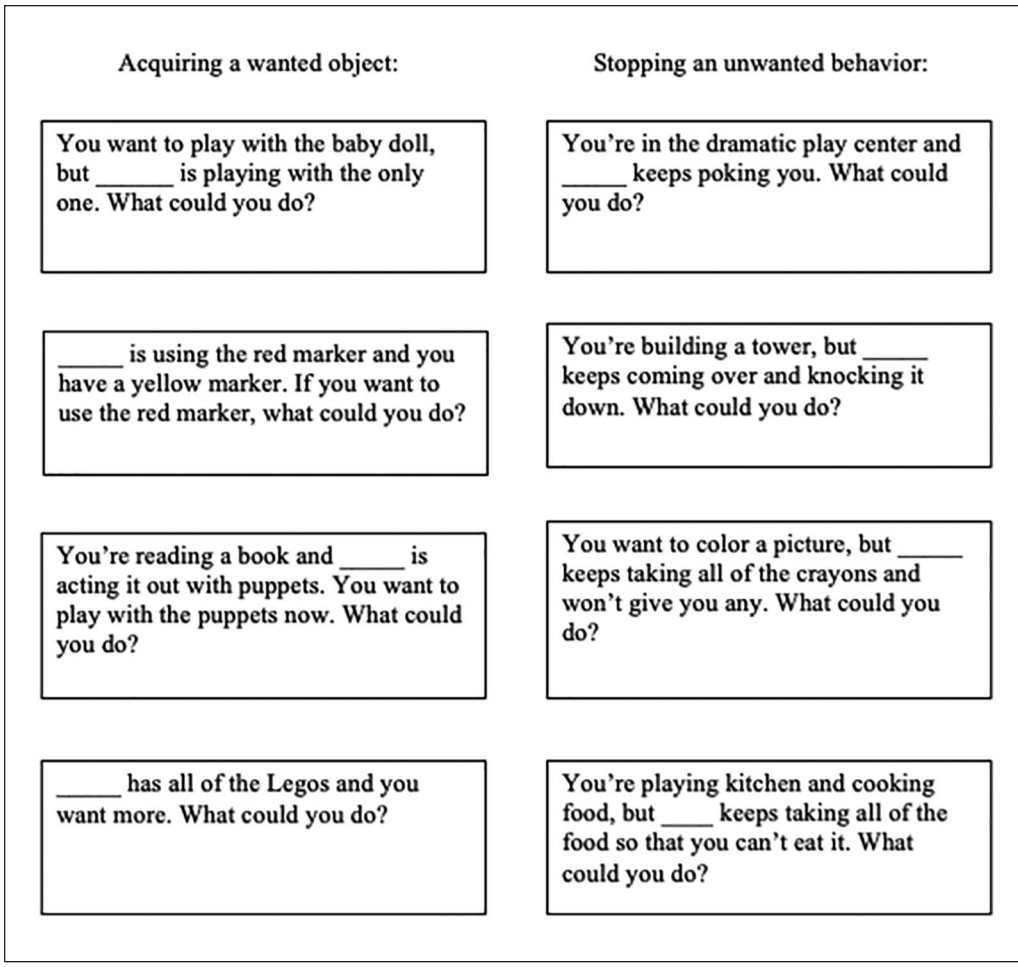

Figure 1. Problem-solving scenario cards.
Note. Blanks on scenario cards were changed to the name of the confederate in each small group. These scenario cards were adapted from Green (2013).

and was used to make all experimental decisions. Naming problem-solving solutions was defined as a correct verbal response to the problem read on the scenario card. The solutions could be said verbally using exact words (e.g., saying, "Please stop") or synonyms of the words (e.g., "Set a timer" instead of "Get a timer"). The solutions could be said in reverse order (saying, "Stop, please" instead of "Please stop"). Nonexamples included naming the solution while also engaging in challenging behavior (e.g., asking to play together while hitting a peer) or naming a solution that was not an appropriate solution to the social problem (e.g., saying, "Let's trade" when there was only one toy present).

The second dependent variable was using problem-solving solutions, defined as using a correct solution to a social problem (D'Zurilla et al., 2004). Some solutions involved the use of verbal statements (e.g., saying, "Please stop"), and those solutions required the use of the phrase or an acceptable variation (e.g., as defined above) that was directed toward the confederate. Some solutions did not require verbal statements (e.g., get a timer), and those solutions were scored as correct if the participant engaged in the action, with or without a corresponding verbal description.

Figure 2. Problem-solving solution cards.
Note. These solution cards were adapted from Green (2013).

The researcher used trial-based event recording to collect data on both dependent variables (J. R. Ledford et al., 2018). Data were collected on a PTD Data Collection Sheet (adapted from J. R. Ledford et al., 2016). There were four possible responses for the dependent variables following

the task directive: unprompted correct (UPC), prompted correct (PC), unprompted error (UPE), and prompted error (PE). A response was marked as UPC if the participant responded with a correct response after the task directive was given and before the controlling prompt was delivered (i.e., 0s, 2s, 4s). A response was marked as PC if the participant responded with a correct response after the controlling prompt was delivered. A response was counted as UPE when the participant gave an incorrect response or did not respond after the task directive was given. A PE was marked when the participant gave an incorrect response or did not respond after the controlling prompt was given following the specific time delay (i.e., 0s, 2s, 4s) or said incorrectly at the same time as the researcher.

Interobserver Agreement

Interobserver agreement (IOA) was calculated for both dependent variables to compare the data collected from the videos by the primary researcher and a secondary coder. IOA was calculated on at least 33% of randomly selected sessions in each condition (i.e., baseline, intervention, generalization, and maintenance) and for each target participant. IOA was calculated using the point-by-point agreement method (J. R. Ledford et al., 2018). Three coders collected data: a primary coder, the first author; and two secondary coders, a master's student in early childhood special education and an undergraduate student in psychology. The primary coder trained the secondary coders on the operational definitions and reviewed examples and nonexamples of the two dependent variables. The primary researcher taught the secondary coders the PTD prompting procedure and how to use the PTD Data Collection Sheet (adapted from J. R. Ledford et al., 2016). The secondary coders then practiced coding data together with the primary researcher and discussed discrepancies as they arose. The secondary coders then coded videos on their own, and their scores were compared with the primary researcher until they had at least three consecutive sessions of 90% or greater agreement. Data on IOA for naming and using problem-solving solutions during all conditions and participants are provided in Table S2 in Supplemental Materials. Naming solutions had an average IOA of 99.5%, and using solutions had an average IOA of 98% across all participants and conditions.

Experimental Design

The researcher used a multiple probe design (days) across participants to evaluate the effectiveness of using PTD during small group to teach children to name problem-solving solutions (Gast et al., 2018). This design was chosen over a reversal design (i.e., A-B-A-B) or comparison design (e.g., ATD, AATD) because naming and using problem-solving solutions are non-reversible behaviors, and the study was not comparing interventions, respectively. The multiple probe design controls for common threats to internal validity such as history and maturation by collecting frequent baseline and intervention data and having the potential to demonstrate consistent change between conditions across tiers (i.e., participants) (Gast et al., 2018). In this study, the intervention, PTD used to teach naming and using of problem-solving solutions, was introduced in a time-lagged manner across participants.

Procedures

This study had four conditions: baseline, intervention, generalization, and maintenance. The researcher implemented the intervention with the first participant after baseline data were stable across participants. The researcher then implemented the intervention with the participant in the subsequent tier after the data in the previous tier stabilized, and the participant assigned to the previous tier reached mastery criterion (i.e., an average of 90% correct responses across three

consecutive sessions). The procedures were applied to both the target participant and the confederate, and both will be referred to in the procedures section as the participant unless the procedures for the target child and peer were different.

Baseline. Baseline sessions had six trials on the problem-solving scenarios and lasted approximately 5 to 10 min. The researcher directed at least four trials toward the target participant and at least two trials toward the confederate in the small group. The researcher interspersed trials for the confederate by reading different problem-solving scenarios that required different problem-solving solutions then the target participant (e.g., target participant was taught solutions to acquire an object and confederate was taught solutions to stop a peer's challenging behaviors). During baseline conditions, the peers were sitting at a table next to each other. The researcher first ensured that the participant was attending (e.g., looking at researcher, quiet voice, sitting in seat). The researcher then read one of the scenario cards (see Figure 1) to the participant and provided the task directive, "What could you do?" The researcher waited 4 s for the participant to answer the task directive. If the participant did not answer, the researcher conducted the next trial. If the participant answered incorrectly, the researcher ignored the response and continued to the next trial. If the participant named the correct problem-solving solution, the researcher gave positive feedback and asked the participant to use the solution (e.g., "Nice job, show me how to get a timer"). The researcher waited 4 s for the participant to begin using the solution. The researcher followed the same steps listed above following the task directive of "show me how to (insert solution stated)." The researcher stood where she could block any problem behavior that occurred and redirected the participant to use the problem-solving solution. If the participant used the solution correctly, the researcher gave positive feedback (e.g., "Great job"). If the participant did not respond or responded incorrectly, the researcher ignored the response and continued to the next trial. Across conditions, opportunities to use the problem-solving solutions were contingent upon a correct response of naming the problem-solving solution; thus, there were no opportunities during baseline.

Intervention. During intervention, the researcher used PTD to teach both naming and using problem-solving solutions. The intervention sessions included 12 trials and lasted approximately 10 to 20 min. The researcher directed eight trials toward the target participant and four trials toward the confederate in the small group setting. The researcher systematically determined when the target participant moved to the next delay interval (e.g., 2s, 4s) after the target participant responded with unprompted corrects or prompted corrects at 100% for two consecutive sessions. Following a correct response, in addition to positive feedback (e.g., "Great job") which was also provided during baseline sessions, participants were given predetermined reinforcers (e.g., stickers, small fidget toys). The reinforcers were chosen based on teacher report and direct observation. Following each trial, the researcher marked the participant's responses on the PTD data collection sheet. The same PTD data collection sheet was used for both dependent variables.

Naming problem-solving solutions (Trial Part 1). During the intervention condition, the researcher used PTD to teach each participant to name solutions. See Figure 3 for a flowchart depicting the steps of PTD for naming problem-solving solutions. The researcher first ensured that the participant was attending (e.g., looking at researcher, quiet voice, sitting in seat). If the participant was not attending, the researcher gave a cue to the participant about how to attend (e.g., say, "Look at me"). The researcher then read one of the scenario cards (see Figure 1) to the participant and asked the task directive, "What could you do?" The researcher waited the predetermined wait interval (e.g., 0s, 2s, 4s) for the participant to respond to the task directive. The researcher's next step was based on how the participant responded to the task directive. If the participant did not answer during the predetermined wait interval, the researcher delivered the controlling prompt.

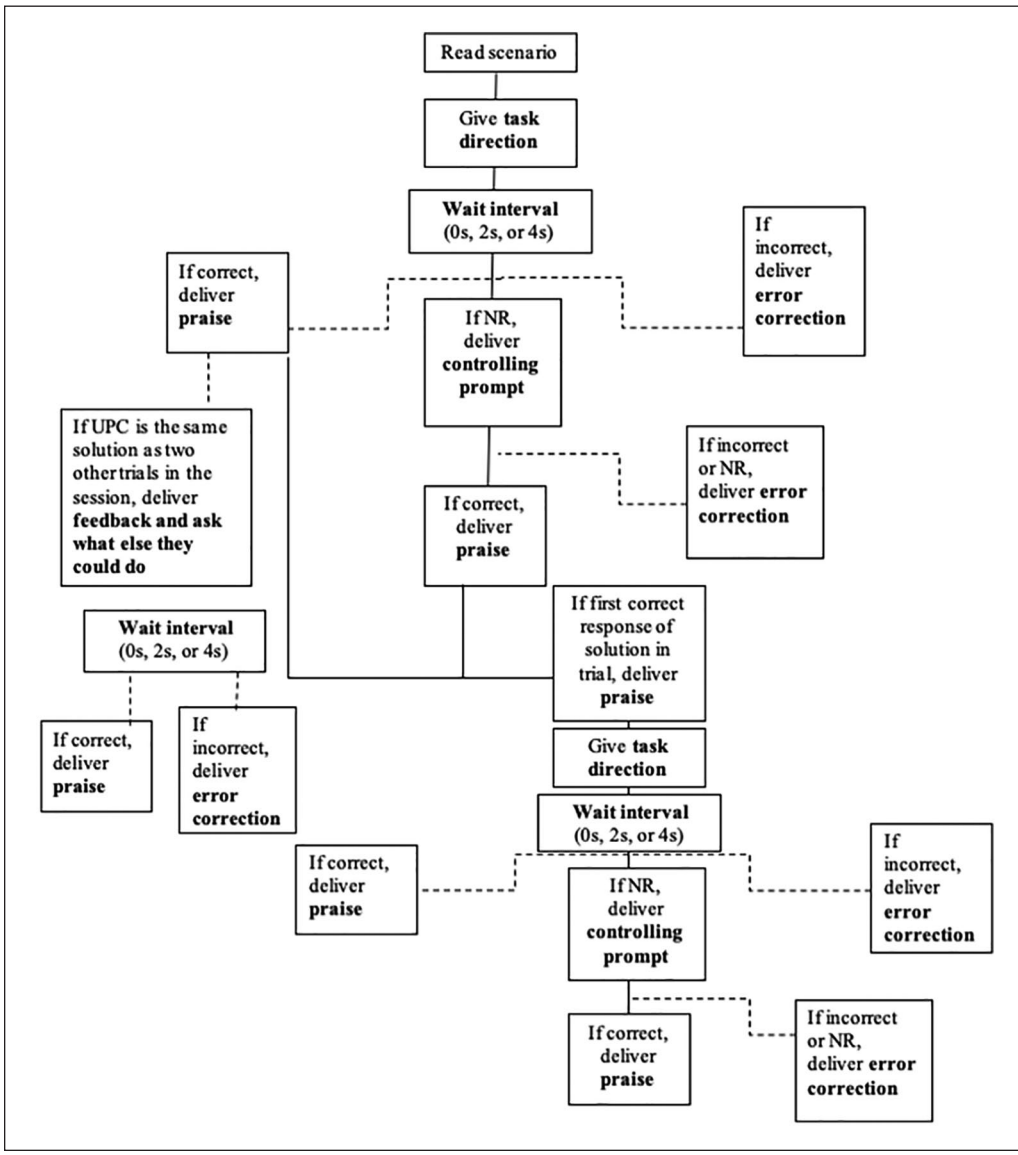

Figure 3. Flowchart of PTD procedures for naming and using problem-solving solutions.
Note. PTD = progressive time delay; UPC = unprompted correct responses; NR = no response.

The controlling prompt was a verbal model of the problem-solving solution while gesturing to the corresponding solution card (e.g., "Say please stop" while showing visual card). If the participant answered incorrectly, the researcher delivered an error correction (e.g., "No, but you could find a new place to play"). The researcher then moved to the next trial. If the participant named a problem-solving solution that did not fit the scenario, the researcher delivered feedback by naming a correct solution (e.g., "You could find a new place to play if your friend knocked down your tower"). If the participant answered correctly with a solution already stated twice in the session, the researcher delivered positive feedback (e.g., "That's right"), and said, "What else could you do?" and followed the PTD prompting procedure described above. If the participant answered correctly, the researcher delivered positive feedback (e.g., "That's right, you could trade") and

the predetermined reinforcer. The researcher showed a visual solution card (see Figure 2) when the name of the problem-solving solution was stated.

Using problem-solving solutions (Trial Part 2). The researcher systematically provided opportunities to use the solution each time the child correctly named a solution. Trials for using the solutions were conducted following the child correctly naming the solution (e.g., at most four opportunities in a session). When the participant named a correct solution, the researcher gave a task directive to use the solution (e.g., "Show me how to trade"). The researcher used PTD to teach the target participant how to use the solution in the classroom with the materials described in the scenario card (e.g., crayons, toy trucks). See Figure 3 for a flowchart of PTD steps for using the solutions. The researcher systematically determined when to increase the delay interval based on the target participant's responding to trials for naming solutions (i.e., 100% unprompted corrects and prompted corrects across two sessions). After delivering the task directive, the researcher waited the predetermined delay interval. If the participant did not respond, the researcher delivered the controlling prompt, a hand-over-hand physical prompt to guide the participant to use the solution if the solution required the student to emit a behavior other than a verbal response (i.e., get a timer, ignore, find a new place to play, play with a different friend, get a different one). If the solution required a verbal response, the controlling prompt was a verbal model of the solution (i.e., "Say, please stop"). If the participant used the solution incorrectly, the researcher delivered error correction (e.g., "Remember wait, and I'll help you"). If the participant used the solution correctly, the researcher gave positive feedback and the predetermined reinforcer.

Individual modifications. One participant (i.e., Jason) had variable responding and required individual modifications. The first modification was the addition of a visual board at Session 17. The visual board had four solutions displayed in an array (e.g., trade, get a timer, get a different one, play together). The visual solution cards were the same solution cards used during intervention. The researcher conducted the intervention sessions following the same procedures; however, the participant had the visual board in front of him to reference when responding to the task directive.

When Jason did not respond to the visual board, the researcher added a token board and decreased the number of trials from eight to four per session beginning at Session 28. Jason was asked the same scenarios, but only one trial per solution was presented. This was visually represented for Jason on a token board. Jason received one reinforcer at the end of the session (e.g., Minnie Mouse video, letter stickers) and verbal feedback following each trial to increase the likelihood of responding.

Generalization. The target participants' confederates were taught how to engage in the behaviors that required a solution (e.g., knocking down a tower the target participant was building, taking a toy truck away from the target participant). These behaviors were different than the scenarios and materials used during the intervention condition. The researcher told the confederate to engage in a specific behavior that would require the use of a solution by the target participant (e.g., "Go up to Jason and take the truck out of his hand"). The researcher stood in an appropriate place to block any problem behavior that occurred. The target participant was given 4 s to respond. If the target participant did not respond or did not start to use a solution within 4 s, it was counted as an incorrect behavior. If the target participant used a correct solution, the researcher delivered positive feedback to the target participant and delivered the predetermined reinforcer. The researcher conducted four trials in each generalization session. Generalization sessions lasted approximately 10 min and occurred in the target participants' classroom during center time. The researcher conducted generalization probes for 20% of sessions in each condition across participants.

Maintenance. The procedures for the maintenance sessions were the same as those used in baseline sessions. Maintenance sessions occurred for each participant 2, 3, and 4 weeks after the target participant reached mastery criterion in the intervention condition.

Procedural Fidelity

Procedural fidelity (PF) was coded from video recordings of baseline, intervention, generalization, and maintenance sessions. PF data were collected for a minimum of 33% of randomly selected sessions across all conditions and participants. The coders marked the occurrence or nonoccurrence of the behavior. If the behavior did not occur because it was not supposed to (e.g., controlling prompt delivered in baseline, error correction in intervention if the student responded correctly) the coders marked NA. PF during PTD sessions was collected by trial with set-up variables (e.g., correct materials present), contextual variables (e.g., target participant and confederate sitting across from implementer at a child-sized table), and completion behaviors (e.g., session ended with "thank you for playing with me") measured once for each session. PF data were calculated by dividing the number of correctly implemented steps by the number of correctly implemented steps plus the number of errors and multiplying by 100. During generalization sessions, the coders collected PF data on whether the confederate engaged in a behavior that would require the target participant to use a solution. Results for PF data during all conditions are provided in Table S3 in Supplemental Materials. Naming solutions had an average PF of 99.5% and using solutions had an average PF of 99%.

Social Validity

Social validity was measured using three different procedures to assess the goals, methods, and outcomes of the study. The first procedure involved naive ratings. Ten master's students in an early childhood special education teacher training program, naive to the purpose of the study, were shown four pairs of 1-min video clips. Each pair included one randomly selected preintervention generalization session and one randomly selected postintervention generalization session. Raters were asked to select the clip in each pair which showed the target participant using a more appropriate problem-solving solution.

The other procedures involved asking teachers to complete one of two questionnaires. The researcher gave the first questionnaire to 10 preservice teachers in an early childhood special education program who were not part of the study. The teachers ranked, on a scale from 1 to 4, 1 being "very unlikely" and 4 being "very likely," how likely they were to teach the problem-solving solutions (e.g., acquiring a wanted object and stopping unwanted behavior) in their classroom. The teachers also ranked, on a scale from 1 to 3, 1 being "unlikely," "unimportant," and "not feasible" and 3 being "likely," "important," and "feasible," how likely they would be to implement an intervention to teach problem-solving in their classroom, how important it is to teach problem-solving in the classroom and how feasible it is to teach problem-solving in the classroom. The second questionnaire was given to the target participants' teachers. This questionnaire asked the teachers if they saw a positive behavior change for the target participant.

Results

Naming Solutions

Visual analysis was used to examine the effects of the intervention on the primary dependent variable, naming solutions (see Figure 4), for all four participants. The researcher used formative and summative visual analysis to analyze the data and made phase change decisions throughout

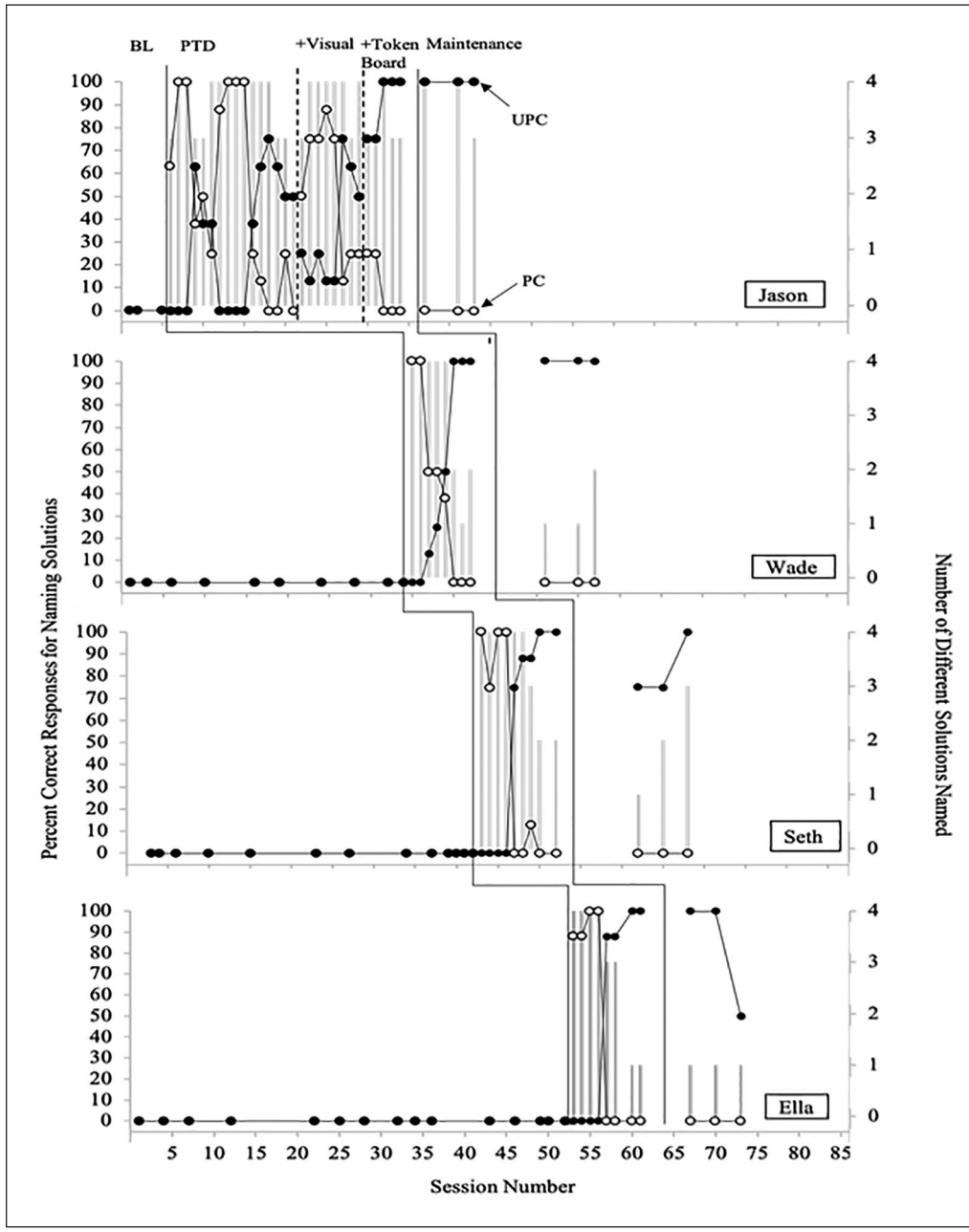

Figure 4. Naming problem-solving solutions.
Note. Percent correct responses for naming problem-solving solutions (line graph) and number of different solutions named (bar graph) are shown. BL = baseline; PTD = progressive time delay; UPC = unprompted correct responses; PC = prompted correct responses.

the study. The level, trend, and variability of data were analyzed within each condition. The immediacy and consistency of change and the overlap in data were analyzed across conditions.

For Jason, baseline data were low and stable with zero correct responding. At the onset of the intervention condition, Jason's prompted correct responding immediately increased for two

sessions before decreasing to 50% or lower for three consecutive sessions following the move to a 2 s delay. Because of inconsistent responding, the researcher returned to a 0 s delay after six intervention sessions. Jason's prompted correct responses immediately increased to 88% followed by three sessions at 100% prompted correct responding. The researcher then moved to a 2 s delay again after Session 13. Jason's unprompted correct responding increased for three sessions and then had a decreasing trend. The researcher conducted a mini lesson with Jason before Intervention Sessions 14, 15, and 16 to explain when it was appropriate to use the solution "trade" as Jason consistently responded with "trade" when trade was not an acceptable solution (e.g., only one baby doll). Based on the decreasing trend for unprompted correct responding, the researcher added a visual board for Jason at Intervention Session 17. Following the use of the visual board, unprompted correct responding decreased to 25%, and the data were variable. Following the decreasing trend in unprompted correct responding, the researcher implemented a token board and decreased the number of trials from eight to four at Intervention Session 25. Following the addition of the token board and visual board, Jason's unprompted correct responding increased to 75% and continued with an increasing trend until mastery criterion (i.e., average of 90% UPC responding across three consecutive sessions) was reached after 29 intervention sessions. There was high variability in his responding. During intervention, Jason named three to four different solutions per session. During the maintenance condition, Jason's unprompted correct responding was at 100%.

For Wade, Seth, and Ella, data were at 0% correct responding throughout the baseline condition. When the intervention was introduced, they had an immediate increase in prompted correct responses. Following the move to a 2 s delay, their unprompted correct responses had an increasing trend until mastery criterion was reached after eight (i.e., Ella) or nine (i.e., Wade and Seth) intervention sessions. There was low variability in their responding. During intervention, they used one to four different solutions per session. For Ella, the number of different problem-solving solutions named reduced to one solution per session as she named the same correct problem-solving solution for each scenario. During the maintenance condition, their unprompted correct responding remained high and stable. Based on their data, there was a functional relation between the use of PTD in small groups and target participant's naming solutions.

Using Solutions

For the secondary dependent variable, using solutions (see Figure 5), Jason's baseline data were low and stable at 0% correct responding. Following the introduction of the intervention, Jason had an immediate increase to 100% prompted correct responding. Following the move to a 2 s delay, Jason's prompted correct responding decreased. Because his prompted correct responding to naming solutions (i.e., the primary dependent variable used to make experimental decisions) also decreased, the researcher returned to a 0 s delay. Jason's unprompted correct responses for using solutions were variable until Session 13 of intervention. The delay interval was increased to 2 s following Session 13 and Jason's UPC responding remained high following the increase in the delay interval. During intervention, Jason used between one and four solutions per session. During the maintenance condition, Jason's unprompted correct responding was at 100% correct.

For Wade, Seth, and Ella, baseline data were at 0% correct responding. Once the intervention was introduced, they had an immediate increase in prompted correct responding. Following the move to a 2 s delay, their unprompted correct responding had an increasing trend until mastery criterion was reached. There was low variability in their responding. During intervention, they used one to four solutions per session. For Ella, the percent correct responses of using problem-solving solutions remained high, even as the number of different solutions she

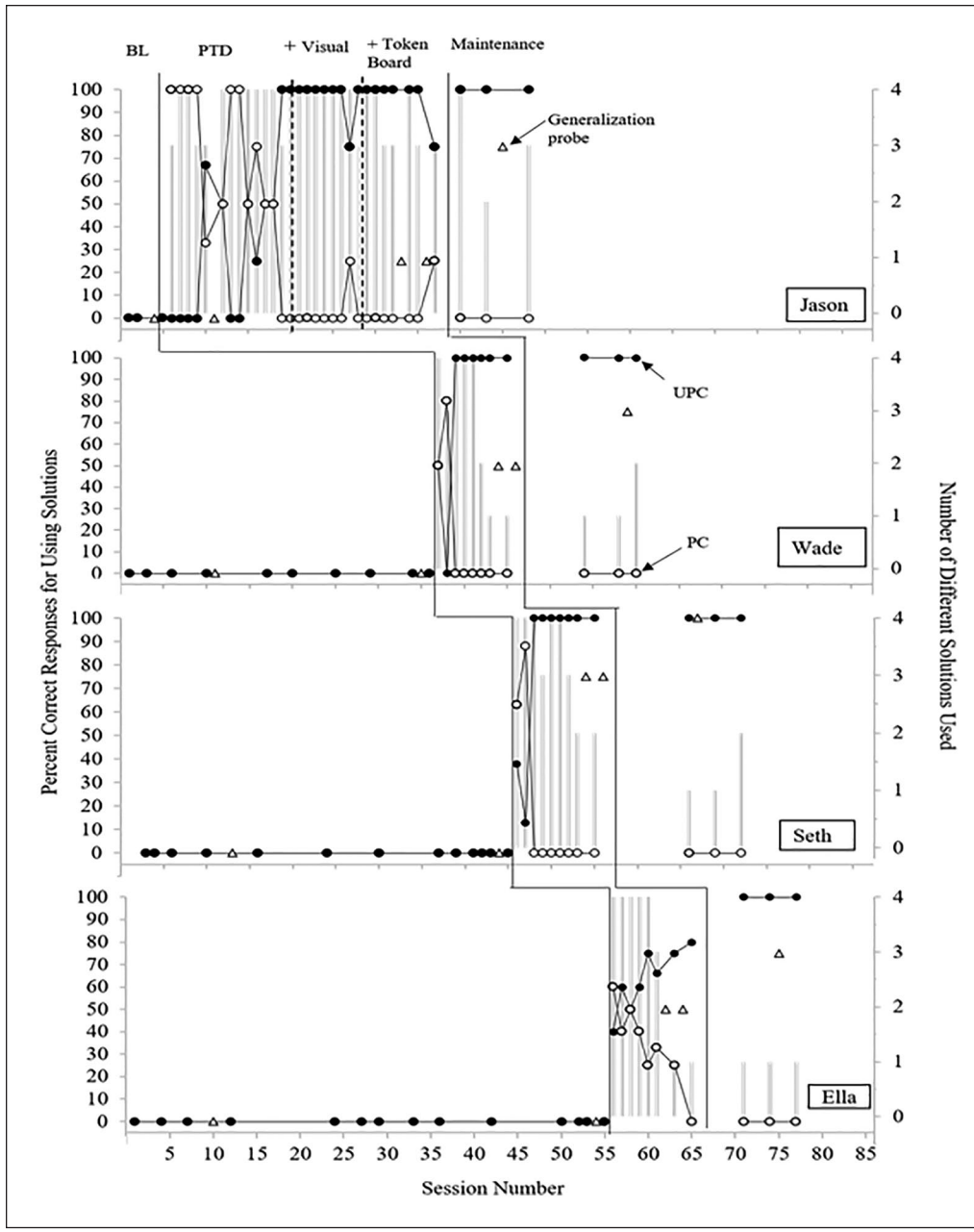

Figure 5. Using problem-solving solutions.
Note. Percent correct responses for using problem-solving solutions (line graph) and number of different solutions used (bar graph) are shown. Triangles indicate generalization data. BL = baseline; PTD = progressive time delay; UPC = unprompted correct responses; PC = prompted correct responses.

used decreased to one, as she correctly used the one solution she named during each trial. During the maintenance condition, their unprompted correct responding was high and stable. Based on their data, there was a functional relation between the use of PTD in small groups and target participant's using solutions.

Generalization

Generalization data are graphed on Figure 5. Generalization data were collected only for using problem-solving solutions as using problem-solving solutions in a natural context is the ultimate goal. For Jason during the baseline condition, data were at 0% for using problem-solving solutions. Once intervention was implemented, there was an increasing trend but not an immediate change in level. Jason's unprompted correct responding during generalization sessions increased to 75% during maintenance.

For Wade, Seth, and Ella, during the baseline condition, all generalization data points were at 0% for using problem-solving solutions. There was an immediate change following the introduction of the intervention for correct responding. There was no overlap between the baseline and intervention conditions. During the maintenance condition, their correct responding increased to 75% (i.e., Wade and Ella) or 100% (i.e., Seth).

Social Validity

Social validity was measured via naive ratings and questionnaires. When shown pairs of video clips from pre- and postintervention generalization sessions and asked to choose the clip in which the target participant used a more appropriate problem-solving solution, naive raters selected the postintervention clip on average 88% of the time. This indicates the target participants were more likely to use an appropriate solution after the intervention than prior to the intervention. In a second measure of social validity, preservice teachers unfamiliar with the purpose of the study rated how likely they were, on a scale of 1 to 4, with 1 being, "not likely," to teach specific solutions in their own classrooms. All of the solutions used in the present study received an average rating of 3.1 or higher (range 3.1–4). The highest rated solution to stop an unwanted behavior was, "Say, please stop" (average rating of 3.9) and the highest rated solution to acquire a wanted object was "play together" (average rating of 4). See Table 2 for complete results. In addition, all raters indicated they would be likely to implement an intervention to teach problem-solving skills and indicated that it was important and feasible to teach social problem-solving in the classroom.

The final measure of social validity was completed by the target participants' teachers. All teachers reported seeing their students use a problem-solving strategy to stop an unwanted behavior and/or acquire wanted objects in the classroom. The teachers reported that the most commonly used solution was to, "Say, please stop." Results showed that both teachers saw change in target participant's behavior in the classroom. One teacher reported, "This program has been wonderful for Wade. His behavior has been night and day compared to before the study."

Summary

A functional relation was present for naming problem-solving solutions and using problem-solving solutions as there were three demonstrations of effect. For three target participants, there was an immediate and consistent change in trend and level from the baseline condition to the intervention condition. PTD was effective for teaching naming problem-solving solutions and for teaching using problem-solving solutions to preschoolers with social skill deficits. There was evidence of generalization and maintenance for all target participants.

Discussion

Overall, the PTD intervention resulted in an increase in correctly naming and using problem-solving solutions. All target participants displayed low and stable levels of naming and using

Table 2. Social Validity Questionnaire Results.

Solutions to stop and unwanted behavior	Say, "please stop"	Get a teacher	Ignore	Find a new place to play	Play with a different friend	Take it back	Push them away
Average score	3.9	3.2	3.1	3	3	1.1	1
Solutions to acquire a wanted object	Play together	Trade	Ask for help	Get a timer	Get a different one	Get a teacher	Take it back
Average score	4	3.6	3.4	3.1	3.1	2.8	1.1

problem-solving solutions in baseline. After the intervention was introduced, there was an immediate increase in correct responding for both naming and using problem-solving solutions, and there was an increasing trend until mastery criteria was reached for three of the four target participants. With individual modifications (e.g., visual board and token board), there was also an increase in Jason's naming and using problem-solving solutions. A functional relation was present for both naming and using problem-solving solutions for three of the target participants. All four target participants maintained both naming and using problem-solving solutions 2, 3, and 4 weeks following intervention. These findings provide support for PTD as an evidence-based practice.

The target participants had a range of developmental levels as measured by the Mullen Scales of Early Learning scores. All target participants scored average or above average on the expressive language domain. However, on the receptive language domain, Jason scored below average while the other three participants scored average or above average. This could explain why Jason needed individual modifications including the visual board. The individual modifications made for Jason were consistent with supports needed by a child with receptive language delays.

Problem-solving is a core social-emotional skill that may result in improved social interactions and competence (Walker et al., 2013). Problem-solving helps children engage in more appropriate behaviors as alternatives to problem behavior (Barnes et al., 2018). Children who engage in challenging behavior often have limited problem-solving skills. An inclusion criterion for the target participants in the current study included students scoring above average on the problem behavior domain and/or below average on the social skills domain of the SSIS. One target participant (i.e., Wade) scored above average and the other three target participants scored well-above average on the problem behavior domain. None of the participants were able to name or use a problem-solving solution in the baseline condition, indicating a possible correlation between limited problem-solving skills and higher levels of reported problem behavior.

There is limited evidence in previous research that children can generalize problem-solving skills from the intervention context (e.g., small group instruction) to a more natural context (e.g., free play) (Hune & Nelson, 2002; Vandelaar, 2017). The current study contributes to the literature by demonstrating not only that PTD delivered in a small group setting was effective for teaching children to name and use problem-solving solutions but also that children generalized the use of problem-solving solutions to a naturalistic context (e.g., center time). There was anecdotal use of observational learning as the teachers reported that the confederates named the problem-solving solutions taught to their peer. For example, Jason was taught solutions to acquire wanted objects and Penny was taught solutions to stop an unwanted behavior. Penny was then paired with Wade and asked to name solutions for acquiring wanted objects. Penny named the solutions that were originally taught to Jason, even though she was never directly taught those solutions. Future research should include a more systematic evaluation of observational learning.

In the current study, the researcher programmed for generalization from the beginning of the study in a number of ways. First, the researcher individualized the participants' intervention by selecting scenario cards that aligned with each target participants' preferences about toys and materials. Second, the researcher utilized materials already found in the target participants' classroom, so the participants were familiar with the materials. Third, the small group setting was designed to promote generalization as the use of the peer confederate helped to create more realistic problem-solving scenarios for the target participant. Following the naming of the solution, the participants were asked to use the problem-solving solution they just named (i.e., Trial Part 2). This gave participants practice using the solutions with the peer confederate and classroom materials, creating a more naturalistic practice opportunity. Finally, it is interesting to note that the one child (i.e., Seth) who showed slightly higher levels of generalization (i.e., generalized 100% during the maintenance condition, while the other three participants generalized 75%

during the maintenance condition) was the target participant whose sessions were implemented within the context of free play in his classroom rather than in an empty classroom.

The study also provides evidence of the need for systematic instruction to help children learn problem-solving skills. The classrooms in this study had visuals related to problem-solving, including some of the solutions that were taught in this study, and the children had been introduced to the solutions during whole group instruction. However, none of the participants in this study were able to name the solutions prior to the intervention being implemented. After the researcher implemented PTD in a small group setting, the participants named and used problem-solving solutions, and the participants maintained their responding after the intervention was withdrawn. This suggests that what often occurs in classrooms around teaching social problem-solving (e.g., large group instruction, visuals) is not likely sufficient to result in the acquisition, generalization, or maintenance of these important skills by children with social-emotional delays or challenging behavior.

Overall, the study expanded previous research on teaching social problem-solving and provides growing evidence for the use of PTD to teach problem-solving solutions in a small group setting to children with social skills delays and challenging behavior. The results are consistent with previous research using PTD in small groups to teach children to name problem-solving solutions (Vandelaar, 2017). This study fills a gap in the literature as participants generalized their use of problem-solving solutions to a novel context. The participants also maintained the naming and using of problem-solving solutions 2, 3, and 4 weeks after the intervention was removed.

Limitations

There are some limitations to this study which should be considered when interpreting the findings. First, Ella responded with the same solution for every scenario (e.g., find a new place to play). While there were some solutions that were not relevant to the scenario (e.g., saying trade when there was only one baby doll), some solutions could be utilized in response to different scenarios (e.g., get a timer, play with a different friend, find a new place to play). Some target participants chose one solution and repeatedly answered with that solution. This limited the number of different solutions the participants learned to name and use, and it limited the variability in responding, acquiring, and utilizing multiple problem-solving solutions.

A second limitation was that some participants responded with solutions that the researcher did not teach, and the data collection system did not allow for coding these as correct responses. For example, participants responded with solutions such as share, ask, and say no thank you. These were appropriate solutions to the scenario cards but had not been taught as part of the study. These responses were recorded as errors for the purpose of the study. Accepting these responses as correct responses might have increased the number of correctly named and used solutions.

Future Research

Based on the results of this study, there are several suggestions for future research on teaching problem-solving to young children. Research should be conducted to determine if naming solutions is necessary for children to learn to use solutions. Previous studies taught the problem-solving process and focused on naming problem-solving solutions (Hune & Nelson, 2002; Vandelaar, 2017). In the current study, participants learned to use the solutions more quickly than they learned to name the solutions. If participants are able to use solutions without first having to learn to name them, the intervention may be more efficient. Research should also be conducted to examine if less intensive interventions, including groups with more children (e.g.,

3–5 students) or embedded instruction, would lead to acquisition and generalization of problem-solving skills. If effective, including more children in the small group or using embedded instruction during child-directed activities to teach naming and using problem-solving solutions may be more feasible and efficient for classroom teachers.

Future research might also examine how instruction on social problem-solving affects children's interactions with their peers throughout the day including the types of social interactions and types of play children engage in outside the instructional context. In the current study, informal observations by the teacher and researcher found that the students increased their social interactions with their peers, engaged in more complex levels of play, and engaged in more back and forth conversations following the intervention. Previous research has found a correlation between social problem-solving and higher social acceptance (Neel et al., 1990). However, these variables were not measured in this study. Previous studies measured social skills and problem behaviors through the Social Skills Rating System (Gresham & Elliott, 1990) and results showed an increase in social skills following intervention (Hune & Nelson, 2002). Future studies should measure social interactions and different types of cognitive and social play as a result of social problem-solving interventions. This research could be extended to determine how this intervention might be used or adapted for children who have delays in executive functioning, are diagnosed with autism spectrum disorder, or are diagnosed with significant developmental delays. There is limited research on the effectiveness of similar interventions with these populations.

Implications for Practice

The findings from this study suggest that using PTD to teach social problem-solving solutions in a small group is effective. This intervention is relatively low cost in terms of time as the sessions lasted on average only 15 min, and the researcher created scenario cards and utilized materials already available in the classroom. This intervention can be used with students with a range of abilities by including individual modifications (e.g., visual board with an array of solutions). PTD can be implemented in a small group or using individualized instruction to support children's acquisition of problem-solving skills (Vandelaar, 2017). Teachers can program for generalization by including peers in the instructional setting, as occurred in this study, increasing the likelihood that target children generalize their use of learned problem-solving skills to natural contexts.

Conclusion

The purpose of this study was to examine the effects of PTD implemented in a small group setting to teach children to name and use social problem-solving solutions. Data from this study indicate that PTD is an effective procedure to increase naming and using problem-solving solutions for preschool children with social skill deficits and challenging behavior. The participants also generalized the use of problem-solving solutions to novel contexts, and their behaviors maintained when the intervention was withdrawn. Future research should be conducted to examine problem-solving solutions and the use of self-regulation strategies, and evaluate the effects of problem-solving instruction on participants' types of social interactions and types of cognitive and social play.

Author's Note

Jarrah Korba is now at Shabani Institute. Portions of these findings were presented as a poster at the following conference: APBS' International Conference on Positive Behavior Support in 2019 in Washington, DC.

Acknowledgments

We thank Libby Day for her time and energy during the data collection process; Kiersten Kinder for her support and flexibility throughout the development and execution of this project; and Jennifer Ledford for her support and guidance.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Our work was in part funded by OSEP Grant H325K140110.

ORCID iDs

Jarrah Korba https://orcid.org/0000-0001-8806-7776

Adrienne K. Golden https://orcid.org/0000-0003-0415-2506

Supplemental Material

Supplemental material for this article is available online.

References

Barnes, T. N., Wang, F., & O'Brien, K. M. (2018). A meta-analytic review of social problem-solving interventions in preschool settings. *Infant and Child Development*, *27*(5), 1–22.

Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (2001). Enhancing social problem solving in children with autism and normal children through computer-assisted instruction. *Journal of Autism and Developmental Disorders*, *31*, 377–384.

D'Zurilla, T. J., Nezu, A. M., & Maydeu-Olivares, A. (2004). Social problem solving: Theory and assessment. In E. C. Chang, T. J. D'Zurilla, & L. J. Sanna (Eds.), *Social problem solving: Theory, research, and training* (pp. 11–27). American Psychological Association.

Francis, R., Winchester, C., Barton, E. E., Ledford, J. R., & Velez, M. (2020). Using progressive time delay to increase levels of peer imitation during play with preschoolers with disabilities. *American Journal on Intellectual and Developmental Disabilities*, *125*(3), 186–199.

Gast, D. L., Lloyd, B. P., & Ledford, J. R. (2018). Multiple baseline and multiple probe designs. In J. R. Ledford & D. L. Gast (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (3rd ed., pp. 240–281). Routledge.

Green, A. (2013). *Teaching children to generate solutions to social problems* [Unpublished master's thesis]. Vanderbilt University.

Gresham, F. M., & Elliott, S. N. (1990). *Social skills rating system: Manual*. American Guidance Service.

Gresham, F. M., & Elliott, S. N. (2008). *Social skills improvement system: Rating Scales*. Pearson Assessments.

Holtz, C. A., Fox, R. A., & Meurer, J. R. (2015). Incidence of behavior problems in toddlers and preschool children from families living in poverty. *The Journal of Psychology*, *149*, 161–174.

Hune, J. B., & Nelson, M. C. (2002). Effects of teaching a problem-solving strategy on preschool children with problem behavior. *Behavioral Disorders*, *27*, 185–207.

Joseph, G. E., & Strain, P. S. (2010). Teaching young children interpersonal problem-solving skills. *Young Exceptional Children*, *13*, 28–40.

Ledford, J., Lane, J. D., & Barton, E. E. (2019). *Methods for teaching in early education: Contexts for inclusive classrooms*. Routledge.

Ledford, J. R., Chazin, K. T., & Maupin, T. N. (2016). *Progressive time delay—Evidence-based instructional practices for young children with autism and other disabilities*. https://ebip.vkcsites.org/progressive-time-delay/

Ledford, J. R., Lane, J. D., Elam, K. L., & Wolery, M. (2012). Using response-prompting procedures during small-group direct instruction: Outcomes and procedural variations. *American Journal on Intellectual and Developmental Disabilities*, *117*, 413–434.

Ledford, J. R., Lane, J. D., & Gast, D. L. (2018). Dependent variables, measurement, and reliability. In J. R. Ledford & D. L. Gast (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (3rd ed., pp. 97–131). Routledge.

Ledford, J. R., & Wolery, M. (2013). Peer modeling of academic and social behaviors during small-group direct instruction. *Exceptional Children*, *79*, 439–458.

Mullen, E. M. (1995). *Mullen Scales of early learning* (pp. 58–64). American Guidance Service.

Neel, R. S., Jenkins, Z. N., & Meadows, N. (1990). Social problem-solving behaviors and aggression in young children: A descriptive observational study. *Behavioral Disorders*, *16*, 39–51.

Parker, J. G., & Asher, S. R. (1987). Peer relations and later personal adjustment: Are low-accepted children at risk? *Psychological Bulletin*, *102*, 357–389.

Strain, P. S., & Timm, M. A. (2001). Remediation and prevention of aggression: An evaluation of the regional intervention program over a quarter century. *Behavioral Disorders*, *26*, 297–313.

Sweeney, E., Barton, E. E., & Ledford, J. R. (2018). Using progressive time delay to increase levels of peer imitation during sculpting play. *Journal of Autism and Developmental Disorders*. Advance online publication. https://doi.org/10.1007/s10803-018-3638-2

Vandelaar, E. (2017). *The effect of progressive time delay to teach social problem-solving skills to preschoolers* [Unpublished master's thesis]. Vanderbilt University.

Venn, M. L., Wolery, M., Werts, M. G., Morris, A., DeCesare, L. D., & Cuffs, M. S. (1993). Embedding instruction in art activities to teach preschoolers with disabilities to imitate their peers. *Early Childhood Research Quarterly*, *8*, 277–294.

Walker, O. L., Degnan, K. A., Fox, N. A., & Henderson, H. A. (2013). Social problem solving in early childhood: Developmental change and the influence of shyness. *Journal of Applied Developmental Psychology*, *34*, 185–193.

Whitted, K. S. (2011). Understanding how social and emotional skill deficits contribute to school failure. *Preventing School Failure*, *55*, 10–16.