Preliminary Study of Social Skills Generalization with Pivotal Response Treatment

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Abstract

This study used a concurrent multiple baseline design to examine the effects of a peer-mediated pivotal response treatment on social interaction skills of a child with autism in inclusive educational settings. Two typically developing peers were trained to implement the intervention with researchers' prompts in non-instructional settings, such as lunch and recess. In addition, Low Effort (LE) sessions, consisting of low invasive prompting provided by researchers to the peers, were conducted in instructional settings to promote generalization (i.e., art, physical education; PE). Results indicated an immediate increase in social interactions following the

peer-mediated pivotal response treatment and maintenance of these interactions during lunch and recess. Some generalization of the interactions also occurred during low effort sessions.

Keywords: *autism, pivotal response treatment, socialization, generalization*

Introduction

Children with autism spectrum disorders (ASD) often exhibit significant difficulties in social interactions (American Psychiatric Association, 2000). In particular, students with ASD may face specific challenges in multiple areas of socialization, such as the initiation and maintenance of conversations, and play with peers (Banda, Hart, & Liu-Gitz, 2010; Thorp & Stahmer, 1995). As a result, students with ASD are at increased risk for peer rejection and social isolation in general education settings (Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010). For successful social inclusion, educators may need to modify or accommodate the environment during non-instructional times of the school day (e.g., recess) by training and/or explicitly involving peers without disabilities (Lang, et al., 2011).

Challenges associated with social and play behaviors of students with ASD may involve a lack of motivation derived from attention difficulties or a history of unsuccessful interactions (Koegel, 2007; Schreibman, 1988). Accordingly, the current study utilized peer-mediated pivotal response treatment (PRT), which has been developed to enhance children with ASD's motivation to acquire critical developmental areas, including socialization, play, and language (Koegel & Koegel, 2006). PRT is a multi-component intervention incorporating various components of naturalistic behavioral interventions, including the environment (e.g., typical classroom), change agents (e.g., peers), and natural reinforcement. Additionally, PRT includes following the child's lead and incorporating child choice, but does not include specific scripts and arbitrary reinforcers.

PRT allows "*a significant amount of choice over the nature of the interaction and stimulus materials, reinforcing attempts to respond, and varying tasks frequently*" (Pierce & Schreibman, 1995, p. 285).

However, researchers examining social skill interventions have reported that the acquired social and play behaviors of many children with ASD and their peers may not automatically generalize to novel playmates, settings, and to times when the interventionist is not present. For example, a meta-analysis of social skills interventions for children with ASD in school settings found that generalization of intervention effects is a pressing issue, but that generalization was greater for interventions conducted within the natural environment (Bellini, Peters, Benner, & Hopf, 2007). However, research in PRT specifically, which is conducted in natural environments (e.g., recess) also shows that generalization may be a critical issue for researchers and practitioners. For example, Pierce and Schreibman (1995) found that one of the study participants did not generalize acquired social behaviors when the child met untrained peers. A more recent PRT study found that teaching children with autism to initiate interactions with peers helped improve generalization of interaction to times when an adult facilitator was not present at recess (i.e., the training context; Koegel, Kuriakose, Singh, & Koegel, 2012). Although the initiation-focused PRT intervention improved the acquisition and generalization of social behaviors without adult facilitators, the study did not assess generalization to other inclusive contexts within the students' school day.

Some previous PRT intervention studies have utilized unstructured "*non-instructional*" times of the school day, such as recess, to help children acquire meaningful socialization behaviors (e.g., Koegel, Vernon, Koegel, Koegel, & Paullin, 2012). Certainly, recess presents an important yet still understudied inclusive context in the education and treatment of students with ASD (Lang, et al., 2011). Researchers have suggested many advantages in improving

socialization during recess (e.g., Harper, et al., 2008; Lang et al., 2011). Specifically, non-instructional school settings offer valuable opportunities for students with autism to practice and experience positive peer interactions in a natural setting. However, these regularly scheduled free times are often underused, such that students with ASD remain less interactive than typically developing peers (Lang, et al., 2011). Based on current PRT research, non-instructional times such as recess and lunch settings may be the most appropriate milieu for full peer-implementation of PRT components.

However, questions remain regarding the generalization of intervention effects from non-instructional contexts (e.g., recess) to instructional periods within school settings. Answering such questions is important, as children with ASD may not only lack consistent social facilitation at recess, but also may not be provided many opportunities for social engagement and interaction with peers across the school day (Chiang, 2009). Ideally, the acquisition of socialization behaviors in non-instructional contexts would generalize to instructional portions of the school day where typically developing peers often continue informal socialization under different stimulus parameters. Because students spend significant amounts of time in instructional, teacher-directed periods (e.g., art, PE, math), generalized use of social interaction behaviors from non-instructional to instructional settings may foster successful development of peer relationships and provide a practical mechanism for improving the social inclusion of students with ASD throughout the school day. However, there may be reasons to suspect that generalization of interactions from recess to instructional class time may be a challenge, even when peers are well trained and motivated to interact with students with ASD (and vice versa) during non-instructional times of the school day.

The current study sought to assess whether acquisition of interactions during non-instructional portions of the school day would generalize to instructional portions of the school

day. However, in order to address the potential for a lack of generalization, the present investigation planned *a priori* to utilize a Low Effort (LE) generalization strategy in the generalization settings, which is a strategy that has been employed in the positive behavior support literature, but has yet to be explored within the social skills literature (Schindler & Horner, 2005). "*Effort*" is defined as the "*technical and procedural demands of the intervention*" (Schindler & Horner, 2005, p. 41). This study design and strategy allows researchers to assess the *interaction effect* of implementing a higher effort (HE; i.e., high degree of adult prompting and full PRT implementation by the peer) strategy in primary skill-acquisition settings and a lower effort (LE; i.e., low intensive adult prompting) strategy in generalization settings. Researchers suggest, "*interventions requiring less effort to implement may be practical in one setting, but only after an intervention requiring more effort and skill from mediators is applied in another setting*" (Schindler & Horner, 2005, p. 37). As demonstrated by Schindler and Horner (2005), the LE strategy in the generalization setting improved generalization of reduced problem behavior *only after* the intervention with HE was introduced in the primary intervention setting. Embracing this generalization strategy in peer-mediated PRT may promote setting generalization by creating the interaction effect between acquisition of interactions in primary settings and generalization of the acquired social interactions in less targeted settings.

The aim of this study was to evaluate the acquisition and generalization effects (i.e., across settings) of peer-mediated PRT on the social interactions of a child with autism and his peers in natural educational environments with an *a priori* planned use of an understudied generalization strategy (i.e., the interaction effect between HE intervention in non-instructional settings and LE prompting in the generalization settings). The acquisition of appropriate interactions was primarily measured in non-instructional settings, specifically recess and lunch. In addition, we assessed whether the social interactions between the peers and the focus child

with autism automatically generalized to more instructional portions of the school day (e.g., group instruction in various subjects), and then assessed whether the use of the LE generalization strategy improved this generalization.

Method

Participants, Settings and Materials

Focus child. The focus child for this study was Tim, a seven-year-old European American boy with autism. He attended a full inclusion elementary school in the Midwestern United States. Tim received occupational and speech therapy to address his symptoms of ASD and to facilitate his access to general education curriculum. According to his recent individualized educational program (IEP), he used oral language to answer and ask questions, comment, and exclaim. Although many of his utterances were complete and intelligible, he frequently used incomplete sentences (e.g., his language skills lacked developmentally appropriate complexity) and/or added unnecessary words that decreased his intelligibility. During recess and other free times, Tim occasionally interacted with his peers, but usually played alone with a few preferred items, demonstrating resistance to new tasks or activities.

Peer mediators. Two typically developing peers participated in the study as peer mediators. The peers were European American males, eight (Brad) and seven years old (Noah), and attended the same classroom as Tim. Their classroom included 50 children with and without disabilities who were in first to third grade and three general educators.

Settings and materials. The peer-mediated PRT intervention took place in non-instructional settings (i.e., the lunchroom and playground during lunch and recess). Generalization sessions (i.e., *generalization probes* and *LE generalization sessions*) took place in instructional settings (i.e., the gym for PE, the art classroom for art class). PE and art class were chosen as the instructional settings because these settings involved more teacher-directed instruction and

activities, but also because we expected higher levels of informal interaction than other instructional school periods. Thus, these classes were favorable for examining generalization of interactions from non-instructional school settings.

Materials used for the sessions were play or classroom materials (i.e., natural stimuli). In acquisition settings (lunch or recess), participants could access favorite snacks and play materials (e.g., m&m's®, chips), playground facilities, and items/activities (e.g., swing, bubbles). Favorite snacks/materials were selected based on Tim's interests and preferences, along with the mutual interest shown by the peer mediators (e.g., cars, printed bug cards). Tim's interests and preferences were assessed by informal parent reports and observation by researchers. In generalization settings, they used only the naturally occurring class materials for the day.

Procedures

Experimental design. We employed a concurrent multiple baseline design across peer mediators to examine the effect of PRT and concurrent setting generalization. Further, the design assessed whether setting generalization of social interactions improved based on an interaction between a higher effort intervention mediated in the non-instructional acquisition setting and lower effort generalization strategy in the instructional setting. The LE generalization sessions and generalization probes during baseline were counterbalanced between tiers in order to provide a control for sequence effects (see Figures 1 and 2).

Baseline. During recess and lunch, Tim and the peer mediators were given an initial instruction to play or have lunch, respectively. The baseline interactions between Tim and Brad were observed during lunch, whereas the interactions between Tim and Noah were observed during recess. The researchers' prompts or PRT instructions for the peer mediators were not delivered during baseline. Each baseline probe lasted for 10 min, two to four times per week, over two to three weeks.

Peer training. The two peer mediators received separate training sessions between baseline and peer-mediated PRT sessions. We adapted the PRT manual by Koegel, et al., (1989) to train the peers. PRT opportunities are always multi-component, and this study consisted of the following antecedent and consequence components:

1. Follow Tim's lead (antecedent PRT component): Peer mediator follows Tim's interests or asks him questions in order to choose preferred activities or items that they would both enjoy. For example, the peer and Tim would play with a sticky ball when the peer noticed that they both were interested.

2. Give choices and/or ask questions (antecedent PRT component): Peer mediator gives choices between and within activities, and provides opportunities for verbal interaction by asking the focus student questions. For example, the peer mediator may ask, "*Tim, do you want to play with a sticky ball or dinosaurs?*" or, *"Which car will you race, the red one or the blue one?"*

3. Share and take turns (i.e., shared control; antecedent PRT component): Peer mediator alternates turns and shares by using the material concurrently with Tim during play. Through taking turns, the focus child is exposed to examples of appropriate responding, interactions, and play, and can learn how to share materials. For instance, when they play with the sticky ball, they share one ball, take turns throwing and catching; on their turn the peer shows Tim new ways to throw the ball. Sharing an item and taking turns also provides an easy way for the peers to provide natural reinforcers contingent on social interactions (i.e., it provides multiple opportunities for social interaction that can be reinforced by the peers). So, in the same example, prior to throwing the sticky ball back to Tim (to take his turn), the peer might wait for Tim to say, "*Throw a curve ball!*" or the peer would ask Tim how the ball should be thrown prior to throwing the ball back to Tim.

4. Deliver desired activities/items contingent on interaction (i.e., natural reinforcement; consequence PRT component): The peer mediator delivers reinforcement by providing the desired chosen items/activities contingent on social interaction. For instance, the peer gives Tim a bug card only when Tim asks or answers the peer's question about the bug card. These reinforcers are logically related to the activity.

During the peer training sessions, the researcher provided verbal explanations to the peers and modeled the desired behaviors. Then the peer mediators and the researcher role-played. The researcher provided verbal or modeling feedback, particularly praise. A visual cue card for each peer was also presented to assist the peer mediators in learning the strategies. The cue cards summarized the aforementioned PRT strategies for each peer, which were called '4 play rules' by the peers (i.e., "*play things my friend likes, give choices, share and take turns, ask and answer first*"). Except for the class materials in art or PE, several preferred materials that would be available at recess and lunch were accessible during peer training. Further, training focused on interactions that might occur during either recess or lunch. Training continued until the peer mediators demonstrated over 80% mastery of skills across peer-training sessions. Each session lasted 15 to 30 min, and the peer mediators reached mastery after three to five training sessions occurring over one to two weeks.

Peer-mediated PRT (HE). Tim and the peer mediators were told to play during recess or to eat together during lunch (just as in baseline sessions). Each peer mediator met Tim in each session during lunch (Brad) or recess (Noah). As in the study by Harper et al. (2008), the researcher in this study asked the peer to explain the strategies prior to each peer-mediated PRT session at recess and lunch. The researcher also provided verbal prompts (e.g., in order to prompt conversation during a bug card game, the adult might say to the peer, "*Tim might have watched bug cartoons last night.*") and showed visual cue cards only to peer mediators if they did not

initiate interactions within 30s of the last interaction. The verbal and visual prompts to the peers resembled the examples used during peer training. Researchers observed the sessions and only provided prompts to peers when necessary. This facilitation, the expectation that peers fully implement PRT, as well as the peer training and child chosen materials specific to recess and lunch, represented the HE intervention. PRT, as the HE intervention, was only conducted during the non-instructional portions of the school day. Each peer-mediated PRT (i.e., HE intervention) session lasted for 10 min and the sessions continued for four to six weeks, one to three times a week. Peers were praised and provided feedback after each session.

As the peers and focus child acquired interaction skills, three *no-adult-facilitation probes* were conducted at recess and lunch to examine whether adult facilitation was indeed needed for peer mediators to interact with Tim in the non-instructional settings. During no-adult-facilitation probes, the researcher did not interact with the peer mediators or provide the visual cue cards, although the researcher asked the peers to explain the four PRT components prior to each peer-mediated PRT session.

Maintenance. Additional probes, resembling the baseline sessions, were taken over the week immediately following the PRT intervention to assess whether gains were maintained in the absence of researcher-provided reminders/feedback to the peer mediators. Consistent with baseline, Tim and the peers were told to play or have lunch, during recess and lunch respectively. Researchers observed the interactions between Tim and Brad during lunch and the interactions between Tim and Noah during recess. The 10 min maintenance probes occurred three times over one week. It was not feasible to assess long-term maintenance given that the school year was ending.

Generalization. Instructional settings (i.e., art class and PE) were used to measure generalization of social interactions between Tim and the peers from the non-instructional

settings. These classes were teacher-directed and focused on instruction, and were selected based on scheduling alignment and on the assumption that informal socialization occurs during these types of instructional periods. The peers were not trained during this time of the day, and they were not trained according to the types of activities and setting variables that might be present during these instructional periods. We assessed whether interactions would carry over from non-instructional times of the school day where the PRT intervention (HE) was being implemented. Each generalization session lasted 10 min and occurred one to two times per week. There were two types of sessions to measure generalization: Generalization probes and LE sessions. The generalization probes, which did not involve prompts by the researchers, and LE prompting sessions in the same generalization settings, were compared to evaluate whether the LE generalization strategy improved generalization of the social interactions to instructional settings.

Low effort (LE) sessions. LE sessions, or low-intensity prompting (Harvey, Lewis-Palmer, Horner, & Sugai, 2003; Schindler & Horner, 2005), were mediated only in the instructional settings (e.g., PE and art) to promote generalization of Tim and the peers' social interactions, only after their interactions increased during the peer-mediated PRT at recess and lunch. At PE and art, the researcher facilitated interaction by giving fewer prompts to the peers (i.e., verbal, visual cue card) than during recess and lunch; at three fixed times (1, 5, and 8 min into each 10 min session). If the participants were already interacting at the fixed times, the researcher did not provide prompts to the peers. This LE prompting strategy was designed to be minimally invasive and time intensive, and to emulate a usual and feasible level of prompting by an educator attempting to address social interaction goals.

Through LE sessions, we assessed the LE generalization strategy effectiveness in facilitating the generalization of the interactions developed during peer-mediated PRT (i.e., HE intervention) in the non-instructional settings (i.e., recess and lunch). Effectiveness was

evaluated *only after* interaction skills were developed within the PRT sessions (i.e., HE) at recess and lunch (i.e., interaction effect; Schindler & Horner, 2005). We examined and compared the students' social interactions in the instructional generalization settings (i.e., PE and art) both before (i.e., during baseline) and after the peer- mediated PRT in non-instructional acquisition settings (i.e., HE settings; recess and lunch).

Generalization probes. Tim's interaction with Brad was observed in art class, whereas his interaction with Noah was observed in PE class. During these probes, researchers observed Tim and the peers' interactions without the LE strategy. In doing so, we examined whether the interactions would automatically generalize from the non-instructional settings to the instructional settings, as well as whether the LE strategy was needed for improving generalization. As with the LE sessions, the researchers conducted the generalization probes in the instructional settings both before and after the peers mediated PRT in the non-instructional acquisition settings (i.e., after the HE intervention began). It was important to conduct generalization probes in the instructional settings simultaneously during the acquisition baseline (in non-instructional settings) in order to establish a level of social interaction specific to the generalization settings *prior* to the onset of intervention in the acquisition settings. Without this component, we would not be able to infer whether observed social interactions in the instructional settings was the generalization effect of the PRT intervention, or the result of extraneous variables in those settings.

Dependent Measures

Peer mediators' initiations. The number of initiated verbal or nonverbal opportunities for interaction provided by each peer (i.e., asking questions, taking turns, giving choices) was measured during each 10-min session. Peer initiations were defined as beginning conversation verbally or physically (e.g., tapping on peer's shoulder, showing an objective to peer), or

introducing a new play theme. Observers scored verbal or nonverbal opportunities as initiations when they were not in direct response to a question, they occurred at least 3s after a preceding interaction, and/or they clearly changed the topic/play theme (Pierce & Schreibman, 1995). Negative initiations (e.g., throwing objects at peers) or murmuring to himself were not scored.

Focus child's responses. Observers also scored the frequency of Tim's responses to peer initiations. Positive nonverbal (i.e., gestural affirmations, such as nodding in response to peer mediator's prompt) or verbal responses were scored, but negative responses were not scored (i.e., verbal and physical protest, screaming and crying, saying contextually unrelated things to the peer's initiation, unintelligible murmuring). However, negative responses were rare. Clarifying questions to peer mediators' initiation (e.g., What did you say?) were also scored as responses.

Focus child's initiations. The number of Tim's play initiations and conversation initiations were measured. Congruent to peer initiations, focus child initiations were defined as beginning conversation verbally or physically or starting a new play theme without the peers' prompts. For example, showing an object to the peer with or without verbalization, verbally asking a peer mediator to play (e.g., saying *"let's play"*), touching a peer's body to get attention (i.e., pulling peer's hand, tapping on peer's shoulder), verbally asking a question on a new topic or after 3s from the last communicative act, and initiating turn taking were scored in this category. Negative initiations (e.g., hitting peer's body, screaming, or throwing objects at peers), echolalia, or murmuring to himself were not scored. Again, negative initiations were quite rare. Other criteria were identical to "*peer initiations*" described above.

Peer mediators' responses. We scored the peer mediators' responses to Tim's initiations. Criteria to score this variable were identical to the "focus child's responses" described above.

Child affect. Tim and the peer mediators' interest and happiness were rated by the researchers to evaluate the enjoyment of social interaction through observing the children's

eagerness to interact with one another (Koegel, Sze, Mossman, Koegel, & Brookman-Frazee, 2006). We measured child affect based on observation of the interactions. Using the subjective affect rating scale (i.e., a five-point scale) by Dunlap and Koegel (1980), child affect was scored for every session across all phases for each participant.

Inter-observer Agreement, Fidelity, and Social Validity

Two researchers independently scored 33% of the sessions across all phases by reviewing video clips of the sessions. Inter-observer agreement for the frequency of each interaction variable (i.e., initiations and responses by the peers and the focus child) was measured by counting the number of interactions observed by each researcher during each 10-min session. The smaller tally was divided by the larger and multiplied by 100 to obtain a percentage (Kazdin, 1982). The inter-observer agreement for peer's initiation was 90% (range: 75–100%), focus child's response was 91% (range: 80–100%), focus child's initiation was 93% (range: 80–100%), and peer's response was 92% (range: 72 –100 %). In order to control for chance agreements, categorical reliability for child affect was calculated using Cohen's Kappa coefficients. Mean kappa coefficients were .70 for focus child's affect, .67 for Brad's affect and .71 or Noah's affect, all representing acceptable levels of reliability.

Two types of treatment fidelity data were collected. First, researchers completed a researcher implementation checklist following each session during 40% of peer-mediated PRT sessions and no-adult-facilitation probes in non-instructional acquisition settings. The mean of treatment fidelity was 100%. Second, the fidelity of peer implementation of the PRT components during recess and lunch was measured by reviewing 33% of the video-recorded peer-mediated PRT sessions and no-adult-facilitation probes for each peer mediator Using a checklist, researchers checked off the correct occurrence of each of the PRT components. The mean treatment fidelity of peer implementation was 84% for Brad (range: 75–100%) and 96% for

Noah (range: 75–100%). Fidelity of peer implementation was only conducted in the HE intervention settings (i.e., recess and lunch) because these are the only settings we expected the peers to fully implement PRT. We were primarily interested in the generalization of their interactions to the instructional PE and art class settings.

The researchers assessed social validity via a questionnaire that was initially developed by Kennedy (1994, 2005) and modified for the present study. The researchers provided the questionnaire to Tim's general educator, PE teacher, and art teacher after intervention. The response to each question was scaled from 1 to 5 points and higher scores indicated greater acceptability and positivity. The mean response rating across items on the questionnaires was 4.1 (range: 3–5). An open-ended question section to gather extended and unstructured answers was also included. All teachers reported that the intervention was helpful and supportive in increasing Tim's social interaction, not only with the peer mediators, but also with other classmates.

Results

Results of the study indicate increased social interactions for Tim and his peer mediators in the non-instructional settings (i.e., lunch, recess). In addition, child affect improved for both Tim and the peers. However, generalization of the interactions to instructional settings varied. Brad and Tim showed generalization at low levels during the no-facilitation generalization probes, and immediately increased generalization during LE generalization sessions in art class. For Noah and Tim, however, the increased interaction did not substantially generalize to the PE setting, even with the LE generalization strategy in place. Improved child affect, however, did seem to generalize for both peers.

Peer Mediators' Initiations and Focus Child's Responses

Figure 1 depicts the number of the peers' initiations and Tim's responses. The first and second tiers show the concurrent data of the number of interaction between Tim and Brad. The

third and fourth tiers present the concurrent data of the number of interaction between Tim and Noah. The results of the intervention in the non-instructional acquisition settings are depicted in the first and third tiers for each peer (i.e., HE settings; recess and lunch).

During the initial baseline in the lunch setting (tier 1), Brad initiated interactions at stable low levels (M = 1.17 occurrences per each session, range: 0 to 5 occurrences). Tim also responded to Brad infrequently during baseline, resulting in stable low levels (M = 0.67, range: 0 to 2 responses). Similarly, during baseline in the recess setting (tier 3), Noah initiated interaction with Tim at stable near zero levels (M = 0.56, range: 0 to 4 initiations) and Tim rarely responded to Noah (M = 0.1, range: 0 to 1 responses). Following the peer-training sessions, however, Tim immediately demonstrated improved and increasing social interactions. During peer-mediated intervention sessions at lunch, Brad increased his initiations, as evidenced by an immediate increase and general upward trend (M = 20 initiations, range: 10 to 25 initiations), and maintained his initiations during the no-adult-facilitation probes (M = 19.67, range: 8 to 33 initiations) and maintenance (M = 15.33, range: 14 to 16 initiations).
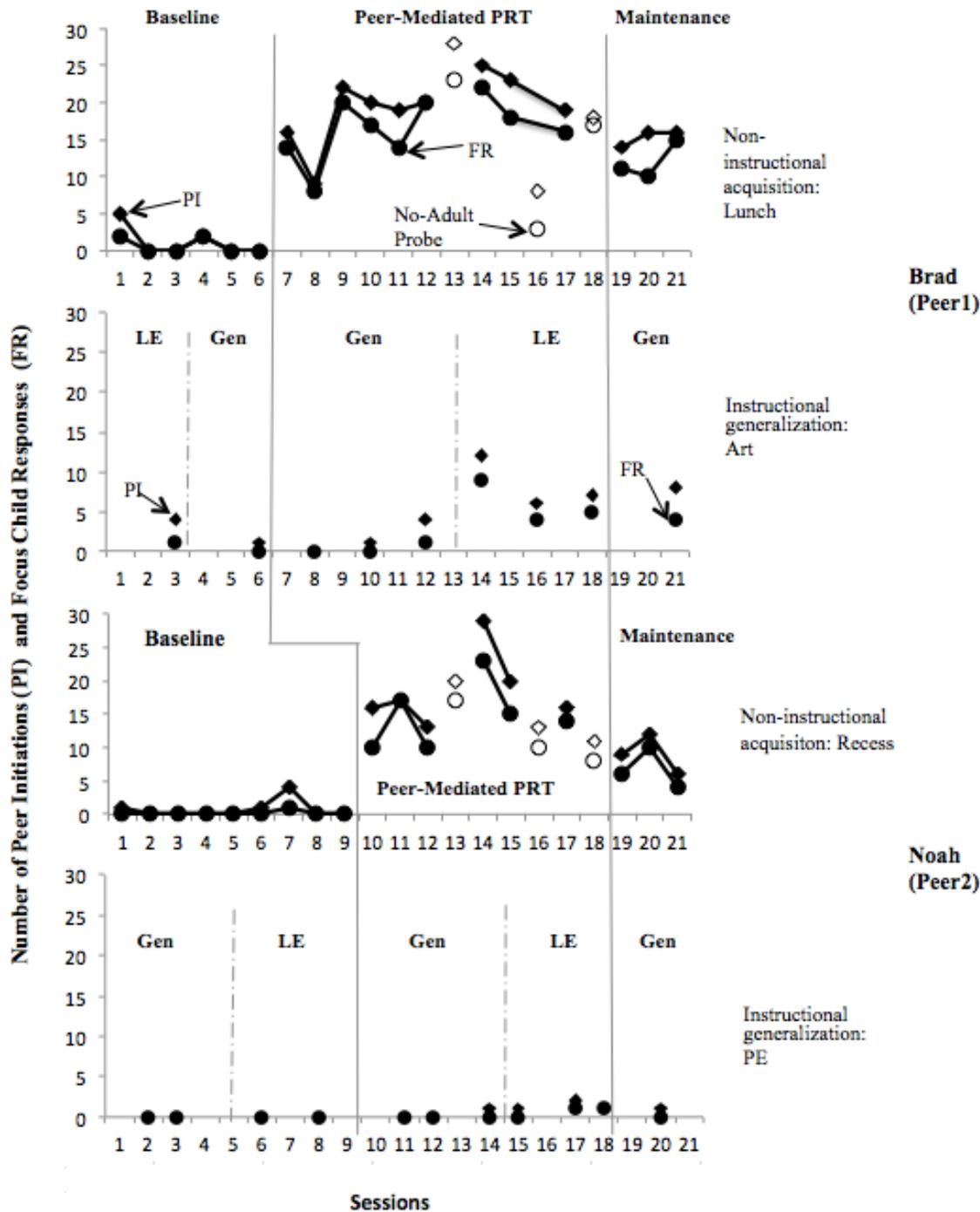
Figure 1. *The Frequency of Peers' Initiations and Focus Child's Responses*
The frequency of peers' initiations and focus child's responses within 10-min session probes. The first and third tiers represent non-instructional acquisition settings. The second and fourth tiers represent instructional generalization settings. PI, FR, Gen and LE represent peer's initiation, focus child's response, generalization probe, and low effort probe respectively. The open symbols represent no-adult-facilitation probes.

During peer-mediated intervention sessions at lunch, Tim also showed a high level of responses to Brad ($M = 17.33$, range: 10 to 23), and he maintained his responding during the no-adult-facilitation probes ($M = 16.33$, range: 3 to 29) and maintenance ($M = 12$, range: 10 to 15). During peer-mediated intervention at recess, Noah also immediately increased his initiations, as evidenced by an immediate increase and general upward trend before leveling off ($M = 19.33$, range: 15 to 29). Noah also maintained his level of initiations during the no-adult-facilitation probes ($M = 15.33$, range: 11 to 20). However, during maintenance at recess, the frequency of Noah's initiations decreased slightly ($M = 9$, range: 6 to 12), yet remained substantially higher than baseline sessions. This occurred because Tim and Noah voluntarily enjoyed physical activities (e.g., tag, soccer) with other peers across the playground, which may have created fewer opportunities for one-on-one social interaction during the three maintenance sessions. Tim's responses to Noah increased during the peer-mediated intervention sessions at recess ($M = 14.83$, range: 10 to 23). Due to the decrease in initiations, Tim's responses to Noah also decreased slightly during the no-adult-facilitation probes ($M = 7.67$, range: 5 to 10) and maintenance ($M = 6.67$, range: 4 to 10), yet remained high relative to baseline and in terms of the percentage of responding.

The second and fourth tiers in Figure 1 present the generalization of acquired social interaction skills to generalization settings that occurred concurrently with the first and third tiers, respectively. Generalization probes assessed whether the social interactions automatically generalized, and whether the LE strategy improved the generalization, to instructional settings. Researchers conducted probes in the generalization settings at the same time as the baseline observations in the non-instructional acquisition setting in order to assess whether peer-mediated PRT had an impact on social interactions in the generalization settings. Prior to peer-mediated PRT in the non-instructional acquisition settings, peer initiations and Tim's responses did not

occur or occurred at very low levels in both generalization settings (i.e., art and PE). Brad initiated one interaction during a generalization probe in the art class and Tim did not respond. Noah did not initiate interaction during probes in the generalization PE class before he was trained. Once the peers were trained and mediated PRT in non-instructional acquisition settings, Brad gradually generalized his social initiations at a low level ($M = 1.67$), but Noah still did not interact during generalization probes in the generalization setting. Before the peer training, Brad initiated four interactions with Tim during LE sessions in the art class and Tim responded once, and Noah did not initiate interaction during LE sessions in PE class. After the peers were trained and began implementing PRT in the non-instructional acquisition settings, Brad's initiations ($M = 8.33$) and Tim's responses ($M = 6$) substantially increased during LE generalization sessions in art class, demonstrating an interaction effect between the HE (i.e., peer-mediated PRT with more frequent adult facilitation prompts at lunch) and the LE generalization strategy (i.e., minimal prompting during art). Noah's initiations ($M = 1.33$) and Tim's response ($M = 0.66$), however, rarely occurred during LE sessions during PE, even after Noah was trained and implementing PRT during recess, thus failing to demonstrate an interaction effect and the generalization of their social interaction to the instructional PE setting.

Focus Child's Initiations and the Peers' Responses

Figure 2 depicts Tim's initiations and the peers' responses. The first and third tiers in Figure 2 show the results in non-instructional acquisition settings. During baseline in the lunch setting, Tim rarely initiated social interaction ($M = 0.33$, range: 0 to 1), but Brad responded to all of the interaction opportunities provided by Tim ($M = 0.33$, range: 0 to 1).
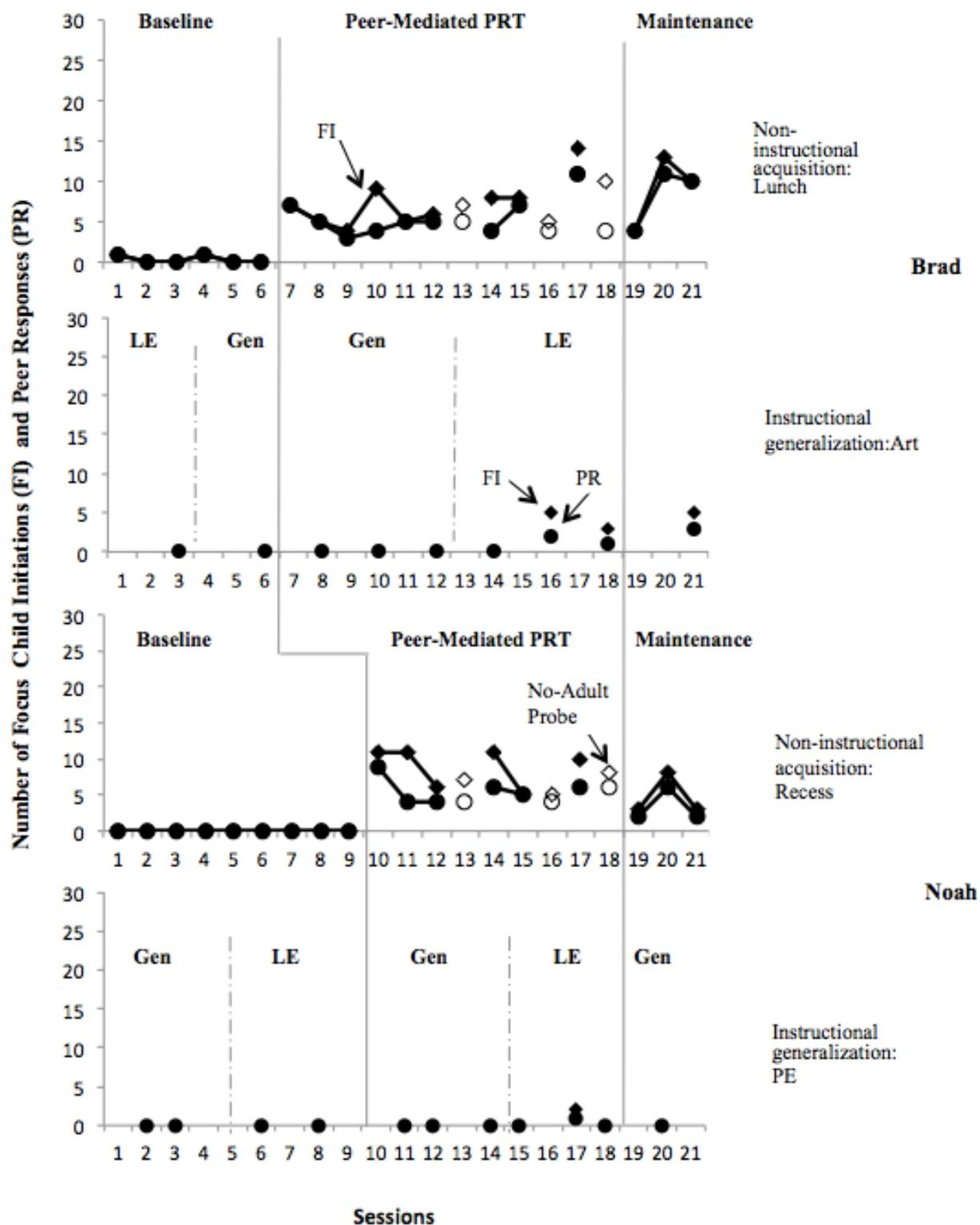
Figure 2. *The Frequency of Focus Child's Initiations and Peers' Responses*
The frequency of focus child's initiations and peers' responses are presented. FI and PR represent focus child's initiation and peer's response respectively.

After peer training, Tim and Brad demonstrated rapidly improved social interactions during the peer-mediated intervention at lunch. Tim immediately improved and increasingly initiated social interaction with Brad during intervention ($M = 7.22$, range: 3 to 14) and he maintained his initiations during the no-adult-facilitation probes ($M = 7.33$, range: 5 to 10) and maintenance ($M = 9$, range: 4 to 13). Brad responded to Tim with an increased level ($M = 5.66$, range: 3 to 11), and he maintained his responses during the no-adult-facilitation probes ($M = 4.33$, range: 4 to 5) and maintenance ($M = 8.33$, range: 4 to 11). In the recess setting, Tim did not initiate social interaction during baseline. During peer-mediated PRT at recess, Tim's initiations to Noah rapidly increased and remained fairly stable ($M = 6$, range: 6 to 11), and he maintained his initiations during the no-adult-facilitation probes ($M = 6.67$, range: 5 to 8) and maintenance ($M = 6.66$, range: 3 to 8). Noah responded to Tim with a mean of 5.67 occurrences per peer-mediated PRT session at recess (range: 4 to 9), and he maintained the number of responses during the no-adult-facilitation probes ($M = 4.67$, range: 4 to 6) and maintenance ($M = 3.33$, range: 2 to 6).

The second and fourth tiers in Figure 2 present the generalization of Tim's initiations and the peers' responses to instructional settings. Before the peers were trained to implement PRT at lunch and recess, neither Tim's social initiations nor the peers' responses occurred during generalization probes in the generalization settings. After the peers were trained to implement PRT at lunch and recess, Tim's increased social initiations in non-instructional acquisition settings (i.e., lunch and recess) did not automatically generalize to instructional generalization settings (i.e., art and PE) during generalization probes.

Before the peers were trained to implement PRT in the non-instructional acquisition settings, Tim and the peers' initiations and responses occurred at low levels or did not occur during LE sessions in the instructional generalization settings. Tim initiated only one interaction

during an LE session in the art class and Brad did not respond and did not initiate social interaction with Noah during LE sessions in PE class. After the peers were trained to implement PRT at lunch and recess, Tim's increased social initiations in the acquisition settings slightly generalized with the LE generalization strategy to only one generalization setting (i.e., art). Tim initiated social interaction with Brad in art class at lower levels than the acquisition setting (i.e., lunch), but at higher levels than the initial baseline probes in both settings ($M = 2.66$, range: 0 to 5), and Brad responded with a mean of one occurrence during each LE session. This demonstrates an interaction effect between HE implementation in the non-instructional acquisition settings and the LE prompting strategy in the instructional generalization setting. Tim rarely initiated with Noah during LE sessions in PE class ($M = 0.66$, range: 0 to 2) and Noah responded to Tim with a mean of 0.3 occurrences (range: 0 to 1), even after Noah was trained and implementing PRT (i.e., the HE implementation) in the non-instructional acquisition setting (i.e., recess), thus failing to demonstrate an interaction effect for the generalization of Tim's initiations using LE prompting in the generalization setting (i.e., PE).

Child Affect

Two dimensions of affect were scored for Tim and the peer mediators: interest and happiness. As Baker, Koegel and Koegel (1998) reported in their early work, the current study also showed a high correlation of the two dimensions. Therefore, following Baker and colleagues (1998), we averaged the two dimensions for each 10-min session. Scores of 3.4–5 indicated a positive score (very interested and happy), 1.7–3.39 indicated a neutral score, and 0–1.69 indicated a negative score (uninterested and unhappy). Figure 3 depicts the children's affect. The data show that the participants' affect ratings increased during peer-mediated interventions in acquisition settings. The increase in affect was maintained during the no-adult-facilitation probes

and maintenance in acquisition settings, and automatically generalized to one of the generalization settings (i.e., art).
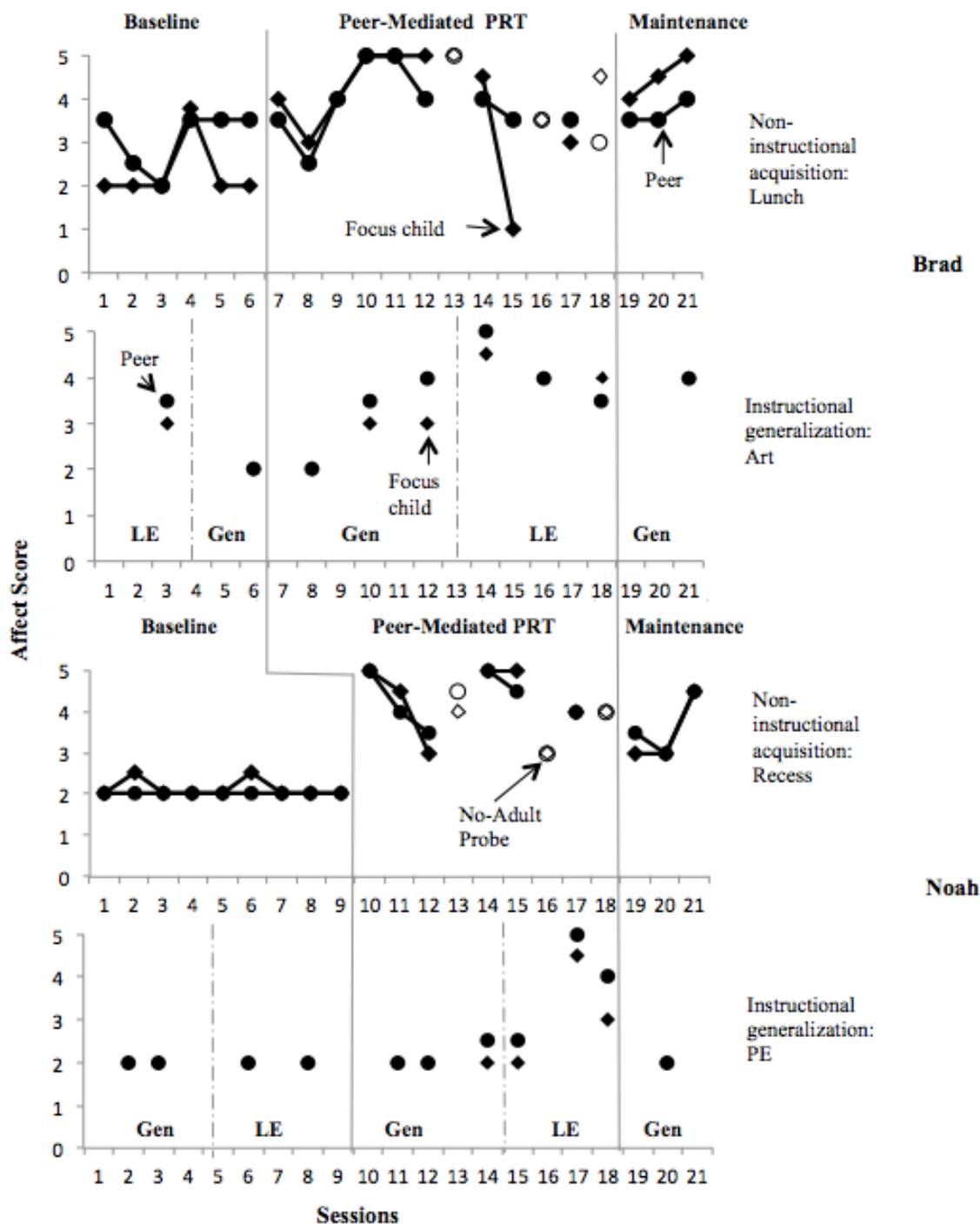

Figure 3. Affect Score for Focus Child and Peers
The focus child and his peer mediators' affect scores across all sessions and settings are presented.

In the lunch setting with Brad, Tim's average affect score was 2.29 (neutral) and Brad's was 3.08 (neutral) during baseline. During the peer-mediated PRT at lunch, Tim's average affect score was 3.83 (positive) and Brad's was 3.89 (positive). During no-adult-facilitation probes at lunch, Tim's average affect score was 4.33 (positive) and Brad's was 3.83 (positive). The increased affect scores also maintained in the lunch setting, where Tim's average score was 4.5 (positive) and Brad's was 3.67 (positive). During recess with Noah, Tim's average affect score was 2.1 (neutral) and Noah's was 2 (neutral) during baseline. During the peer mediated PRT at recess, Tim's average affect score was 4.42 (positive) and Noah's was 4.33 (positive). During no-adult-facilitation probes at recess, Tim's average affect score was 3.66 (positive) and 3.83 (positive) for Noah. These increased scores were also maintained at recess, where Tim's average score was 3.5 (positive) and Brad's was 3.67 (positive).

During probes in instructional generalization settings, before the peers were trained to implement PRT in the acquisition settings, Tim's affect score was 2 (neutral) and Brad's was also 2 (neutral) in the art class. Tim's average score was 2 (neutral) and Noah's was 2 (neutral) in the PE class. The scores gradually increased or remained the same after the peers were trained and began implementing PRT in the non-instructional acquisition settings. Tim's average score was 2.67 (neutral) and Brad's was 3.17 (neutral) during generalization probes in art. Tim's average score was 2 (neutral) and Noah's was 2.16 (neutral) in PE. During LE sessions in generalization settings, before the peers were trained and began implementing PRT in the acquisition settings, Tim's score was 3 (neutral) whereas Brad's was 3.5 (positive) in art class. Tim's average score was 2 (neutral) and Noah's was also 2 (neutral) in PE class. The affect scores, however, increased when the LE strategy was mediated in the generalization settings, but only after the peers began implementing PRT in the acquisition settings. In art class, Tim's average score was 4.17 (positive) and Brad's was 4.17 (positive) during LE sessions. Similarly, Tim's average score was 3.17

(neutral) and Noah's was 3.83 (positive) in PE. These data suggest an interaction between the HE PRT implementation at lunch and recess (i.e., non-instructional acquisition settings) and LE prompting strategies during art and PE (i.e., instructional generalization settings) on child affect. In the maintenance phase, the affect scores for Tim and Brad during generalization probes in art class remained positive.

Discussion

Peer-mediated PRT effectively increased the social interactions of a child with autism and his peers during non-instructional times of the school day, specifically lunch and recess. Results from this study support previous research indicating increases in social interaction from baseline levels during peer-mediated PRT (Pierce & Schreibman, 1995, 1997; Kuhn et al., 2008). Prior to the peer implementation of PRT, Tim demonstrated a low level of social interaction in both non-instructional and instructional settings. Once peers were trained and the peer-mediated PRT was introduced at lunch and recess, Tim's social interaction immediately increased in those non-instructional settings. Notably, their interactions developed with the decreased numbers of researcher's prompts to peers, which might indicate they engaged in more frequent voluntarily interactions (i.e., from the mean of 6 times in the first three sessions to the mean of 3 times in the last three sessions). Although the number of interactions seemed to slightly decrease during the no-adult-facilitation probes and maintenance, social interactions were maintained at an increased level relative to baseline. Importantly, during intervention we found that Tim's initiations increased toward peers, despite the fact that peers and facilitators did not directly teach Tim to initiate. Collateral increases in initiations may indicate that the peers successfully mastered PRT aimed at motivating Tim to interact.

The LE generalization strategy was somewhat effective for the generalization of Tim and Brad's acquired interaction skills in the art class setting. The low invasive prompting strategy

helped Brad facilitate the generalization of interactions from the lunch setting to art class, even thought the prompts to peers were provided only 1-2 times across LE sessions. This generalization allowed Tim to practice interaction more frequently and extend his developing friendship with Brad across educational contexts. However, the same generalization did not occur for Tim and Noah in the PE setting. This limited generalization seemed to be due to the PE class being structured in a way that discouraged interaction. Instead, PE was focused on physical activity and following a strict set of rules. Anecdotally, most students did not interact during PE, even though we expected frequent informal interaction. Further, Tim and Noah rarely had proximity to appropriately interact in PE. In contrast, during art students were informally allowed to interact for independent work following the teacher's instructions. Students could help and comment on each other's work during that time. This result is meaningful because interaction in some instructional contexts might be less relevant to those classes' main goals (e.g., music, PE). Future research on generalization of social interaction skills across school contexts should establish peer comparison data in each setting to show relative levels of interaction.

Researchers should consider investigating contextual/cultural differences across school settings in which social interaction is differently accepted and valued (Chan et al., 2009). Future research might also investigate the diverse school contexts in which social skills interventions may contribute directly to the achievement of educational goals (e.g., math; Schmidt & Stichter, 2012). Furthermore, because the current study found varied results for the interaction effect (i.e., HE/LE), future studies might investigate additional strategies for setting generalization. For example, interventionists may consider collaborating more closely with teachers in order to arrange instructional contexts to be more conducive to social interaction, particularly in terms of proximity. The use of pre-teaching strategies, such as LE with video-modeling or self-management, or specific efforts to train the peers with respect to the generalization contexts, may

also improve generalization of interaction skills. However, such additions may be more invasive and require greater effort to produce the desired generalization effect.

As Figure 3 indicates, both Tim and his peers' affect increased positively, showing improved interest and happiness following the peer-mediated intervention, which maintained without adult facilitation. Although the generalization of social behaviors varied, positive child affect generalized, particularly during the LE sessions. The children learned how to play with mutually interesting items/themes and naturally reinforced each other for positive interactions during the acquisition sessions, which may have helped to maintain interaction and promote positive social relationships (Baker et al., 1998). The positive results in child affect, along with the social validity results reported by teachers, suggest that the intervention was meaningful and socially valid. This study demonstrated that increases in socialization at recess/lunch did not adversely impact Tim or his peers' affect during instructional portions of the day, which may be a concern of some educators (Lang et al., 2011). Researchers also found anecdotal improvements in the interaction quality over the course of intervention, whereby later interactions indicated the development of meaningful relationships. For example, Tim began appropriately joking with Noah and even once shared that he was having a bad day because he had hurt himself. Importantly, one of the highest quality interactions occurred during a generalization probe. During art (i.e., an instructional generalization setting), Brad invited Tim to his birthday party, Tim accepted, and then they began discussing birthday party activities. Future studies should analyze quality changes related to behavioral indicators of friendship development, as well as examine how social interactions carry over from PRT opportunities to more informal natural interactions. Moreover, researchers should evaluate the additive role the motivational PRT components have on general peer-mediated interventions that do not include PRT components.

Challenges related to recruiting an additional peer (i.e., classmates) and additional students with autism who were included in general education limit this study. This study showed two demonstrations of a main intervention effect with only one participant with autism; however, three demonstrations are the standard to infer a functional relation between the intervention and dependent variables (Kratochwill, et al., 2010) and three participants with autism would have been ideal (Horner, et al., 2005). Therefore, our ability to infer a functional relation between the peer-mediated PRT and the acquisition of social interaction is limited. Lack of an additional demonstration of an effect is somewhat mitigated by the immediacy of the effects for both peers and the richness of the generalization data collected, which was the primary concern of this study. The results add preliminary evidence to the limited literature on generalization of social interactions across natural settings, particularly inclusive school contexts.

Furthermore, data were collected only on the interactions between Tim and the peer mediators, and not on the interactions between Tim and other peers with whom Tim might have interacted. The ultimate goal of this intervention was to promote Tim's socialization across his natural educational environments, so we did not prevent interaction between Tim and other peers. However, anecdotally, Tim had few additional interactions beyond those that were recorded, particularly during baseline. Future research might assess the role of including several peers or groups of peers from the focus child's classroom as peer mediators. Research should evaluate the benefits of either focusing on a few peers versus many peers. Additionally, future research should evaluate whether the increased socialization generalizes to untrained classmates.

Lastly, this study did not measure the long-term maintenance of the intervention. Long-term maintenance was not assessed due to the termination of the school year. Because the teachers indicated in the social validity questionnaire that the intervention would likely produce permanent effects and they would be willing to use the intervention in the future, further research

might assess the generalization and maintenance effects by using natural adult facilitators, instead of researchers. For instance, various school personnel such as teachers, para-educators, or lunch monitors could be coached to facilitate in the varied settings (e.g., Robinson, 2011).

Despite these limitations, the findings of this study add to the previous findings on the use of peer-mediated PRT for improving the socialization of children with autism in inclusive school settings. We found that peer-mediated PRT improved the acquisition and maintenance of socialization of a child with ASD in his inclusive educational settings. Although the LE generalization strategy was only partially successful, it is noteworthy that the child with autism exhibited high levels of responding to peer mediators across generalization settings, and that the focus child's initiations indirectly increased without being directly targeted by peers or adults. The current study adds to the literature by evaluating the use of recess/lunch as primary intervention contexts, as well as the generalization of social interaction across educational situations so that included students with autism have frequent opportunities to interact meaningfully and positively with their peers throughout the school day.

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