A Pilot Investigation of Individual and Dyad Instructional Arrangements

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Abstract

An essential goal for individuals with autism spectrum disorder (ASD) is to reach maximal independence on a variety of tasks that facilitate academic and vocational engagement and community integration. One-to-one instructional arrangements do not adequately prepare individuals with autism to function within various group contexts and limit opportunities for positive social interactions with one or more peers. Furthermore, group instructional formats have multiple benefits, including potentially increased instructional time and additional learning opportunities. The purpose of this pilot study was to evaluate the acquisition and maintenance of verbal behavior targets in individual and dyad instruction, as well as to compare levels of engagement across these instructional arrangements. Results suggest that three of the four participants acquired more targets during individual instruction, and three of the four participants maintained more targets within individual instruction. In addition, three of the four participants spent less time in instruction and more time on break during dyad instruction. These findings demonstrate the diversity of outcomes for dyad instruction for people with ASD. Directions for future research and suggestions for clinical implementation are provided.

Keywords One-to-one instruction · Dyad instruction · Autism · Discrete trial instruction

The development of effective group instructional arrangements for individuals with developmental disabilities is a crucial task for the fields of special education and human service provision. The ability to follow instructions delivered to a group is essential to successful integration in school, vocational, and community settings. However, many students with developmental disabilities receive individualized instruction for many years.

Group learning has been demonstrated to be effective for individuals with ASD, particularly when evidence-based practices are used in instruction (e.g., Kamps, Dugan, & Leonard, 1994; Kamps et al., 2016; Kamps, Walker, Locke, Delquadre,

& Hall, 1990; Rotholz, 1990). Group instruction has been done with both typical peers and with peers who also have learning challenges (e.g., Kamps, Barbetta, Leonard, & Delquadri, 1994; Ledford & Wehby, 2015; Tekin-Iftar & Birkan, 2010). Kamps, Barbetta, et al. (1994) improved reading skills and peer interactions through a class-wide tutoring program with typical peers and students with ASD. Tekin-Iftar and Birkan (2010) examined the use of group observation to teach food preparation skills to individuals with autism. Praise was given for attending to the peers' instructional sequences, and contingent access to the peers' snacks was also provided. All participants learned the sequences for all learners; this outcome is interesting from an efficiency perspective because learners mastered all nine food preparation sequences, and not just the three that were targeted for the individual student. Additionally, Kamps, Leonard, Potucek, and Garrison-Harrell (1995) demonstrated that the use of two to five peers to support a student with ASD led to increased social interaction and some generalization of the skills to novel settings.

Most individuals with ASD learn the majority of their skills in 1:1 instruction, and rarely have access to group instructional experiences where they might benefit from exposure to other learners and where they might develop group learning skills. Many individuals with ASD do not transition from individual

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instruction to a dyadic instructional arrangement. Hence, they may not learn to share teacher attention, wait appropriately in an instructional context, or respond to an instruction delivered to more than one learner. The limiting nature of 1:1 instruction, therefore, has been noted and is a clinical concern. Although a 1:1 model of instruction is efficient and effective in developing skills, it is difficult to financially maintain and support over time and learners may not generalize the skills learned in 1:1 formats to other instructional formats (Kamps & Walker, 1990). The resources required for individualized instruction are immense, and funding for such intense staffing is rarely available (e.g., Kamps, Walker, Maher, & Rotholz, 1992). Young adults with ASD, hence, often are ill prepared to enter group learning environments. In many cases, they have become dependent upon 1:1 staffing and fail to adapt to environments with fewer resources. It is imperative to address this issue to prepare learners for future environments. In the absence of such planning, students are unlikely to succeed in adult service placements or in community employment contexts.

There is clearly a need to support the identification of effective ways to teach group learning skills and to compare rates of learning in group or dyadic and individual formats (Skinner, 2010). In addition to the costs associated with intensive staffing, research indicates that individual instructional formats hinder generalization of skills, eliminate the potential for observational learning, and require far more instructional time than do group formats (Favell, Favell, & McGimsey, 1978; Keel & Gast, 1992; Koegel, Egel, & Dunlap, 1980). Such research provides the rationale for practitioners to develop ways to shape group learning skills. Moreover, there is little research addressing dyad instructional formats, which may serve as an efficient bridge to broader group instructional arrangements.

Thus, the purpose of this pilot study was to compare acquisition and maintenance of verbal behavior targets in individual and dyad arrangements in learners with autism. Potentially, learner readiness for the earliest form of group instruction—dyadic instruction—could be assessed by examining differential performance of tasks in these arrangements. This pilot project provided data on the learners' mastery and maintenance of skills in both formats and evaluated levels of engagement of each participant across the instructional arrangements.

Method

Participants

Four participants were included in this study. Max was a 9-year-old male child of African American ethnicity. Max was diagnosed with autism at 18 months, and later as having AD/HD. Prior to being served in the approved private school

where the present study was conducted, Max received instruction in a Full Time Autistic Support classroom in public school, with 1:1 support for direct instruction and management of severe challenging behaviors from age six. When tested in 2011 on the Battelle Developmental Inventory-Second Edition (BDI-2; Newborg, 2005), Max was found to have significant developmental delays across all cognitive subtests, as well as the self-care and personal responsibility subtests. On the Stanford Binet Intelligence Scales-Fifth Edition (SB5; Roid, 2003), Max earned a full-scale IQ of 42, consistent with a diagnosis of intellectual disability. Max demonstrated severely deficient skills in adaptive functioning, as indicated on the Vineland Adaptive Behavior Scale-Second Edition (Vineland-II; Sparrow, Cicchetti, & Balla, 2005). Max also received ratings consistent with a diagnosis of severe autism on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988), completed by multiple informants.

Greg was an 11-year-old Caucasian male who was diagnosed with autism, AD/HD, and developmental delays following evaluation by a developmental pediatrician. Specifically, Greg scored in the "Autism" range on each of the social communication, play, and motor mannerism domains of the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999). On the Carolina Curriculum for Preschoolers with Special Needs-Second Edition (CCPSN; Johnson-Martin, Hacker, & Attermeier, 2004), Greg was found to have delays across social, cognitive, language, motor, and adaptive skills. Greg was also assessed as having global developmental delays on the Brigance Inventory of Early Development-Second Edition (Glascoe, 2004). Greg was not able to participate in standardized testing methods on the Kaufman Assessment Battery for Children (KABC; Kaufman & Kaufman, 1983), but was noted to have severe developmental delays. On the SB5 (Roid, 2003), Greg earned a full-scale IQ of 46, consistent with a diagnosis of intellectual disability. Across multiple informants on the Vineland-II (Sparrow et al., 2005), Greg demonstrated low to moderate deficits in all areas of adaptive functioning. Greg continued to display behaviors consistent with a diagnosis of autism across multiple ratings, scales, and observations. As a result of his multiple diagnoses and significant educational and behavioral needs, Greg was served in an Autistic Support classroom prior to attending the private school in the present study. Greg received 1:1 support from a therapeutic support staff (TSS) from the age of 5 to the time of the study.

Taylor was an 18-year-old African American male with a diagnosis of autism and intellectual disability. Prior to the age of 12, Taylor was served in an Autistic Support classroom in his home school district and participated in small group instruction for more than 75% of his day. Around this time, Taylor began exhibiting increases in challenging behaviors in the setting and was not making notable educational

progress. Taylor was then referred to the approved private school where the current study took place. Prior to placement, Taylor was assessed via the Differential Ability Scales-Second Edition (DAS-II; Elliot, 2007), wherein he scored at the 1st percentile in Sequential and Quantitative Reasoning and an overall estimate of nonverbal reasoning at 0.1 percentile. On the Vineland-II (Sparrow et al., 2005), Taylor scored at < 1st percentile across communication, daily living, socialization, and adaptive behavior composite scales.

Ryan was a 15-year-old Caucasian male with a diagnosis of Down's syndrome and intellectual disability. Until the age of 12, Ryan was served in a public school environment with 1:1 instruction from a child-specific aide in a dedicated Life Skills classroom used only by him and integration with same-age peers for less than 25% of his educational day. Ryan was generally sociable and well-liked by peers, but began displaying more severe challenging behaviors and choosing to not participate in any nonpreferred instruction, which negatively impacted his education progress and placement. Ryan received a functional behavior assessment, positive behavior support plan, and a crisis plan from a consulting behavior specialist, but was unable to be maintained in the school district and placed with agreement of parents into the approved private school in which the current study took place. On the Comprehensive Test of Nonverbal Intelligence (C-TONI; Hammill, Pearson, & Weiderholt, 1997), Ryan scored in the poor to very poor range across subtests with a composite nonverbal IQ score also in the very poor range. On the Behavior Assessment System for Children-Second Edition (BASC-2; Kamphaus & Reynolds, 2007), Ryan's behaviors, as rated by indirect teacher and parent informants, indicated clinically significant barriers in somatization, attention problems, learning problems, and the School Problems Index with clinically significant deficits in functional communication, study skills and overall Adaptive Skills Composite. On the Vineland-II (Sparrow et al., 2005), Ryan scored at < 1st percentile across all of the communication, daily living, socialization, and adaptive behavior composite domains. Although Ryan's cognitive and adaptive skills were found to be well below his age and grade level, it was also noted that his educational progress was further impeded by his challenging behaviors, resulting in below ability performance.

All participants were enrolled in a multiple disabilities classroom at a private academic school in suburban Pennsylvania. Educators completed functional behavior assessments, academic assessments, and ongoing data collection to inform individualized behavior support and educational programming at the private school. Participants received individual, direct instruction for more than 50% of the school day and had positive behavior support plans that included arrangement of the instructional environment, visual schedules, choice-making, and planned reinforcement for task completion. Two of the four participants (Max and Greg) had

exposure to working in dyads for approximately 25% of the 6-h school day (e.g., during morning meeting, adaptive physical education, art, and music classes) while the other two participants (Taylor and Ryan) worked in dyads approximately 50% of the school day. Typically, instructional targets were isolated during individual, direct instruction and mastered/maintenance targets were run during dyadic arrangements.

Materials and Setting

Sessions with Max and Greg were conducted in the students' classrooms. Sessions with Taylor and Ryan were conducted in a treatment room with a two-way mirror. A video camera and tripod were used to record each session. Each session required index cards with the target skills and various materials as indicated by the operant (e.g., picture cards, fine motor tasks). Additionally, the putative reinforcers provided during the sessions were an iPad© for Max and Ryan and edible stimuli (e.g., chips, popcorn, cookies, veggie straws) for Greg and Taylor. A timer was used to measure the session duration and collect engagement data for all participants.

Dependent Measures

Data were collected during each session on the percentage of independent responses (e.g., the participant completed the trial with no prompting from the therapist). Each target was taught using most-to-least prompting (i.e., full physical, partial physical, gesture, independent). Data for each operant were calculated by dividing the number of trials completed independently by the total number of trials run, and multiplying by 100. A target was considered to be mastered following five consecutive sessions with 100% independence for Max and Greg. For Taylor and Ryan, a target was considered mastered following five consecutive sessions with 90% independence. For all participants, following three consecutive trials with success at the prescribed prompt level, a less intrusive prompt was provided. Following two consecutive errors, a more intrusive prompt was provided. Additionally, following three consecutive sessions with 0% independence, an acquisition target was discontinued and a new target introduced. Following two consecutive sessions with 0% independence, a mastered target was discontinued and a new target introduced.

The session videos were coded to collect data on the percentage of the session each participant spent in instruction and on break to evaluate levels of instructional engagement. Instructional time was defined as any time the participant was delivered the discriminative stimulus (S^D), responded to the S^D (including prompting), or was listening to vocal praise from the therapist. Break time was defined as any time the participant was not engaged in the task or was consuming his specific reinforcer (iPad© for Max and edibles for Greg and Taylor). Break time included instances when the

instructor was gathering materials or a peer, but not the participant, was receiving instruction during the dyad arrangement. For each session, the total duration spent in instruction and on break was measured. Data were converted into a percentage of the total session duration by dividing the total duration spent in instruction/on break by the total session duration and multiplying by 100 (e.g., percentage of session spent in instruction = total duration in instruction divided by total session duration, multiplied by 100).

Interobserver agreement (IOA) data were collected on the percentage of independent responses per session and duration of the session spent in instruction and on break. Interobserver agreement data were calculated using the total method, where the smaller number was divided by the larger number and multiplied by 100. Interobserver agreement data were collected for 25% of sessions across participants. For all participants, there was 100% agreement of percentage independence of acquisition and maintenance targets. The mean IOA for Max's time in instruction was 91% (range, 87–100%). The mean IOA for Max's time on break was 92% (range, 83–100%). The mean IOA for Greg's time in instruction was 93% (range, 81–100%). The mean IOA for Greg's time on break was 94% (range, 86–100%). The mean IOA for Taylor's time in instruction was 94% (range, 82–100%). The mean IOA for Taylor's time on break was 96% (range, 84–100%). The mean IOA for Ryan's time in instruction was 95% (range, 87–100%). The mean IOA for Ryan's time on break was 97% (range, 86–100%).

Procedural Integrity Measure

A procedural integrity checklist was created to monitor and measure that the intervention procedures were implemented as intended (see Appendix A). Data were collected on the percentage of steps correctly completed by the therapist. Procedural integrity data were collected for 25% of sessions across participants. The checklists were completed by the first two authors of the study. Procedural integrity averaged 99% (range, 93–100%) across all sessions for all participants.

Experimental Design

An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare acquisition rates and levels of engagement across individual and dyad instruction formats. In the adapted alternating treatments design, each intervention focuses on a unique set of instructional stimuli, separate from the other intervention (e.g., Sindelar et al., 1985; Yaw et al., 2014). The stimuli assigned to the individual or dyad conditions were distinct, and the items assigned to the two interventions were assessed by the authors as being equivalent (e.g., response effort for each target was the same or similar). All other elements of the study were

consistent with an alternating treatments design. Sessions with Max and Greg were conducted over 8 weeks, with three to four sessions run per day, and at least 4 days of sessions run per week. Sessions with Taylor and Ryan were conducted over 6 weeks, with three to four sessions run per day, and at least 3 days of sessions run per week.

The first two authors of this manuscript acted as therapists for all sessions. Both were Master's level clinicians and received direct training and oversight from the study's contributors before beginning data collection. Interobserver agreement and procedural integrity were collected across role play sessions with both therapists until 100% was achieved, then the study began. Therapists were counterbalanced across instructional formats, and the order of operants presented was randomized with the stipulation that an operant session was not repeated twice in a row.

Across all sessions, 10 trials of acquisition targets (interspersed with six trials of mastered targets) were presented in discrete trial instruction. Taylor did not have any mastered targets when the study began, and therefore only completed 10 trials of acquisition targets. The targets were chosen from up to three different types of verbal operants for each participant (e.g., listener responding, match-to-sample, imitation, echoic, and intraverbal). For Max, Greg, and Taylor, targets were chosen from the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) from each operant for which they had yet to exhibit independent responding. For Ryan and Taylor, targets were chosen based on the functionality of the target for each learner. For example, Ryan exhibited poor articulation when speaking with peers and adults about topics he enjoyed; therefore, targets were chosen based on his interests to better facilitate a conversation with peers and adults. All echoic targets were reviewed by a speech and language pathologist for equality across targets. For Taylor, intraverbal targets were chosen based on questions he may receive from someone he may encounter in his daily life (e.g., he was asked where he washes the dishes). Targets for Taylor were also assessed by a speech and language pathologist to determine which targets were appropriate and which required the same amount of response effort (i.e., how many folders or categories he had to navigate in his iPad® before identifying the appropriate answer). An errorless teaching procedure was used for acquisition targets, and a least-to-most prompting hierarchy was followed for maintenance targets if an error occurred. Throughout the sessions, all appropriate requests to use the bathroom were honored, and all other requests were honored if the student was on break. Reinforcement was provided on a variable ratio schedule for three of the participants (VR 4 for Max and Taylor and VR 3 for Greg). Ryan received access to a reinforcer following the completion of the session.

During individual instruction, one of the participants and the therapist were seated across from each other at the

Fig. 1 Percentage independence of acquisition targets across individual and dyad instruction for Max

student's desk. During dyad instruction, a pair of participants and the therapist were seated across from each other in a triangular formation, with each participant sitting at his desk. Sequential instruction was used during the dyad instruction sessions, such that the therapist presented one trial to the first participant, then one to the second, and so on. Concurrent instruction was not used because the targets were different across participants.

Results

Acquisition and Maintenance

Figures 1, 2, 3, and 4 depict acquisition data for each of the participants. Percentage independent of acquisition targets during individual and dyadic instruction is depicted in the left and right panels, respectively. Max's independence with the

Fig. 2 Percentage independence of acquisition targets across individual and dyad instruction for Greg

acquisition targets was overall consistent across operants (see Fig. 1). Max mastered a total of five targets in individual instruction and two targets in dyad instruction. During individual instruction in imitation, Max mastered the first target within eight sessions. A second target was introduced, and Max demonstrated 0% independence across three consecutive sessions, so that target was discontinued and a new target was

introduced. Max was able to demonstrate 100% independence with this target by the third session; the study ended before the mastery criterion was reached. During individual instruction in match-to-sample, Max mastered one target over seven sessions, and a second target over six sessions. During individual instruction in listener responding, Max again mastered one target over seven sessions, and a second target over six

Fig. 3 Percentage independence of acquisition targets across individual and dyad instruction for Taylor

sessions. During dyad instruction in imitation, Max did not master any targets; he consistently demonstrated at least 90% independence with completing the skill, but did not meet the mastery criterion of 100% independence across five consecutive sessions. During dyad instruction in match-to-sample, Max mastered two targets over six sessions each. During dyad instruction in listener responding, Max did not master any targets; his percentage independence varied across sessions. The target was not discontinued because he did not demonstrate 0% independence across three consecutive sessions.

Greg's independence with the acquisition targets varied across operants (see Fig. 2). Across the study, Greg mastered no targets during individual instruction and mastered one target during dyad instruction. During individual instruction in imitation, match-to-sample, and listener responding, Greg's percentage independence varied across sessions. The targets were not discontinued because he did not demonstrate 0% independence across three consecutive sessions. During dyad instruction in imitation, Greg mastered one target within six sessions. A second target was introduced, and Greg demonstrated 0% independence across three consecutive sessions, so that target was discontinued and a new target introduced. Greg

was able to demonstrate increasing independence with this target; however, the study ended before the mastery criterion was reached. During dyad instruction in match-to-sample, Greg demonstrated increasing independence with the target skill, but did not meet the mastery criterion. During dyad instruction in listener responding, Greg consistently demonstrated at least 90% independence with completing the skill (except for the outlier of the final session), but did not meet the mastery criterion.

Taylor's independence with the acquisition targets varied across operants (see Fig. 3). Overall, Taylor mastered two targets during individual instruction and one target during dyad instruction. During individual instruction in intraverbals, Taylor mastered the first target within six sessions. A second target was introduced and mastered within eight sessions. A third target was introduced and Taylor was able to demonstrate 100% independence with this target by the second session; the study ended before the mastery criterion was reached. During individual instruction in listener responding, Taylor demonstrated increasing independence with the target skill, but did not meet the mastery criterion of 90% independence over five consecutive sessions. During dyad instruction

Fig. 4 Percentage independence of acquisition targets across individual and dyad instruction for Ryan

in intraverbals, Taylor's percentage independence varied across sessions. During dyad instruction in listener responding, Taylor mastered a target within six sessions. A second target was introduced, and Taylor was able to demonstrate increasing independence with the target skill; again, the study ended before the mastery criterion was reached.

Ryan's independence with the acquisition targets was overall consistent across the operants (see Fig. 4). Across the study, Ryan mastered four targets in individual instruction and three targets in group instruction. During individual instruction in intraverbals, Ryan mastered two targets within six sessions each. During individual instruction in echoics, Ryan mastered one target within six sessions; a second target was introduced and mastered within eight sessions. During dyad instruction in intraverbals, Ryan mastered one target within nine sessions. A second target was introduced, and Ryan demonstrated 100% independence by the second session; the study ended before the mastery criterion was reached. During dyad instruction in echoics, Ryan mastered one target within six sessions, and a second target within seven sessions.

Maintenance data for mastered targets were collected during each session. Figure 5 depicts maintenance data for

Max and Greg, and Fig. 6 depicts maintenance data for Taylor and Ryan. During imitation sessions, Max demonstrated 100% independence with the maintenance target used in dyad instruction. He was not able to independently demonstrate the target used in individual instruction; after three sessions, another mastered target was introduced, and Max was able to more consistently demonstrate independence. During match-to-sample sessions, Max demonstrated 100% independence across both dyad and individual maintenance targets. During listener responding sessions, Max demonstrated 100% independence with the maintenance target used in individual instruction (except for one outlier of 67%). He was not able to independently demonstrate the target used in dyad instruction; after three sessions, another mastered target was introduced, and Max was able to demonstrate some independence with the skill, although his overall independence varied across sessions. Greg demonstrated varying levels of independence with all maintenance targets presented, across operant and instructional condition. Taylor did not have a maintenance intraverbal target at the beginning of the study; once the first acquisition target was mastered, it became the maintenance

Fig. 5 Percentage independence of maintenance targets across individual and dyad instruction for Max (left) and Greg (right)

target and another acquisition target was introduced. Throughout the rest of the study, Taylor demonstrated varying levels of independence with that maintenance target. During listener responding sessions, Taylor demonstrated more independence with the maintenance target used in dyad instruction than the target used in individual instruction. Ryan demonstrated consistently high levels of

independence with all maintenance targets presented, across operants and instructional conditions.

Efficiency Measures

Figures 7 and 8 present percentages of each session spent in instruction and on break. During individual instruction, time

Fig. 6 Percentage independence of maintenance targets across individual and dyad instruction for Taylor (left) and Ryan (right)

Max spent in instruction was at a moderate level, with high variability and no trend. Overall, he spent an average of 60% (range, 35–84%) of the total session duration in instruction (see Fig. 7). During dyad instruction, time Max spent in instruction was at a low level, with moderate variability and no trend. Overall, Max spent an average of 22% (range, 12–35%) of the total session duration in instruction. During individual instruction, time Max spent on break was at a moderate level, with high variability and a decreasing trend. Overall, he spent an average of 40% (range, 16–65%) of the total session duration on break. During dyad instruction, time Max spent on break was at a high level, with moderate variability and no trend. Overall, Max spent an average of 78% (range, 65–89%) of the total session duration on break.

During individual instruction, time Greg spent in instruction was at a high level, with high variability and no trend. Overall, he spent an average of 73% (range, 23–90%) of the total session duration in instruction (see Fig. 7). During dyad instruction, time Greg spent in instruction was at a low level, with high variability and an increasing trend. Overall, he spent 33% (range, 17–62%) of the total session duration in instruction. During individual instruction, time Greg spent on break was at a low level, with high variability and no trend. Overall,

Greg spent an average of 27% (range, 10–77%) of the total session duration on break. During dyad instruction, time Greg spent on break was at a high level, with high variability and a decreasing trend. Overall, he spent an average of 67% (range, 38–83%) of the total session duration on break. When paired during dyad sessions, Greg spent more time in instruction and less time on break as compared to Max.

During individual instruction, time Taylor spent in instruction was at a moderate level, with high variability and no trend. Overall, he spent an average of 61% (range, 39–76%) of the total session duration in instruction (see Fig. 8). During dyad instruction, time Taylor spent in instruction was at a low level, with moderate variability and an increasing trend. Overall, Taylor spent an average of 22% (range, 11–37%) of the total session duration in instruction. During individual instruction, time Taylor spent on break was at a moderate level, with high variability and no trend. Overall, he spent an average of 39% (range, 24–61%) of the total session duration on break. During dyad instruction, time he spent on break was at a high level, with moderate variability and a decreasing trend. Overall, Taylor spent an average of 78% (range, 63–89%) of the total session duration on break.

Fig. 7 Percentage of total session duration spent in instruction and on break across individual and dyad instruction for Max (left) and Greg (right)

During individual instruction, Ryan spent 100% of the total session duration in instruction (see Fig. 8). During dyad instruction, time Ryan spent in instruction was at a moderate level, with high variability and no trend. Overall, Ryan spent an average of 61% (range, 47–75%) of the total session duration in instruction. During individual instruction, Ryan spent 0% of the total session duration on break. During dyad instruction, time he spent on break was at a moderate level, with high variability and no trend. Overall, Ryan spent 39% (range, 25–53%) of the total session duration on break. When paired during dyad sessions, Ryan spent more time in instruction and less time on break as compared to Taylor.

Discussion

The purpose of this pilot study was to evaluate the acquisition and maintenance of verbal behavior targets within both individual and dyad instruction. Previous research has cited the importance of group instruction to increase the generalization of skills and the potential for observational learning, and decrease instructional time (Favell et al., 1978; Keel & Gast,

1992; Koegel et al., 1980). In addition, individual instruction is less efficient and more costly, and does not prepare individuals with autism to function within group contexts (Kamps & Walker, 1990). Previous research had found positive outcomes for group instructional formats for learners with ASD (e.g., Kamps, Dugan, & Leonard, 1994; Kamps et al., 2016; Kamps et al., 1990; Rotholz, 1990). Although this study evaluated a *dyad* arrangement, the results do not support previous research on *small group* instruction. Three of the four participants mastered more targets during individual instruction; the fourth participant mastered only one target during dyad instruction. Additionally, three of the four participants maintained mastered skills better if they were presented during individual instruction. In general, three of the four participants spent more time on break than in instruction during the dyad arrangement. Taken together, these findings suggest that individual instruction was more effective for most of the learners, and that instructional opportunities were maximized during individual instruction. More work needs to be done to identify which learners may do better in dyad arrangements, or what other factors would increase the effectiveness of group learning arrangements.

Fig. 8 Percentage of total session duration spent in instruction and on break across individual and dyad instruction for Taylor (left) and Ryan (right)

Interventions aimed at evaluating effective teaching strategies have their challenges and limitations. One limitation was that the therapists involved in this study were novel to the participants, and therefore had not established instructional control, which could have led to an increase in challenging behavior during sessions. In addition, only four participants were included in this study, and only certain skills were evaluated within it. Although three of the four participants were able to acquire more targets in individual instruction, they were also able to acquire some targets in dyad instruction. It may be that the targets selected impacted acquisition, and that alternate targets would have resulted in more rapid or differential acquisition. If additional sessions had been conducted, the difference in acquisition between the conditions might have been equated or even reversed. For example, some of the participants did not have the prerequisite fine motor skills to complete some of the selected targets, and therefore different targets were introduced. Perhaps a standardized criterion for item inclusion (e.g., selecting targets based on assessments such as the Assessment of Basic Language and Learning Skills-Revised [ABLLS-R; Partington, 2006] or VB-MAPP [Sundberg, 2008]) would have been associated with

differential learning or improved dyad performance. Additionally, the criterion to terminate a target following three sessions with 0% independence was missed twice during individual imitation with Greg, and a new target was not introduced. Doing so might have led to an increase in independence during this condition.

A third limitation is that one of the two dyads included in this study was not an ideal pair. Max often spent time waiting during dyad instruction because Greg needed additional prompts to complete the target skills, leading to an increase in out-of-seat behavior by Max during the dyad sessions. Lastly, the criterion to master a novel target was stringent—five consecutive sessions with 100% independence (90% independence for Taylor and Ryan), as compared, for example, to a criterion of 90% independent responding for three consecutive sessions, as presented by Rodgers and Iwata (1991). Had the criteria been reduced to either three consecutive sessions, or three out of five sessions, it is possible that the participants would have mastered additional targets.

There are several future directions for this study. The first is to examine the characteristics of the individual learners as a test of readiness for dyad or group instruction, and potentially

introduce learners to group instruction in a tiered fashion. For example, learners could first work on solely mastered targets during dyad instruction, then later introduce acquisition tasks if learners demonstrate they are successful with the mastered material, then begin to introduce additional students into a larger instructional group. Another consideration is whether instructional time can be increased. Is there a change the instructors could make to increase engagement (e.g., provide reinforcement more immediately, increase the precision of instructions) and decrease waiting, or is there a way to alter the pacing of instruction in general to reduce waiting? Perhaps choral responding or a shared instruction model would reduce waiting time and be an interesting direction for research. Further, shared instructional models could be assessed for additional benefits such as observational learning. It would also be helpful to examine the social benefits of dyad and group instruction in terms of social interactions and generalization of social contact to nontraining settings, especially when a peer tutor model is used. Finally, examining the types of training practices to ensure staff are maximally efficient in providing dyad and group instruction might also enhance outcomes.

It is our hope that this research will eventually yield an assessment methodology to identify students who are ready for group instruction. Toward that end, it might be helpful to identify whether the ability to maintain skills is associated with increased performance in dyad arrangements, or a high level of learner engagement in individual instruction is associated with better performance in groups. For example, low levels of challenging behavior and solid attending skills in individual instruction might serve as prerequisites to forms of group instruction. Another clinically relevant direction would be to establish cutoffs or termination criteria associated with success in group instruction. Key behaviors to examine might include number of days to acquisition or presence of interfering behaviors, such as out-of-seat behavior and poor attending skills.

It is still the case that individuals with ASD need to develop group instruction skills, and that future environments will present mostly group contexts for learning. Therefore, there is a need to continue to identify the skills and formats that will lead to successful engagement in group instruction. It seems likely that there will need to be a more molecular analysis of the factors—both individual and instructional—associated with readiness success. In addition, more examination of the formats of instruction on a nuanced level should yield helpful guidelines.

Compliance with Ethical Standards

Ethical Approval All procedures in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare that they have no conflict of interest.

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