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Effectiveness of a low-intensity peer-mediated intervention for middle school students with autism spectrum disorder

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ABSTRACT

Background: Peer-mediated interventions (PMI) are used to promote social interactions and academic engagement between individuals with autism spectrum disorder (ASD) and their peers. Most PMI research has been conducted with preschoolers and students in the early elementary grades. There is a need for additional research examining the effectiveness of low-intensity PMI for older students.

Method: This study used a non-concurrent multiple-baseline, multiple-probe across participants design to investigate the effectiveness of a low-intensity PMI on engagement and communicative acts for middle-school aged students with ASD during lunch breaks at school. Nine typically developing peers received 40–50 minutes of peer coach training. Peer coaches were encouraged to interact with their classmate with ASD during lunch breaks at school, using the strategies they learned. They were provided with brief feedback and/or praise after each probe observation during intervention and follow-up.

Results: Results showed a functional relation between the intervention and both engagement and communicative acts, with three demonstrations of effect across participants. Indicators of mutual enjoyment were observed for the majority of probe observation sessions across groups. There was some maintenance of effect at 1–4 weeks follow-up. Social validity was high for both peer coaches and classroom teachers.

Conclusions: This study contributes to and extends the existing PMI research by including middle school students with varying intellectual and social-communication abilities. Schools may be more likely to adopt evidence-based interventions such as the one used in this study if they are also efficient.

1. Effectiveness of a low-intensity peer-mediated intervention for middle school students with autism spectrum disorder

Peer-mediated interventions (PMIs) focus on training typically-developing peers to support peers with disabilities in a variety of settings (e.g., classrooms, playgrounds). There is a growing body of research demonstrating the effectiveness of this approach for increasing social interactions and academic engagement for students with autism spectrum disorder (ASD) in school settings (Bene, Banda, & Brown, 2014; Chang & Locke, 2016; Watkins et al., 2015). Teaching peers to interact with classmates with ASD is also a socially valid and practical approach for social skills development in a school setting (Chan et al., 2009). PMI is well-suited for use in school settings as it can be incorporated into natural routines within the classroom (2017, Carter et al., 2016) or other environments in the school (e.g., cafeteria, library; Bambara, Cole, Kunsch, Tsai, & Ayad, 2016; Hochman, Carter, Bottema-Beutel, Harvey, &

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Gustafson, 2015).

The authors of three reviews summarized and evaluated the existing PMI research for students with ASD and other developmental disabilities. In 2009, Chan and colleagues found 42 PMI studies that met their inclusion criteria. The studies included a wide range of dependent variables, including academic skills and reduction of disruptive behaviours as well as social skills. Chang and Locke (2016) evaluated PMI research that utilized group designs. They focused on studies with social interaction goals for students with ASD and found a total of five studies. Watkins et al. (2015) found 14 PMI studies published after the Chan et al. review that met their inclusion criteria. The focus of this review was to evaluate the effectiveness of PMI as an intervention to improve social interaction skills of students with ASD in inclusive settings. Chan et al. and Watkins et al. identified three strategies that are commonly taught to peers in PMI research – initiation (e.g., Hughes et al., 2013; Schmidt & Stichter, 2012), prompting (e.g., Hughes et al., 2011) and reinforcement (e.g., Hughes et al., 2011; Loftin, Odom, & Lantz, 2008). In addition, the authors of all three reviews concluded that PMI is a promising intervention for promoting social interaction between students with ASD and their peers and encouraged ongoing research, especially with diverse samples (Chang & Locke, 2016). They noted that PMI has the potential of reducing demands on school staff (Chan et al., 2009) and promoting generalization of skills across peers and/or settings (Watkins et al., 2015). The majority of practitioners, students with ASD and typically developing peers who have participated in PMI research have reported high levels of satisfaction with the intervention (Watkins et al., 2015).

The review authors made a number of recommendations for future research, including the need to include more diverse participants in terms of age and cognitive ability. In particular, they noted a lack of research evaluating the effectiveness of PMI interventions with middle or high school students. Indeed, only 11 out of 60 studies across the three reviews (approximately 18%) included participants who were 11 years old or older. In addition, the majority of participants did not have an intellectual disability and were often noted to be "high-functioning." It is important that research reflect the wide spectrum of ASD, as it cannot be assumed that an intervention that is effective with preschool or elementary-aged children with ASD will be effective with adolescents, nor can it be assumed that an intervention that is effective with individuals who do not have an intellectual disability will also be effective with those who do.

The intensity of peer training has also varied considerably across PMI research for middle and high school participants. Intensity has ranged from one, 20-minute training session (Hughes et al., 2013) to six, 40-minute training sessions plus six, 40-minute follow-up sessions (Schmidt & Stichter, 2012). Interestingly, the results of most published research with middle and high school students – regardless of the length of peer training – indicates that PMI had a significant, positive impact on participants' social interaction skills. If the goal is to increase evidence-based interventions for students with ASD in schools, it is important to identify efficient and effective interventions that can be readily adopted by school teams.

The purpose of this study was to examine the effectiveness of a low-intensity intervention for middle-school aged students with ASD. Inclusion criteria allowed for participants with a range of cognitive ability and social-communication abilities. In addition, the intervention occurred during lunch breaks rather than during structured classroom times. The primary research question in this study was: Is there a functional relation between a low-intensity PMI and increased engagement and communicative acts of middle-school aged youth with ASD during school break time? Secondary questions examined the extent to which (a) changes in engagement and/or communicative acts were maintained at 1–4 week follow-up, (b) behaviours indicating mutual enjoyment (i.e., shared eye contact, smiling, laughing) were evident for peer coaches and students with ASD; and (c) peer coaches and teachers rated the intervention as socially valid.

2. Method

The study was conducted in accordance with the guidelines of the Declaration of Helsinki as revised in 2000 (World Medical Association, 2013). Ethics approval was secured from the authors' Institutional Review Board and from the administrative team of the school where the study was conducted. Informed consent was obtained from all adults in the study and from the parents of participants with ASD and peer coaches; assent was also obtained from both groups of students, when possible. All participant names are pseudonyms.

2.1. Inclusion criteria

Three groups of participants were recruited for this study: classroom teachers, students with autism spectrum disorder (ASD), and peer coaches.

2.1.1. Classroom teachers

Classroom teachers were identified by the school's Education Support Services Coordinator as having a student with ASD who met the study criteria as a member of their class. There was no other criterion for classroom teachers.

2.1.2. Students with ASD

Inclusion criteria for students with ASD were as follows: (a) ages 11–15; (b) diagnosed with ASD through an independent assessment by an experienced multidisciplinary team; (c) enrolled in the same grade level classroom as typically developing students of the same chronological age, with an adapted or modified curricular program; (d) low social engagement with classmates; and (e) social-communication goals identified on an individualized education plan (IEP). Students were excluded if they had a history of significant problem behaviour that might interfere with participation due to safety concerns.

2.1.3. Peer coaches

Peer coaches were members of the same classroom as a student with ASD. Each classroom teacher was asked to nominate 2–4 students who met the following criteria: (a) previous expression of interest in interacting with their classmate with ASD and (b) strong social skills. Exclusion criteria included (a) a history of significant problem behaviour that might interfere with participation due to safety concerns and/or (b) a teacher's perception that participation might be disruptive to their own academic or social functioning at school. Teachers were given flexibility regarding the number of peer coaches who were nominated in order to accommodate the overall needs and composition of each classroom.

2.2. Participants

Three groups of participants, each in a different middle school classroom in the same school, participated in the study.

2.2.1. Group 1: Stuart

Group 1 included a grade 6 classroom teacher with 5 years of teaching experience; two peer coaches; and Stuart, a student with ASD. Both peer coaches, one girl and one boy, were 11 years old and spoke fluent English. Stuart was a 12-year old Chinese-Canadian boy whose primary language was English; his family sometimes spoke Cantonese at home. He was on a modified academic program across all grade 6 subjects and participated in most classroom activities with support from a full-time 1:1 educational assistant (EA). He communicated verbally and was able to make a variety of requests and comments, using 1–4 word phrases and full sentences with prompting. Stuart had limited conversational skills, particularly with peers; he would often answer questions but rarely reciprocated with follow-up questions or comments. Stuart was able to follow daily routines at school and needed only minimal support with daily living skills. On the Leiter International Performance Scale, 3rd edition (Leiter-3; Roid, Miller, Pomplun, & Koch, 2013), Stuart achieved a nonverbal IQ score of 100 (50th percentile). Stuart's classroom teacher identified a variety of preferred break-time activities, including Lego, comic books, and computer use.

2.2.2. Group 2: Thomas

Group 2 consisted of a grade 7 classroom teacher with 7 years of teaching experience; four peer coaches; and Thomas, a student with ASD. All four peer coaches were 12-year old boys who spoke fluent English. Thomas was a 12-year old Chinese-Canadian boy whose primary language was English; his family sometimes spoke Cantonese at home. He was on a modified academic program across all grade 7 subjects. Although he was a member of the grade 7 classroom, he spent approximately 80% of the school day in a resource room or learning skills in the community, where he was engaged in individualized instruction (e.g., grocery shopping) and/or programming related to behaviour management (e.g., functional communication training for the reduction of disruptive behaviour). Thomas had full-time support from a 1:1 EA. He communicated using 1–4 word requests and had limited conversational skills (e.g., he did not typically reciprocate questions or comments). Thomas required verbal support to complete daily living skills such as dressing. On the Leiter-3, Thomas achieved a nonverbal IQ score of 49 (< 0.1 st percentile). Thomas' classroom teacher identified swings as his most preferred break time activity, with few alternatives.

2.2.3. Group 3: Alexander

Group 3 consisted of a grade 8 classroom teacher with 5 years of teaching experience; three peer coaches; and Alexander, a student with ASD. All three peer coaches were 13 year old boys who spoke fluent English. Alexander was a 13 year old Chinese-Canadian boy whose primary language was English; his family sometimes spoke Cantonese at home. He was on an adapted or modified academic program across all grade 8 subjects and participated in most classroom activities with support from a full-time 1:1 EA. He was able to complete some academic tasks at grade level with support, while other tasks required significant modification (e.g., reading comprehension). Alexander spent between 10%–30% of the day outside of the general education classroom; the amount varied depending on his academic schedule and the occurrence of minor problem behaviour. Alexander communicated verbally and was able to make a variety of requests and some comments about the immediate environment and events. He had limited conversational skills, rarely initiated communication with others, and sometimes engaged in scripted communication. Alexander was largely independent with daily routines at school with some visual supports (e.g., schedules and social stories). On the Leiter-3, Alexander achieved a nonverbal IQ score of 100 (50th percentile). His classroom teacher identified a wide range of preferences for break activities, including basketball.

2.3. Settings

The study took place at a private middle school located in a metropolitan suburb in Western Canada. Approximately 53% of the population living in this municipality identify as ethic Chinese (Statistics Canada, 2017), and many of these families send their children with ASD to private schools such as the one involved in this study. Training sessions for peer coaches took place in empty classrooms during lunch break (i.e., students who were not participating in the study were not present during training). Baseline and intervention sessions took place during lunch breaks in natural environments that included the school yard, the library, and an indoor common area. During lunch break, all ˜245 students in the school ate lunch and then had free time afterward; typically, the free time period was approximately 30 min long and was supervised by 4–5 educational assistants, teachers, and/or parent volunteers. The school yard had a climbing structure, swings, picnic tables, sports equipment, basketball hoops, paved areas, and a grass field. The library was open to students during lunch break and indoor games and toys were made available (e.g., Lego, decks of cards, board

games, iPads etc.). The common area included tables, benches, a ping pong table, and a foosball table.

2.4. Dependent variables

The primary dependent variables included the percentage of 30 s intervals during a 10 min free time observation period with (a) engagement between a participant with ASD and at least one peer, and (b) communicative acts (both initiations and responses) by a participant with ASD toward a peer. Engagement was scored for an interval when a participant with ASD and at least one peer (a) participated together in an activity that required two or more people (e.g., playing catch, tag, or basketball); or (b) shared materials or took turns during an activity (e.g., building a Lego structure, watching a YouTube video together, taking turns on a swing). When a participant and peer coach engaged in a parallel activity (e.g., swinging next to one another), engagement was counted only if a communicative act occurred during the same interval. Communicative acts (CAs) included unprompted gestures (e.g., high-fives, waves), facial expressions (e.g., eye contact and smiling), verbal utterances, or vocalizations by a participant with ASD. A CA was coded as an initiation if it was not contingent on a peer's immediately prior CA (i.e., it occurred at 5 s or more following the peer's CA). A CA was coded as a response if it was contingent on a peer's immediately prior CA.

Secondary variables included (a) the presence of an indicator of mutual enjoyment between a peer coach and a participant with ASD during the 10 min observation period and (b) teacher and peer ratings and comments on a social validity survey. Mutual enjoyment behaviours included smiling, eye contact, and laughing and was scored if both the participant and at least one peer coach were observed engaging in a behaviour during a lunch break session. Teacher and peer social validity surveys had 10 items each and participants were asked to rate each item on a 4-point Likert-type scale where 1 = strongly disagree and 4 = strongly agree. Comments were also invited via an open-ended question at the end of each survey. Peer coaches completed the social validity survey following the intervention phase and teachers completed the survey following both the intervention phase and follow-up phases. Although classroom teachers did not collect observational data during the intervention or follow-up phases, they all had naturally occurring opportunities to observe the participants with ASD and peer coaches during lunch breaks. In addition, they interacted regularly with other lunch break supervisors and with the participants themselves. Teachers were asked to complete the social validity survey based on these informal observations and interactions.

2.5. Measurement

All observations were 10 min in duration and took place during a lunch break free time period at the school. Each 10 min observation session was divided into 30 s intervals and partial interval recording was used. In general, an observation session began as soon as a participant with ASD completed the transition from the cafeteria where he ate lunch to the setting he chose for free time. The exception was Thomas, who ate slowly on the first two days of intervention. On those two days, the observation began 10 min prior to the end of the lunch break period, while he was still eating in the cafeteria.

The first author was the primary observer; two research assistants acted as secondary observers for inter-rater agreement. Observers remained as unobtrusive as possible and minimized interactions with the participants and other students who were in the same setting at the time of the observation (i.e., they did not initiate any interactions but would politely and briefly respond if a student spoke to them). Observers wore an earbud in one ear and were alerted to the start of each interval through a pre-recorded electronic signal. Data were collected in vivo, using paper and pencil data sheets.

Peer engagement was coded by recording occurrence or non-occurrence for each 30 s interval. Percentage of peer engagement was calculated by dividing the total number of intervals by the total number of occurrences and multiplying by 100. CA initiations and responses were coded separately. Observers recorded the occurrence or non-occurrence of CAs for each 30 s interval. Percentage of initiations was calculated by dividing the total number of intervals by the total number of occurrences and multiplying by 100. Percentage of responses was calculated using a parallel procedure. Observers recorded mutual enjoyment for each 10-minute break time session by indicating whether or not an indicator behaviour occurred (Yes or No) for both the participant with ASD and at least one peer coach.

2.6. Inter-observer Agreement (IOA)

Two research assistants (RAs), blind to both the purpose of the study and the experimental phase, were trained to collect reliability data. During training, they were provided with a written manual with operational definitions of the dependent variables and protocols for observation and coding; data sheets; and an electronic signal for interval recording. They practiced coding data using break time videotapes of children who were not involved in the study. The videos included both indoor and outdoor play activities. Training continued until each RA achieved at least 90% accuracy for all dependent variables across three consecutive video sessions.

IOA data were collected for 55.7% of observation probes across randomly selected baseline, intervention, and follow-up sessions from different participants. IOA was obtained for engagement, responses, and initiations using interval-by-interval recording. Agreement occurred when both observers recorded either occurrence or non-occurrence for a specific interval. Total agreement was divided by the total number of intervals and multiplied by 100. Agreement for mutual enjoyment occurred when both observers recorded Yes or No for the same behaviour (e.g., smiling) for a 10-minute session Total agreement was divided by the total number of behaviours and multiplied by 100.

Overall, IOA across groups was 97.5% for engagement (range: 85%–100%), 89.2% for responses (range: 60%–100%), 98.3% for initiations (range: 95%–100%), and 95.1% for mutual enjoyment (range: 67%–100%). One low score for responses (60%) occurred

during the first observation probe for one of the two RAs. During this observation, the RA wore two earbuds with the volume turned up high for the interval beep; this affected her ability to hear the responses of the student with ASD. Subsequently, observers either wore only one earbud or turned the volume low so that they could hear both CAs and the interval beep. One additional low score for responses (75%) and two low scores for mutual enjoyment (67%) are representative of the difficulty in collecting accurate in-vivo data in a natural environment like a loud and busy playground.

2.7. Implementation fidelity

Peer coach implementation fidelity was assessed during each 10-minute observation in the baseline, intervention, and follow-up phases. An implementation checklist listed the five key strategies taught during the peer coach training phase, and observers placed a check mark next to each strategy that was used at least once by at least one of the peer coaches during the observation (see Appendix A). Peer coaches were provided with brief feedback after each session, with specific reference to the strategies that were used and/or not used.

Implementation fidelity during baseline was 0% across all groups (i.e., none of the peer coaches used any of the strategies during this phase). During intervention and follow-up combined, fidelity across strategies was 95% for Stuart's peer coaches (range: 50%–100%); 85% for Thomas's peer coaches (range: 56%-100%), and 71% for Alexander's peer coaches (range: 44%–80%). Scores less than 80% occurred for two of the strategies, TALK: prompt communicative acts (Groups 2 and 3) and TALK: praise/compliment the student with ASD (Groups 1 and 3). The remaining three strategies – DO: initiate/join in an activity, HELP: prompt engagement in the activity, and TALK: initiate communicative acts – were used by at least one peer coach during 80% or more of sessions.

2.7.1. Inter-observer agreement

IOA for implementation fidelity was calculated by adding total agreement (strategy used or not used during the observations) for each strategy, dividing by total agreement plus disagreement, and multiplying by 100. IOA across strategies was 100% for Stuart's peer coaches; 96% for Thomas's peer coaches (range: 80%–100%), and 88% for Alexander's peer coaches (range: 60%–100%). The single low score for Alexander's coaches occurred during a session in which he and his peers moved around the playground rapidly (playing basketball), making it difficult for both observers to hear CAs when they occurred.

2.8. Effect size

There is considerable debate about how to assess effect size in single-case research, and numerous methods have been developed for this purpose (see Parker, Vannest, & Davis, 2011 for a review). We elected to calculate Improvement Rate Difference (IRD; Parker, Vannest, & Brown, 2009), one of the most commonly used and interpretable methods, as an index of behaviour change from baseline to intervention and from intervention to follow-up. IRD is the change in percent of high, or "improved," scores between phases; for example, an improved score in the baseline phase (A) is one which is above some of the intervention phase (B) scores, and a low score in B is one that is below some A scores. If all B scores are above A scores, IRD is 1.00. If the scores in A and B are the same, IRD equals zero (see Parker et al., 2009, for IRD calculation instructions). Parker et al. determined general effect categories for IRD scores as follows: IRD at about 0.50 or lower signifies small or questionable effects; between 0.50 and 0.70 suggests moderate effects; and at around 0.70 or higher are large or very large effects.

2.9. Research design

This study employed a non-concurrent multiple-baseline, multiple-probe across participants design (Horner & Baer, 1978; Watson & Workman, 1981). Although the baselines were non-concurrent, the entire study took place over a 3-month period, with all three groups of participants starting baseline within a 4-week period. Participants were randomly assigned a baseline length of 4, 6, or 8 days, per the conventions of the non-concurrent baseline design (Barlow, Nock, & Hersen, 2009; Watson & Workman, 1981). Such randomization makes it highly unlikely that changes in behaviour occurring at the point of intervention can be functionally related to a variable other than the treatment, given that intervention is implemented at pre-determined and random points of time.

2.10. Procedures

2.10.1. Initial assessments

The Leiter-3 (Roid et al., 2013) was administered to all participants with ASD at the start of the project to assess nonverbal intelligence and general cognitive ability. The test is completely nonverbal, making it particularly useful for assessing individuals who are minimally verbal and/or have a cognitive delay. A psychometrist experienced in administering the Leiter-3 with children and youth with ASD conducted the assessment with each participant during school hours in a quiet room at the child's school.

In addition, a school-specific preference inventory was developed by the first author and provided to classroom teachers to identify preferred activities for each student with ASD. The inventory included a list of age-appropriate activities that were available to all students during the break periods at the school where the study took place. Teachers were asked to identify activities in which the student with ASD in their classroom engaged, both regularly and occasionally.

2.10.2. Baseline

Baseline sessions took place during lunch break times at school and were of randomly-assigned, pre-determined lengths. Observation probes were conducted in the break time location selected by the student with ASD each day. Peer coaches were not provided with training or feedback during baseline.

2.10.3. Peer coach training

The first author provided training to each group of peer coaches during two 20–25 minute sessions that occurred during lunch breaks at the school; participants with ASD were not present for training sessions. All three of the common strategies identified by Chan et al. (2009) and Watkins et al. (2015) were introduced to peer coaches during training and were labeled DO, HELP, and TALK. The DO strategy required peer coaches to initiate an activity with their classmate with ASD that would be fun for everyone. Peer coaches could either join in an activity their classmate was already doing (e.g., "I'm going to read comics with you") or provide activity choices. The HELP strategy taught the coaches how to recognize when their classmate with ASD required assistance and how to provide it. Specifically, peer coaches learned to prompt engagement in activities by (a) telling or showing their classmate how to engage in the activity; (b) taking turns with their classmate; and/or (c) giving choices. The TALK strategy included three ways to provide verbal feedback for engagement and to prompt communication: (a) prompt a CA by repeating questions or offering a choice; (b) use positive, enthusiastic language (i.e., praise) and compliments; and (c) talk about the current activity or ask questions about it.

Behaviour skills training (BST; Miltenberger, 2004) was used to teach each strategy. Peer coaches were provided with a one-page hand-out describing the strategies. For each strategy, the researcher provided a brief description, modelled two to three examples of its application, provided each peer coach with opportunities to role play the strategy, and provided feedback. Corrective feedback was provided when a peer coach omitted a component of a strategy during a role play (e.g., did not provide a choice when initiating an activity); that coach then repeated the role play until the strategy was executed correctly. The role plays were conducted using mutually preferred activities that were identified on the student preference inventory completed by each group's teacher. For example, one group of peers role played each of the strategies in the context of playing basketball; another group of peers role played each of the strategies while playing Lego or reading comic books.

Peer coaches were instructed to use the strategies during lunch break times with their classmate with ASD. They were asked to work as a team to make sure their classmate had someone to engage with during each lunch break. However, no guidelines were provided for how they might structure these interactions on a day-to-day basis or who would play with the student each day. Peer coaches were reminded that their own enjoyment during lunch breaks was important as well. They were also encouraged to include other peers, as appropriate. No additional group training was provided.

2.10.4. Intervention

The conditions for intervention were the same as during baseline, except that the first author provided brief verbal feedback and praise to the peer coaches either following each probe session or prior to the next one. Feedback included reminders to use the strategies. Verbal praise included specific examples of strategies used well. The feedback for peer coaches following a probe with 0% implementation fidelity was a brief reminder to use the strategies. The intervention phase was discontinued when a participant with ASD achieved (a) 70% or higher engagement and (b) either 70% or higher total communicative acts OR no increase in communicative acts across three consecutive probes. Social validity questionnaires were completed by peer coaches and classroom teachers at the end of the intervention phase.

2.10.5. Follow-up

No additional peer training or feedback occurred between the intervention and follow-up phase. Follow-up probes were obtained 5–18 school days post-intervention. Conditions were similar to intervention, except that peer coaches were provided with brief praise but no other feedback following each probe session. Social validity surveys were completed by classroom teachers at the end of this phase.

3. Results

The purpose of this study was to investigate the effectiveness of a low-intensity PMI intervention on the social-communication behaviours of middle-school students with ASD during lunch breaks. The following sections describe the results for engagement with peers, CAs, mutual enjoyment, and both peer coach and teacher social validity.

3.1. Engagement

Fig. 1 displays the results for engagement for Stuart, Thomas, and Alexander. Lower-case letters next to each data point are used to identify peer coaches. In addition, because the study was conducted in the natural environment of a school, classmates who were not trained as peers sometimes joined a participant with ASD and his peer coach(es) during an activity (e.g., in a game of basketball, or while watching a YouTube video). The presence of untrained peers was noted by the observers and is indicated by asterisks in Fig. 1.

3.1.1. Group 1: Stuart

Two peer coaches (peers -a and -b) were trained to interact with Stuart. No peers (including coaches) engaged with him during

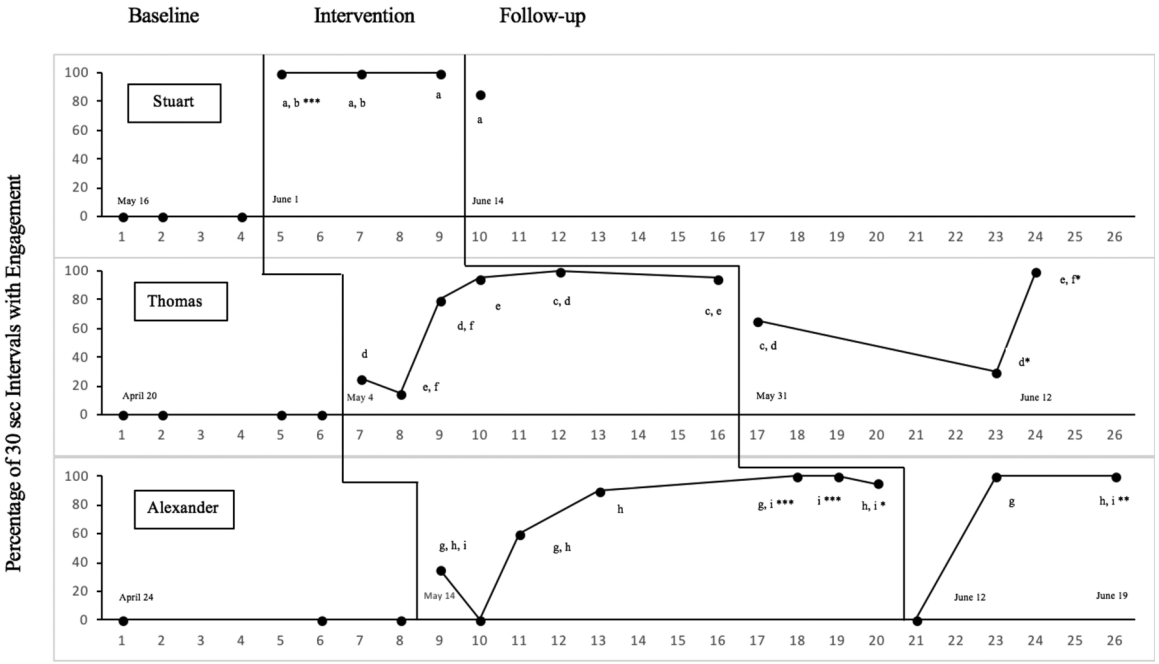

Fig. 1. Percentage of 30 s intervals with engagement. Letters (-a, -b, etc.) indicate the peer coach(es) who were present in the observation; * indicates untrained peers who were also present.

baseline. Following training, there was an immediate change in engagement level for three consecutive sessions and no overlap with baseline data. In a single follow-up session, engagement remained at 100% of intervals; a second follow-up probe was not possible because the school year ended. Stuart and his peers engaged in computer, Lego, and playground activities during these sessions. Peer-a engaged with Stuart during all intervention and follow-up sessions; peer-b was out of town for sessions 9 and 10. During session 5, three untrained peers joined -a and -b with Stuart. The IRD for Stuart was 1.0, indicating a very effective intervention.

3.1.2. Group 2: Thomas

Four peer coaches (peers -c, -d, -e, and -f) were trained to interact with Thomas. No peers engaged with him during baseline. Following training, there as an immediate but modest change in the level of engagement for the first two sessions, and no overlap with baseline data. Thomas ate lunch slowly on these two days and had little time to interact with his peers, who waited for him outside. After the second session (session 8), the first author suggested to the peer coaches that they invite Thomas to play with them while he was eating lunch instead of waiting for him outside. This resulted in a steep upward trend to 80% engagement or higher across the next four consecutive probe sessions, which met the mastery criterion for engagement. Over three follow-up sessions, engagement varied between 30%–100% of intervals, with an overall mean of 65%. Although there was significant variability during follow-up, there was no overlap with baseline. Thomas and his peers played exclusively on the swings in the playground during all intervention and follow-up sessions. All four peer coaches engaged with Thomas during the probe sessions, and two different untrained peers joined them during the final two follow-up sessions. The IRD for Thomas was 1.0.

3.1.3. Groups 3: Alexander

Three peer coaches (peers -g, -h and -i) were trained to interact with Alexander. No peers engaged with him during baseline. Following training, there was an immediate but modest change in the level of engagement for the first session (session 9) with a return to baseline level for the second session (session 10). After the second session, the researcher met with the peer coaches briefly for feedback. The researcher reminded the peer coaches of the first strategy, DO. After this feedback, there was an immediate increase in level to 60% engagement for session 11 and a steep upward trend to 90% engagement or higher across the next four consecutive probe sessions, meeting the mastery criterion for engagement. Although there was overlap between baseline and intervention during session 10, there was no overlap following session 10. Over three follow-up sessions, engagement varied between 0%–80% of intervals, with an overall mean of 45%. Alexander and his peers played a variety of activities during intervention sessions. The majority of play involved basketball or volleyball on the playground. All three peer coaches engaged with Alexander during the probe sessions, and untrained peers joined them during 40% of probe sessions across the intervention and follow-up phases. The IRD for Alexander 0.86, and the overall IRD (averaged across all three participants) was .95.

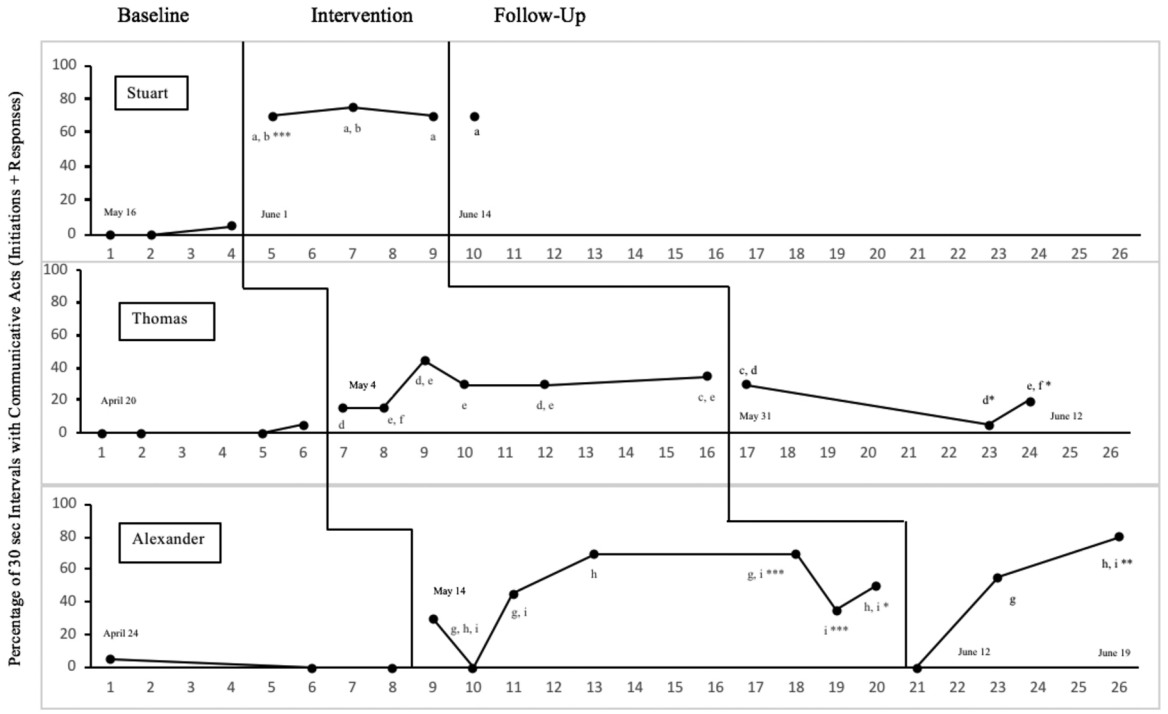

Fig. 2. Percentage of 30 s intervals with communicative acts (initiations + responses). Letters (-a, -b, etc.) indicate the peer coach(es) who were present in the observation; * indicates untrained peers who were also present.

3.2. Communicative acts

Fig. 2 displays the results for Stuart, Thomas and Alexander for total CAs.

3.2.1. Groups 1: Stuart

None of the baseline intervals included responses and 1.7% included initiations. Following training, there was an immediate change in level to 70% or higher over three consecutive sessions and no overlap with baseline data, meeting the mastery criterion for CAs. Across probe sessions, 30% of intervals included initiations and 65% included responses. During one follow-up probe, CAs occurred during 75% of all intervals; 5% of intervals included initiations and 75% included responses. The IRD for Stuart was 1.0, indicating a very effective intervention.

3.2.2. Group 2: Thomas

None of the of the baseline intervals included responses and 1.3% included initiations. Following training, there was an immediate change in level to 15%–45% of probe sessions, with no overlap between baseline and intervention. There was no change in level for the final three sessions (sessions 10, 12 and 16) so the intervention phase was terminated, per the discontinuation criteria described previously. During intervention probes, CAs occurred during 28.3% of all intervals; 0.08% of intervals included initiations and 28.3% included responses. During follow-up, there was a decrease in level to 5%–30% of probe sessions, with one data point overlapping with baseline. Across three follow-up sessions, CAs occurred during 21.7% of intervals; 3.3% of intervals included initiations and 18.3% included responses. The IRD for Thomas was 1.0.

3.2.3. Group 3: Alexander

None of the of the baseline intervals included responses and 5% included initiations. Following peer coach training, there was an immediate change in level during the first intervention session to 30%, followed by one session with 0% CAs (session 10). The remaining sessions showed an increase in level with some variability between 35%–70%. There was no improvement in CAs after session 18, so the intervention phase was terminated, per the discontinuation criteria described previously. During intervention probes, CAs occurred during 49.3% of all intervals; 7% of intervals included initiations and 49.3% included responses. Across three follow-up sessions, CAs occurred during 45% of all intervals; 1.7% of intervals included initiations and 43.3% included responses. The IRD for Alexander was 0.86, and the overall IRD (averaged across all three participants) was .95.

3.3. Mutual enjoyment

Table 1 displays the results for mutual enjoyment for Stuart, Thomas, and Alexander across intervention and follow-up phases.

Table 1
Percentage of sessions with mutual enjoyment (peer coach + participant with ASD) during intervention and follow-up phases.

Indicator Behaviour	% of sessions		
	Group 1/ Stuart	Group 2/Thomas	Group 3/Alexander
Smiling	50	100	100
Eye contact	75	90	100
Laughing	0	70	88
% of sessions with 1 or more measures of mutual enjoyment	75	100	100

The table includes only data from sessions where peer coaches engaged with the participant with ASD (i.e., if no peer coaches were present, data were not included).

Overall, mutual enjoyment was observed for the majority of intervention and follow-up sessions across groups. Specifically, at least two indicators of mutual enjoyment were observed for 75% of sessions for Group 1 (Stuart) and 100% of sessions for Groups 2 (Thomas), and 3 (Alexander).

3.4. Social validity

Table 2 displays the results for peer coach social validity and Table 3 displays the results for classroom teacher social validity. Overall, teachers and peer coaches in all three groups rated the peer coaching experience quite positively. Some coaches also submitted comments that were largely positive (e.g., "Peer coaching is beneficial for both sides of the coaching. I really like this program"). Two exceptions were one comment from Thomas's coach ("I like coaching Thomas but the lack of response from him makes me feel that my acts are useless. I also dislike that I constantly do swings and push, making me feel more like a servant than a friend") and one comment from Alexander's ("I really enjoyed being a peer coach, but I think there should be more peer coaches so it doesn't feel like a job or a chore"). All comments from teachers were positive (e.g., "All three coaches had an extremely positive experience…and the student with autism is now being invited to join friends at launch and break and has been communicating more. The coaches have also helped to calm him down when stressed… I would love to see more training at our school in the future").

4. Discussion

This study investigated the effectiveness of a low-intensity PMI intervention on social behaviours for middle-school aged students with ASD during lunch breaks at school. Results provided evidence of a functional relation between the intervention and both engagement and CAs, with three demonstrations of effect across participants. Results maintained during follow-up with some decrease in level and increased variability. Mutual enjoyment was evident for all participants and social validity ratings were high for both peer coaches and classroom teachers. This study adds to the existing PMI research and extends that research by including middle-school aged students and students with varying intellectual and social-communication abilities during lunch breaks in natural settings. Previous studies with this age group typically utilized longer durations of initial and/or ongoing training (e.g., Carter, Cushing, Clark, & Kennedy, 2005; Haring & Breen, 1992; Hochman et al., 2015; Schmidt & Stichter, 2012).

4.1. Engagement, communicative acts, and mutual enjoyment

The complete lack of peer engagement and the very low rate of CAs during baseline suggest that all of these participants were socially isolated at school. This finding is consistent with existing research showing that individuals with ASD are at increased risk of social isolation, especially as they get older (Petrina, Carter, & Stephenson, 2014). Following peer coach training, engagement

Table 2
Social validity ratings: Peer coaches.

Item	Mean rating (*range*)			
	Group 1: Stuart	Group 2: Thomas	Group 3: Alexander	Mean
1. I am excited to be a peer coach.	4.0 *(4.0)*	3.25 *(3.0–4.0)*	4.0 *(4.0)*	3.75
2. I feel confident about my ability to be a peer coach.	3.5 *(3.0-4.0)*	3.25 *(3.0–4.0)*	3.7 *(3.0–4.0)*	3.5
3. I learned helpful strategies during the training sessions.	4.0 *(4.0)*	4.0 *(4.0)*	4.0 *(4.0)*	4.0
4. Participating in this study had a bad impact on my social life.	1.0 *(1.0)*	1.75 *(1.0–3.0)*	1.0 *(1.0)*	1.25
5. I had fun during the training.	4.0 *(4.0)*	3.75 *(3.0–4.0)*	4.0 *(4.0)*	3.9
6. I would recommend being a peer coach to my friend.	3.0 *(3.0)*	3.25 *(3.0–4.0)*	3.5 *(3.0–4.0)*	3.25
7. I would be a peer coach again in the future.	3.5 *(3.0–4.0)*	3.25 *(3.0–4.0)*	3.8 *(3.5–4.0)*	3.5
8. I consider the classmate I coached to be a friend.	3.5 *(3.0–4.0)*	3.25 *(3.0–4.0)*	3.8 *(3.5–4.0)*	3.5
9. I think other kids should learn how to be peer coaches.	3.5 *(3.0–4.0)*	3.4 *(2.5–4.0)*	4.0 *(4.0)*	3.6
10. Overall, I enjoyed being in this project.	4.0 *(4.0)*	3.5 *(2.5–4.0)*	4.0 *(4.0)*	3.8

Table 3
Social validity ratings: Teachers.

Item	Mean rating for intervention/follow-up			
	Group 1: Stuart	Group 2: Thomas	Group 3: Alexander	Mean
1. I think that peer training is a good way to address the social needs of students with autism.	4.0/4.0	4.0/4.0	4.0/4.0	4.0
2. I would like to see more peer training for students at RCS in the future.	4.0/4.0	4.0/4.0	4.0/4.0	4.0
3. The student with autism as benefitted socially from participating in the study.	4.0/4.0	3.0/4.0	4.0/4.0	3.8
4. The peer coaches benefitted socially from participating in the study.	4.0/4.0	4.0/4.0	4.0/4.0	4.0
5. The student with autism has more friends as a result of the study.	4.0/4.0	2.0/4.0	4.0/4.0	3.7
6. The study was disruptive to my classroom and/or students.	2.0/1.0	1.0/1.0	1.0/1.0	1.2
7. I think other students would benefit from peer training.	4.0/4.0	4.0/4.0	4.0/4.0	4.0
8. Peer coaches enjoyed participating in the study.	4.0/4.0	4.0/4.0	4.0/4.0	4.0
9. The amount of time required to participate in this study was reasonable for all students.	4.0/4.0	4.0/4.0	4.0/4.0	4.0
10. I would like to learn how to train students to be peer coaches.	3.0/3.0	4.0/4.0	4.0/4.0	3.7

increased to various degrees across the three groups. The variability across groups did not appear to be related to the number of peer coaches involved with each student; in fact, Stuart, who had the fewest peer coaches, also had the largest increases in both engagement and CAs. Rather, the variability within and across groups may have been a function of how typically developing youth spend their time during lunch breaks at school. One would not expect most middle-school aged students to play the same activity with the same peer(s) every day; indeed, one would expect to see some variability in the activities that they choose and in the peers with whom they engage. The peer coaches in this study were encouraged to make sure that they continued to enjoy their lunch breaks. It is possible that some of the variability in engagement occurred because peer coaches were more interested in a different activity than their classmate with ASD or wished to play with different peers on one of the probe days. Although peer coaches were encouraged to engage with the participant with ASD, there was no requirement that they do so daily; despite this, all three participants with ASD engaged with at least one peer coach during the majority of observation probes.

Similar to engagement, there was an increase in total CAs for all participants with ASD, again with considerable variability across participant groups. Stuart, whose social-communication skills were more advanced than either of the other students with ASD, was the only participant who showed increases in initiations during intervention and follow-up. In contrast, Thomas, whose communication delays were the most delayed, had the lowest increase in CAs following peer coach training. CA variability can also be attributed to the different activities in which the participants were engaged. For example, Group 3 (Alexander) typically played ball games. While there was friendly banter back and forth between Alexander and his peer coaches while they played, there were often natural lulls in the conversation as well, as they focused on playing the game rather than talking. The fact that up to 70% of intervals included CAs is impressive in this context. Thomas' group played on the swings, which also seemed to limit natural opportunities for CAs. In contrast, Stuart and his peer coaches played more subdued activities (e.g., building a Lego structure together) which offered more opportunities for conversation.

Indices of mutual enjoyment may also have been impacted by the types of activities in which participants were engaged. Both Thomas and Alexander engaged in high-energy, physical activities with peers, and at least one measure of mutual enjoyment was observed for 100% of probes for these two groups. Stuart and his peer coaches had fewer indices of mutual enjoyment; however, this may have been due to activity in which they engaged rather than an indication that they did not enjoy it. Given that Stuart's peer coaches had high social validity ratings and that the activities were highly preferred by Stuart and the peer coaches, it would seem that some indicators of mutual enjoyment might not have been captured by the definition used in this study.

4.2. Peer coach training

A number of factors may have contributed to the success of this low-intensity intervention package. First, the peer coach training included a priori identification of mutual interests for both peer coaches and their classmate with ASD. This was included as part of the training because children often define friendship in terms of mutual enjoyment of a preferred activity (Newcomb & Bagwell, 1995). Second, the behaviour skills training package that was used to train the peer coaches included multiple opportunities to role play the DO, HELP and TALK strategies with feedback from the researcher. In addition, several coaches commented that they liked having a simple one-page handout summarizing the strategies. Third, the brief feedback provided to peer coaches by the first author following each probe observation during intervention appeared to be an important component of the overall intervention package. Observing and then providing feedback allowed the researcher to guide the coaches in quickly solving the initial logistical problems that arose for both Thomas's and Alexander's groups. Fourth, the inclusion of multiple peer coaches likely contributed to the positive outcomes. This was implied in the comment by one of Alexander's coaches, who suggested that more peers should be trained so that coaching does not feel like a "job or a chore." It may have been that peer coaches were more confident and enjoyed engaging with their classmate with ASD when they had another friend present. In addition, having multiple peer coaches reduced the responsibility for each individual peer coach.

In this study, formal peer coach training required only 40–50 minutes over two days. This is at the lower end of the range of intensity reported in previous PMI studies focused on middle or high school students with ASD. However, shorter training times have

also be shown to be effective (e.g., one, 20 min session that resulted in increased frequencies and durations of peer initiations toward three high school students with ASD; Hughes et al., 2013). Thus, although the training in this study was of low intensity, it is conceivable that even less training might have been sufficient to achieve similar outcomes.

4.3. Future research

The logistical factors that accounted for variability in engagement have implications for future peer coach training. For example, it might be helpful to support peer coaches during training to make a schedule for engaging with their classmate with ASD. Another strategy might be to ask teachers to check in with peer coaches prior to lunch break each day. A schedule or a daily check-in might reduce the likelihood of peer coaches occasionally forgetting or assuming that another coach is playing with their classmate; most likely, one or both of these strategies could be faded over time.

Overall, social validity scores were high; however, these results should be interpreted with some caution, as both peer coaches and teachers were broadly aware of the purpose of the intervention and this might have influenced their ratings (McCambridge, de Bruin, & Witton, 2012). Responses to the open-ended question on the survey ("Do you have anything else to add?") were also mainly positive. The exceptions were one peer coach in Thomas's group, who commented that Thomas's lack of response to his social overtures made him feel "useless" and that the repetitiveness of playing on the swings every day made him feel like a "servant." While this student was in the minority, his comment should guide future extensions of this study because it highlights the importance of mutual enjoyment for both peer coaches and students with ASD when implementing a PMI. For students with ASD with limited interests or for those who engage in only one highly preferred break time activity, it would be helpful to introduce an intervention to expand appropriate play activities prior to or in conjunction with PMI. Future extensions might also include supplemental positive reinforcement to peer coaches during the initial stages of peer coaching, particularly when they are engaged with classmates with ASD who have limited communication skills. In addition, future research might include an intervention aimed at teaching participants with ASD to initiate and/or respond to peer interactions. Finally, future research could also investigate a train-the-trainer(s) application of this intervention package, to teach school staff (e.g., classroom teachers, educational assistants) to implement a similar low-intensity PMI. Training professionals who are employed by school districts would further increase the feasibility and affordability of this intervention.

4.4. Limitations

The Leiter-3 was administered as a pre-intervention assessment to provide information regarding the cognitive functioning of the students with ASD in this study. However, there is some evidence that individuals with ASD score significantly higher on nonverbal assessments in comparison to verbal assessments (Dawson, Soulieres, Gernsbacher, & Mottron, 2007; Grondhuis & Mulick, 2013). Thus, some authors recommend that multiple cognitive measures be used when assessing individuals with ASD and/or that cognitive measures include both verbal and performance scales (Scattone, Raggio, & May, 2012; Scattone, Raggio, & May, 2011). Given this, the test scores reported in this study should be considered with caution.

Another potential limitation was that reactivity may have occurred during observation sessions. Reactivity is more likely to occur when observation methods are obtrusive (i.e., participants are aware of the observer and the reason for their presence) (Cooper, Heron, & Heward, 2007). Because this study took place in the natural environment of a school playground, both the researcher and the RA had to be in close proximity to participants in order to see and hear CAs. However, since all of the participants attended the same school and were part of the study at the same time, the researcher was on the school playground on most days for a few months over the course of the study. She often observed peer coaches engaging with participants with ASD on days when she was not collecting data for that group. School staff also shared frequent anecdotes with the researcher about interactions between peer coaches and participants with ASD that they had observed when she was not present. In addition, there were days when the researcher collected data and no peer coaches engaged with the participant. Given these considerations, reactivity did not appear to be a significant concern, although it may have occurred to some extent.

In this study, participants with ASD were not involved in either intervention planning (for example, they could have been involved in the selection of peer coaches) or in direct assessment of the intervention outcomes. The inclusion of a measure of mutual enjoyment partially offsets the latter limitation, as the results for this dependent variable suggest that all three participants with ASD found engagement with the peer coaches to be a positive experience. Nonetheless, it would have been possible to include a social validity measure designed for these participants, with simple text and a face-based Likert-type scale depicting various degrees of enjoyment or satisfaction (Reynolds-Keefer & Johnson, 2011). Future research should endeavour to include participants with ASD, especially those who are adolescents or adults, as research partners as well as research participants.

Generalization was assessed indirectly in this study by noting interactions with untrained peers during the free time period. However, the lack of systematic generalization data is a limitation, as is the brevity of the follow-up period. The final observation probes occurred during the last few days of school before the summer holiday. Follow-up that extended for a longer duration would have provided valuable information regarding the maintenance effects of this low-intensity PMI.

4.5. Conclusions

This study extended the PMI research by including middle-school aged students with ASD with social-communication delays and moderate to significant support needs. Results indicated that students with ASD who were socially isolated during break times began

to engage and communicate with peers during their lunch breaks. There was evidence that these interactions were mutually enjoyable and were rated as socially valid. It is important to identify interventions that have high social validity from the perspective of teachers, as interventions that are both effective and efficient may be more likely to be adopted by schools. In fact, the researcher was asked by administrators at the school where the study took place to implement the PMI intervention with additional students in subsequent school years. Future research should continue to investigate the effectiveness of PMI for students between the ages of 11–18 with varying intellectual abilities and communication abilities and/or modalities during breaks at school in natural environments.

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Appendix A

Peer Coach Implementation Fidelity Checklist

Strategy	Yes	No	N/A
DO: Did peer coach initiate an activity with the participant or engage in a participant-initiated activity?			
HELP: Did the peer coach model engagement or provide assistance in the activity?			
TALK: Did the peer coach prompt a communicative act (e.g., by repeating a question)?			
TALK: Did the peer coach praise or compliment the participant?			
TALK: Did the peer coach comment about the activity or ask a question?			

References

Bambara, L. M., Cole, C. L., Kunsch, C., Tsai, S. C., & Ayad, E. (2016). A peer-mediated intervention to improve the conversational skills of high school students with autism spectrum disorder. *Research in Autism Spectrum Disorders, 27*, 29–43. https://doi.org/10.1016/j.rasd.2016.03.003.

Barlow, D. H., Nock, M., & Hersen, M. (2009). *Single case experimental designs: Strategies for studying behavior for change* (3rd ed). Boston: Pearson Education.

Bene, K., Banda, D. R., & Brown, D. (2014). A meta-analysis of peer-mediated instructional arrangements and autism. *Review Journal of Autism and Developmental Disorders, 1*(2), 135–142.

Carter, E. W., Asmus, J., Moss, C. K., Biggs, E. E., Bolt, D. M., Born, T. L., ... Fesperman, E. (2016). Randomized evaluation of peer support arrangements to support the inclusion of high school students with severe disabilities. *Exceptional Children, 82*(2), 209–233. https://doi.org/10.1177/0014402915598780.

Carter, E. W., Cushing, L. S., Clark, N. M., & Kennedy, C. H. (2005). Effects of peer support interventions on students' access to the general curriculum and social interactions. *Research and Practice for Persons with Severe Disabilities, 30*(1), 15–25. https://doi.org/10.2511/rpsd.30.1.15.

Carter, E. W., Gustafson, J. R., Sreckovic, M. A., Dykstra Steinbrenner, J. R., Pierce, N. P., Bord, A., ... Mullins, T. (2017). Efficacy of peer support interventions in general education classrooms for high school students with autism spectrum disorder. *Remedial and Special Education, 38*(4), 207–221. https://doi.org/10.1177/0741932516672067.

Chan, J. M., Lang, R., Rispoli, M., O'Reilly, M., Sigafoos, J., & Cole, H. (2009). Use of peer-mediated interventions in the treatment of autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 3*(4), 876–889. https://doi.org/10.1016/j.rasd.2009.04.003.

Chang, Y. C., & Locke, J. (2016). A systematic review of peer-mediated interventions for children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 27*, 1–10. https://doi.org/10.1016/j.rasd.2016.03.010.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis* (2nd ed.). Upper Saddle River, NJ: Pearson Education.

Dawson, M., Soulieres, I., Gernsbacher, M., & Mottron, L. (2007). The level and nature of autistic intelligence. *Psychological Science, 18*, 657–662. https://doi.org/10.1111/j.1467-9280.2007.01954.x.

Grondhuis, S. N., & Mulick, J. A. (2013). Comparison of the Leiter International Performance Scale—Revised and the Stanford-Binet Intelligence Scales in children with autism spectrum disorders. *American Journal on Intellectual and Developmental Disabilities, 118*(1), 44–54. https://doi.org/10.1352/1944-7558-118.1.44.

Haring, T. G., & Breen, C. G. (1992). A peer-mediated social network intervention to enhance the social integration of persons with moderate and severe disabilities. *Journal of Applied Behavior Analysis, 25*(2), 319–333. https://doi.org/10.1901/jaba.1992.25-319.

Hochman, J. M., Carter, E. W., Bottema-Beutel, K., Harvey, M. N., & Gustafson, J. R. (2015). Efficacy of peer networks to increase social connections among high school students with and without autism spectrum disorder. *Exceptional Children, 82*(1), 96–116. https://doi.org/10.1177/0014402915585482.

Horner, D. H., & Baer, D. (1978). Multiple-probe technique: A variation of the multiple baseline. *Journal of Applied Behavior Analysis, 11*, 189–196.

Hughes, C., Golas, M., Cosgriff, J., Brigham, N., Edwards, C., & Cashen, K. (2011). Effects of a social skills intervention among high school students with intellectual disabilities and autism and their general education peers. *Research and Practice for Persons with Severe Disabilities, 36*(1-2), 46–61. https://doi.org/10.2511/rpsd.36.1-2.46.

Hughes, C., Harvey, M., Cosgriff, J., Reilly, C., Heilingoetter, J., Brigham, N., ... Bernstein, R. (2013). A peer-delivered social interaction intervention for high school students with autism. *Research and Practice for Persons with Severe Disabilities, 38*(1), 1–16. https://doi.org/10.2511/027494813807046999=.

Loftin, R. L., Odom, S. L., & Lantz, J. F. (2008). Social interaction and repetitive motor behaviors. *Journal of Autism and Developmental Disorders, 38*(6), 1124–1135. https://doi.org/10.1007/s10803-007-0499-5.

McCambridge, J., de Bruin, M., & Witton, J. (2012). The effects of demand characteristics on research participant behaviours in non-laboratory settings: A systematic review. *PloS One, 6*, e39116. https://doi.org/10.1371/journal.pone.0039116.

Miltenberger, R. (2004). *Behavior Modification: Principles and Procedures* (3rd ed.). Belmont, CA: Wadsworth Publishing.

Newcomb, A. F., & Bagwell, C. L. (1995). Children's friendship relations: A meta-analytic review. *Psychological Bulletin, 117*(2), 306–347. https://doi.org/10.1037/

0033-2909.117.2.306.
Parker, R., Vannest, K., & Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children, 75*, 135–150. https://doi.org/10.1177/001440290907500201.
Parker, R., Vannest, K., & Davis, J. (2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification, 35*, 303–322. https://doi.org/10.1177/0145445511399147.
Petrina, N., Carter, M., & Stephenson, J. (2014). The nature of friendship in children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 8*(2), 111–126. https://doi.org/10.1016/j.rasd.2013.10.016.
Reynolds-Keefer, L., & Johnson, R. (2011). Is a picture worth a thousand words? Creating effective questionnaires with pictures. *Practical Assessment, Research, & Evaluation, 16*(8)http://pareonline.net/getvn.asp?v=16&n=8.
Roid, G. H., Miller, L. J., Pomplun, M., & Koch, C. (2013). *Leiter international performance scale* (3rd edition). Leiter-3). Los Angeles: Western Psychological Services.
Scattone, D., Raggio, D. J., & May, W. (2011). Comparison of the vineland adaptive behavior scales and the bayley scales of infant and toddler development. *Psychological Reports, 109*(2), 626–634. https://doi.org/10.2466/03.10.PR0.109.5.626-634.
Scattone, D., Raggio, D. J., & May, W. (2012). Brief report: Concurrent validity of the Leiter-R and KBIT-2 scales of nonverbal intelligence for children with autism and language impairments. *Journal of Autism and Developmental Disorders, 42*, 2486–2490. https://doi.org/10.1007/s10803-012-1495-y.
Schmidt, C., & Stichter, J. P. (2012). The use of peer-mediated interventions to promote the generalization of social competence for adolescents with high-functioning autism and Asperger's syndrome. *Exceptionality, 20*(2), 94–113. https://doi.org/10.1080/09362835.2012.669303.
Statistics Canada (2017). *Richmond, British Columbia and Canada. Census profile. 2016 census.* Ottawa, ON: Statistics Canada Catalogue no. 98-316-X2016001 Released November 29, 2017https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=5915015&Geo2=PR&Code2=01&Data=Count&SearchText=Bridgeport&SearchType=Begins&SearchPR=01&B1=Ethnic%20origin&TABID=1(Accessed 21 January 2019).
Watkins, L., O'Reilly, M., Kuhn, M., Gevarter, C., Lancioni, G. E., Sigafoos, J., ... Lang, R. (2015). A review of peer-mediated social interaction interventions for students with autism in inclusive settings. *Journal of Autism and Developmental Disorders, 45*(4), 1070–1083. https://doi.org/10.1007/s10803-014-2264-x.
Watson, P. J., & Workman, E. A. (1981). The non-concurrent multiple baseline across-individuals design: An extension of the traditional multiple baseline design. *Journal of Behavior Therapy and Experimental Psychiatry, 12*, 257–259. https://doi.org/10.1016/0005-7916(81)90055-0.
World Medical Association (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053.