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The Effects of Visual Cues, Prompting, and Feedback within Activity Schedules on Increasing Cooperation between Pairs of Children with Autism Spectrum Disorder

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Abstract

Activity schedules are visual support strategies that use visual cues, such as photographs and/or written words, to teach a learner to engage in a sequence of tasks or activities independently. Until recently, research on activity schedules has involved one schedule being followed by one individual. In order to facilitate cooperation between two individuals to complete one task, and to increase engagement between peers, cooperative activity schedules are being introduced as interventions in educating students with autism. A multiple baseline design across three activities was used to assess the effects of including an instructional package consisting of visual cues, prompting, and feedback to increase cooperation within an activity schedule between two students with autism spectrum disorder (ASD). This design was replicated across two pairs of participants. Baseline data indicated a lack of cooperation across both of the pairs. Following intervention, an increase in cooperation amongst both of the pairs was demonstrated. All prompting and reinforcement systems were effectively faded out for both pairs, and 2-week and 1-month follow up probes indicated cooperation maintained in the presence of the visual cue.

Cooperative Activity Schedules in Children with Autism Spectrum Disorder

Children diagnosed with autism spectrum disorder (ASD) often present with a range of social impairments that make it difficult to engage in cooperative behavior with others (Liebal, Colombi, Rogers, Tomasello, & Wareken, 2008). These include deficits in imitation skills (Rogers & Pennington, 1991; Griffith Pennington, Whener, & Rogers, 1999; Sigman & Ungerer, 1984; Bryson & Smith, 1998), the use of joint attention (Jones & Carr, 2004; Bono, Daley, & Sigman, 2004; Kasari, Sigman, Yirmiya, 1990; Sigman & Mundy, 1989), and initiating bids for joint attention (Baron-Cohen, 1987). Imitation plays a fundamental role in the development of coordinated acts (Liebal et al., 2009). Imitation skills provide children with visual or verbal cues on how to socially respond in various situations, in relation to peers or others responding within the same context. Joint attention is the shared focus of two individuals on an object. It is achieved through eye gazing, pointing, or other verbal or non-verbal acts (Bono et al., 2004).
Impairments in cooperation skills in children with ASD may in part be due to deficits in imitation and joint attention along with their inability to share intentions and experiences with others (Tomasello, Carpenter, Behne, & Moll, 2005).

Similar to joint attention, cooperation involves activities with shared goals and intentions (Liebal et al. 2008). Shared cooperative activities have three main features that consist of cooperating partners who are 1) mutually responsive to each other, 2) hold a shared goal, and 3) mutually support each other in their roles in order to achieve that shared goal (Bratman, 1992). Individuals with ASD tend to demonstrate difficulty engaging in cooperative behavior, either in play or during social activities, thus leading to difficulties within group teaching contexts (Spriggs Gast, & Ayres, 2007). Cooperation skills are defined as two students working together to complete a task. This may involve turn taking and sharing responsibilities of task completion (Betz, Higbee, & Reagon, 2008). Studies have demonstrated cooperative behavior between typical toddlers between the ages of 18 and 24 months (Warneken, Chen, & Tomasello, 2006) and between the ages of two and three in dyads with their respective peers (Ashley & Tomasello, 1998). The results of the above studies indicate that even before their second birthday, typically developing toddlers are capable of forming a shared goal and then coordinating their behavior and attention with an adult in pursuit of this common purpose (Warneken et al., 2006).

Deficits in cooperative skills in individuals with ASD can contribute to dependence on caregivers, teachers, and supervising adults to initiate a task or activity (Copeland & Hughes, 2000). Many intervention packages rely heavily on verbal instructions, modeling, and gestures. These stimulus prompts are often associated with reinforcement during teaching, and might, thereby, acquire stimulus control over the target responses (MacDuff, Krantz, & McClannahan, 1993). Consequently, learners with ASD may become prompt dependent. That is, they fail to perform target responses independently and rely on interaction with the instructor to complete the skill and the presence of the stimulus prompts. For example, an individual with autism might learn a complex behavior chain, such as playing with toys, completing vocational tasks, or engaging in functional skills, yet often fail to exhibit these responses independent of prompting procedures (Billingsley & Romer, 1983; Sheinkopf, 2005). Thus, increasing independence in individuals with ASD is one of the key elements in creating an effective curriculum. In order to facilitate increased independence in both task completion and social interactions, an activity schedule may be implemented. Research has demonstrated that activity schedules have been an effective tool in increasing on task behavior and thereby independence (McClannahan & Krantz, 1999).

An activity schedule is a visual support strategy that uses visual cues, such as photographs and/or written words, to facilitate following a sequence of tasks or activities independently (McClannahan & Krantz, 1999). Visual stimuli can be presented in a variety of forms. Photographs (MacDuff et al. 1993; Jolly, Test, & Spooner, 1993), pictures and line drawings (Frank, Wacker, Berg, & McMahon, 1985; Pierce & Schriebman, 1994), and symbols and words (Stromer, Mackay, McVay, & Fowler, 1998) are examples of visual stimuli that can be used within a schedule to prompt a correct response. The visual component of the activity schedule is likely a critical component contributing to its effectiveness across situations. The visual components of activity schedules provide communication as to what and how much work should be completed, and, often, for how long a duration (Bryan & Gast, 2000). The visual component also provides a structured teaching environment which makes clear expectations and decreases
the reliance on continuous adult prompting (Schopler, Hearsay, & Mesibov 1995). When visual cues are used as a primary form of instruction and communication, an increase in skill acquisition in students with ASD has been noted (Shopler et al., 1995).

Additionally, individuals with ASD often have difficulty initiating the next step in a complex chain of behavior. As an individual learns to brush his teeth, he may not be able to complete the steps consecutively without a prompt to initiate each specific skill within the chain (MacDuff, et al. 1993). For example, the individual may not put the toothbrush in his mouth after putting the toothpaste on the brush. Activity schedules mediate transitions between activities by using visual prompts to occasion specific behavior chains. As a result, an activity schedule can promote independence in a sequence of multiple activities, such as a self-care morning routine.

**Activity Schedules and Cooperation**

A specific area lacking research is the application of activity schedules to increase cooperation between students with autism and their peers. As the prevalence of ASD in children rises, the number of individuals requiring long-term services will also continue to increase (Center for Disease Control and Prevention, 2012). As the projected costs of treating an individual with ASD continue to rise as the cost of living increases yearly, the need for cost-effective interventions that require less direct staff intervention to service larger numbers of clients is an immediate priority (White, E., Hoffman, B., Hoch, H., & Taylor, B., 2011). Students with ASD have difficulty functioning within group settings due to a myriad of reasons, including behavioral concerns when in larger settings (White, et al. 2011) and, therefore, only participate in programs with 1:1 student-teacher ratios (Harris & Handleman, 2006). In order to make group instruction more efficient and worthwhile, individuals with ASD would require more independence in schedule following and transitioning between activities (White et al. 2011).

When using activity schedules, students with ASD typically follow individualized schedules that target the behavior of one individual at a time. Research that has reviewed activity schedules and social interactions jointly has typically involved one individual with autism following an activity that prompts interactions with a partner who is not following an activity schedule, but is the recipient of the prompted interaction, such as that of a conversation partner (Betz, et al. 2008). In order to increase the efficiency of the technology of activity schedules, the overall scope should be broadened to include targeting the behavior of more than one individual at a time.

Because students with ASD have marked impairments in social skills, a cooperative activity schedule provides the context to teach social skills, such as social interactions, in addition to the task being targeted for completion. A cooperative activity schedule has been shown to incorporate the addition of prompting peer engagement in activities, turn taking, and cooperative play (Betz, et al. 2008). These activities are pertinent to social skill development and are often neglected in classrooms due to the emphasis of academic programs within a student’s curriculum. Cooperation within activity schedules may lead to a decrease in reliance on adult prompts for both activity completion and social interaction, as well as a decrease in the total duration required to complete tasks. It could also decrease the instructional support needed within the classroom setting (White, et al. 2011). In this study, a cooperative activity schedule
would require two students to work together to complete one task on one schedule that could be otherwise completed alone, but would provide opportunities for students to socially interact.

Research on cooperation in activity schedules has focused on teaching pairs of students to work towards one terminal end goal through cooperative schedules, but has highlighted different aspects of peer interactions. Cooperative schedules have successfully demonstrated an increase in peer engagement for students with ASD (Betz, et al. 2008) and more recently, increased collaborative work in completing vocational tasks (White, et al. 2011).

Betz, Higbee, & Reagon (2008) focused on teaching preschool students with ASD to follow joint activity schedules that cued both individuals to engage in interactive games with each other. During baseline, the two children were asked to go play. Specific board games were already selected and no activity schedules were present. During teaching, a joint activity schedule was present. The results indicated low levels of engagement during baseline, which, following intervention, reached or surpassed criteria, and were maintained across the maintenance phase. Overall, joint activity schedules were effective at increasing peer engagement across all three dyads.

The second study by White et al. (2011) that specifically looked at joint activity schedules also demonstrated success. The tasks selected for this study included teaching three different adapted living skills. Baseline included completing the task without prompts, reinforcers, or error corrections. The session ended when the task was completed or when three 1-minute intervals of non-engagement occurred. Intervention consisted of teaching and probe sessions. Teaching sessions incorporated prompting the participants to complete only their designated portion of the behavior chain. During probe sessions, participants were asked to complete the tasks. The results indicated that all three groups were able to meet criterion to complete a single activity schedule together. Overall, participants cooperatively worked together on one activity schedule to complete tasks. The key factor in both of these studies is that selected participants were able to fluently follow independent activity schedules, and the goal was to increase cooperative behavior within their dyad.

These studies are important for a number of reasons. Due to increased difficulty children with autism have with social interactions (Sheinkopf, 2005), using activity schedules to promote peer engagement, cooperation during tasks, and cooperative play amongst children is a new area of research to be explored. As the results indicate, following independent schedules may facilitate the mastery of two individuals jointly following a schedule (White, et al. 2011). It should also be noted that following an activity schedule cooperatively is a distinct skill compared with following one independently (Betz, et al. 2008; White, et al. 2011). Currently, there is a need to replicate these studies in order to support and build on these findings. The research question that was investigated in this study was: Do activity schedules with embedded cues for cooperation increase cooperative behavior in students with ASD? This study examined the effects of visual cues, prompting, and feedback within activity schedules on increasing cooperation between pairs of children with autism.
Method

Participants
Participants included four children diagnosed with ASD between the ages of 9 and 14 years who were enrolled in a special education school that utilizes the principles of applied behavior analysis. The first pair included a fifteen-year old male, Landon, and a fourteen-year old female, Alana. The second pair included a 9 year-old male, Dennis, and 10-year old male, Joey. Participants were selected based on their abilities to independently and accurately follow picture activity schedules and their results from the Vineland Adapted Behavior Scale. All participants were diagnosed with autism as toddlers by medical physicians according to DSM-IV (2000) criteria. All participants exhibited deficits in language, socialization, adapted living, vocational, and cooperation skills.

Setting
All sessions were conducted in the participants’ school building (a special education school for children diagnosed with ASD), either in the classroom or the school kitchen, depending on the activity being targeted. Sessions lasted approximately 20 minutes in duration and occurred five times per week.

Materials
Cooperative Activity Schedules. Activity schedules for both pre-training and intervention sessions were designed based on participant need. All materials necessary to complete the designated vocational tasks were located within the work center (e.g., spray bottle, rags). Activity schedules were created with word descriptions of the activity in list format (e.g., replace the staples). Each participant was assigned to three different activities per dyad group, which included cleaning the office, cleaning the kitchen, and putting away laundry. Participants had no prior experience with the specified vocational tasks prior to the start of the study. All activity schedules were printed on 8-inch by 5-inch, white laminated paper. Times new roman font was used consistently throughout the schedules, with size 36 font for the student’s name, followed by size 24 font for the steps to each activity. All tokens were round, blue poker chips, 1.5 inches in diameter. A Sony Handycam 16 gigabyte camera with 3.3 pixels was used to video record all sessions throughout the study.

Vineland Behavior Adaptive Scales. The Vineland Adaptive Behavior Scales, 2nd Edition (VABS-2; Sparrow, Cicchetti, & Balla, 2005) provides a comprehensive assessment of typical performance of the day-to-day activities required for personal or social sufficiency as perceived by the individual(s) completing the form. Community-University Partnership evaluated the reliability and validity of the Vineland-II (CUP, 2011). The overall Vineland is broken down into five domains. These domains include communication, daily living skills, socialization, motor skills, and maladaptive behavior domains. The domains focused on in this study include communication, socialization, and daily living skills.

Dependent Variables and Measurement Procedures
Schedule Following. Data were collected on the percentage of trials with correct responding across schedule-following components throughout all phases. Correct responding was defined as a participant checking the schedule, crossing off the next step with a dry erase marker prior to completing the step, completing the first or next consecutive step in the activity schedule as
outlined by the listed photographic schedule accurately, and returning to the schedule to see the next step not checked off. Each step was scored separately, although all steps must be completed independently and accurately for the trial to be scored as correct. Participants were directly observed, and data were collected by scoring a plus or minus on the data sheet during probe sessions. Probe sessions were conducted every third session throughout the study.

**Percentage of Cooperative Steps Completed.** Data were collected on the percentage of opportunities in which cooperation with a peer occurred throughout all phases. Five opportunities for cooperation were programmed into the schedule during each session for each dyad. Cooperation was defined as two students working together to complete one task on one schedule. These tasks could be completed alone but provided an opportunity for students to interact with each other. For cooperation to be scored as correct, an interaction between the two participants to complete one portion of the task occurred, which included one participant vocally requesting assistance from his/her peer, and then both participants completing the next step within the chain together in its entirety. Data were collected on individual steps, but all steps had to be independent and accurate for an opportunity of cooperation to have successfully occurred. Following cooperation, the participant who asked for help thanked the second participant for helping, which indicated the task was completed and that the participant could return to his/her own schedule. Data were scored on whether the second participant returned to his/her original task (schedule). Throughout schedule following, data were also collected on accuracy of the participants completing the schedule of tasks. Participants were directly observed and data were collected during probe sessions by scoring a plus or minus on the data sheet.

**Frequency of Request for Help.** Data were collected on the frequency of prompted requests throughout the activity schedule for each peer. Data were also collected on spontaneous requests for help or assistance that occurred throughout sessions in the absence of the picture cue. Participants were prompted to respond by saying “thank you” following completion of helping to indicate they were finished and could return to their own schedule. Participants were directly observed, and data were collected on a frequency of prompted and independent “thank you” responses during probe sessions.

**Experimental Design and IOA**

A multiple-baseline-across-activities design was used to evaluate the effects of an instructional package which included a visual cue, prompting, and feedback, on increasing cooperative behavior during tasks between two children with ASD. This design was replicated across two participant dyads. Inter-observer agreement (IOA) data were obtained for 30% of all sessions conducted across all conditions by a second trained observer. Agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100. An agreement was defined when both observers scored a response as either correct or incorrect. IOA data averaged 97% agreement for schedule following and ranged between 94% and 100%, 100% agreement for opportunities when cooperation occurred, and 100% agreement for frequency of spontaneous requests for help across baseline and training.

Procedural integrity was obtained for 30% of sessions as well. Procedural integrity was calculated by examining the total percentage of opportunities in which the procedure was correctly implemented across two observers. Data were collected on the following components: use of the correct schedule, use of the correct materials, correct placement of materials, correct
verbal instruction to begin the activity, correct dyad pairing, proper instruction and prompt fading, and correct reinforcement schedule. Procedural integrity data averaged 100% for use of the correct schedule, 100% for use of the correct materials, 100% for correct placement of materials, 97% correct verbal instruction to begin the activity with a range of 93% and 100%, 100% for correct dyad pairing, 94% for proper instruction and prompt fading with a range of 91% to 100%, and 97% for correct distribution of the reinforcer with a range of 94% to 100% across both baseline and training.

Social Validity
To assess social validity, classroom teachers of the participants were provided an anonymous questionnaire to complete prior to the start of the study, and following the completion of the study. The questionnaire included questions to assess: (a) if the overall outcome of the study is meaningful to the participants’ lives, (b) the overall social acceptability of the treatment, (c) the teacher’s satisfaction with the amount of helping going on within the classroom, and (d) the feasibility of implementation for teachers in their own classroom. Participants were asked to answer questions using a Likert scale, ranging from one to five, with one equaling strongly disagree, two being disagree, three being neither agree or disagree, four being agree, and five strongly agree. Additionally, normative data were collected on typically developing individuals of the same age as the participants (9-14 years of age) to determine how much helping is standard when completing such tasks.

To assess social validity, six videos were shown to four observers who were naïve to the experimental conditions. Viewers were teachers at the school the participants attended but were not the participants’ teachers. Videos consisted of both baseline and intervention clips. Videos provided an array of clips, showing cooperation, no cooperation, and varying amounts of cooperation. Viewers that were not involved in the study were asked to score cooperation throughout the clips using a Likert scale, ranging from one to five, one equaling not cooperative, two being not very cooperative, three being neither cooperative or not cooperative, four being cooperative, and five being very cooperative.

Procedure

Task Selection. Tasks were selected through interviews of the participant’s teacher, direct observation, and the Vineland Adapted Behavior Scales. The tasks selected were based on total number of steps to completion and total duration of time required for task completion; all tasks were similar in duration. For example, cleaning a table and making the bed are within the same relative duration for completion and may thus be selected versus cleaning an entire room and making the bed, which vary widely in the duration of time required to complete the task. The duration of completion for these tasks was assessed through a competent performer. An example of a potential schedule for cleaning the kitchen includes 10 steps to completion (see Figure 1 for example of cleaning the kitchen schedule).
Pre-training. Prior to the study, participants were trained to follow activity schedules to complete three different tasks independently. The activity schedules consisted of cleaning the kitchen, organizing the office, or folding laundry.

Graduated guidance with spatial fading was used to manually prompt activity schedule following responses and task completion. Manual prompts were always delivered from behind the participant. An unspecified prompt fading procedure was implemented, where upon moment-to-moment decisions about prompting and fading were made based on the participant’s demonstration of the skill. Fading started by moving from a full physical prompt to a less intrusive prompt, until independence was achieved. Initially, hand-over-hand manual guidance was provided, with the experimenter first guiding the participants’ hands, then elbows, and then upper arm (White, et al. 2011). Following changing the location of the prompt, the experimenter shadowed the participant. The experimenter followed the participants’ movement, without touching them. The distance of shadowing was increased from one to three meters between the participant and the experimenter (White, et al., 2011).

Participants were prompted to check the step off in the activity schedule with a dry erase marker prior to completing the step. No verbal prompting was used and teaching continued until participants independently achieved 100% accuracy in responding across two consecutive sessions with the experimenter three meters away. Tokens were provided contingent on correctly completing a step of the chain, and were exchanged for other primary or secondary reinforcers (e.g., candy, computer games) following the completion of the task. The experimenter approached the participants’ and showed them the actual delivery of the token in their respective bags. Participants exchanged tokens for their self-selected reinforcers following completion of the activity schedule. For safety purposes, the occurrence of maladaptive behavior would have resulted in the termination of the session, however, this did not occur for either dyad group throughout the study. This procedure was replicated across all three activities selected for each participant during the skill assessment.

Baseline. During baseline, both participants in a dyad were present, were provided with sufficient materials to complete a task in parallel and could, at any time, work cooperatively.
Participants were initially instructed to follow one presented activity schedule acquired during the pre-training phase (See Figure 2 for baseline example).

![Activity Schedule](image)

**Figure 2. Steps contained within baseline schedule for doing laundry.**

Both participants individually demonstrated mastery (100% independent accurate responding) of the selected tasks prior to beginning baseline measures. Participants were set up at one work station and had access to one schedule and the needed task materials. Throughout the baseline condition, participants were presented with the instruction, “Let’s work together to complete (specific activity).” No prompting, error correction, or reinforcement was provided during baseline. Visual cues to prompt cooperation were not provided in the schedule. Sessions were scored for percentage of independent and accurate responding, percentage of cooperation between the two peers, and frequency of requests for help. If both participants had stopped working for a duration longer than 3 minutes, the activity would have been ended. This did not occur for either participant dyad group.

**Intervention.** The cooperative schedule incorporated visual cues for cooperation embedded throughout the activity schedule with their assigned peer on the same task they previously had acquired individually during pre-training (See Figure 3 for schedule with opportunities of cooperation).
The sequential placement of the give/take picture was consistent throughout the schedule. In each session, five cues for cooperation were embedded into the schedule for each activity for each dyad pair. These opportunities were indicated through a give/take picture, which depicted a hand placing an item into another hand. The picture indicated the need for the other participant to ask for help. Participants stopped their current activity and were vocally prompted, “I need help,” or “Can you help me?” following sight of the picture depicted in the schedule. All vocal prompts were faded out systematically until participants were vocally requesting for help following just the sight of the picture. No gestures to the picture were required throughout initial training, as the picture aligned with the task precisely. For example, a participant (1) checked the schedule, (2) crossed off the step, (3) completed the actual step, and (4) returned to the schedule. For specific examples of cooperation, a participant (1) checked the schedule, (2) crossed off the step, (3) vocally asked the other participant for help, (4) completed the step with the other participant, and (5) returned to the schedule. Manual guidance was used to facilitate helping, if the participant that was the recipient of the request failed to help after three seconds of the request. Prompting and fading procedures were the same as in the pre-teaching condition.

During teaching sessions, one participant was asked to begin the activity schedule and immediately guided to check off the first item indicated. For each selected activity, five opportunities for cooperation were identified. For example, if cleaning the kitchen was the selected target in the 10-step task analysis, five opportunities to request for assistance from the assigned peer were identified through a give/take picture icon. These opportunities included one participant completing the step in the activity schedule, followed by requesting help when the give/take picture was present, and the two participants completed the step cooperatively. The participant who asked for help returned to the schedule and crossed out and completed the next step in the activity schedule, while the other participant returned to the step he was completing before helping his peer (See figure 4 for schedule example).
Table of Activity Schedule Steps:

<table>
<thead>
<tr>
<th>Participant A</th>
<th>Participant B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean the stove.</td>
<td>Clean the table.</td>
</tr>
<tr>
<td></td>
<td>Ask for help.</td>
</tr>
<tr>
<td>Helps clean the table.</td>
<td></td>
</tr>
<tr>
<td>Returns to cleaning the stove.</td>
<td>Straighten the chairs.</td>
</tr>
<tr>
<td>Wash the dishes/utensils.</td>
<td></td>
</tr>
<tr>
<td>Ask for help.</td>
<td>Helps dry the dishes/utensils.</td>
</tr>
<tr>
<td></td>
<td>Returns to straightening chairs.</td>
</tr>
<tr>
<td>Cleans the cabinets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sorts and puts away the dishes/utensils.</td>
</tr>
<tr>
<td></td>
<td>Ask for help.</td>
</tr>
</tbody>
</table>

Figure 4. Steps contained within an activity schedule for cleaning the kitchen

The order of which participant started the activity schedule was randomized so that the same participant did not start the activity schedule daily. Manual guidance was used as needed to prevent any errors.

Tokens were provided contingent on correctly completing a cooperation opportunity, defined as requesting for help and the peer completing the next step in the schedule, and were cashed in following the completion of the task. The experimenter went over to the participant and delivered the tokens in their respective bags on their workstation. Participants later exchanged their tokens for their self-selected reinforcers following completion of the activity schedule.

**Probe sessions.** Probe sessions were conducted after every third teaching session and followed the exact same contingencies as in baseline, except the give/take picture was embedded within the activity schedule. Teaching sessions were terminated once mastery criteria of 95% independent and accurate responding was achieved. All subsequent sessions were probe sessions and a proximity fading procedure was implemented. The fading procedure involved increasing the distance between the experimenter and the participant in 1-meter increments (beginning with immediately behind the participant and ending across the room from the participant) following each probe session at 95% independent and accurate responding.

**Generalization Sessions.** Generalization sessions were conducted to assess if cooperation would occur with a novel peer, in different settings, and with different activities. Participants were presented with a novel activity with a novel partner in a novel setting and assessed to see if generalization occurred from the original peer, setting and activity. During generalization sessions “help” cues were embedded throughout the schedule. Additionally, baseline probes
were conducted every 6th teaching session to assess if cooperation occurred when the give/take picture was removed from the activity schedule.

Results

Pre-training
The results of pre-training demonstrated steady acquisition of all three tasks by all four participants (See Figures 5 and 6). Figures 5 and 6 depict the acquisition rate, which ranges from 4 to 7 sessions for all participants to reach mastery.

Figure 5. Line graph showing percentage of schedule following and percentage of accuracy for Landon (left) and Alana (right) during pre-training. Closed circles indicate percentage of accurately completing the tasks independently within the schedule, and open circles indicate accuracy of following the schedule in sequential order.
Figure 6. Line graph showing percentage of schedule following and percentage of accuracy for Joey (left) and Dennis (right) during pre-training. Closed circles indicate percentage of accurately completing the tasks independently within the schedule, and open circles indicate accuracy of following the schedule in sequential order.

Landon demonstrated the quickest rate of mastery, averaging four sessions per activity to meet mastery. Figures 5 and 6 also depict schedule following during pre-training. All participants initially required prompting to check off the step prior to completing it. All participants met mastery criteria and remained consistent with schedule following throughout all conditions.

Baseline. All four participants acquired the skill of independent schedule following during pre-training and maintained it during baseline (see Figures 7 and 8). Throughout baseline, Landon made one error following his schedule during the kitchen task, but maintained at 100% accuracy for both the office and laundry (see Figure 7). Alana maintained schedule following, also having one one error during the kitchen task (see Figure 7). Joey was the most inconsistent with schedule following, with an error during the kitchen task, and multiple errors made during the laundry task (see Figure 8). Dennis maintained schedule following, also having one error during the kitchen task (see Figure 8). Throughout both baseline and intervention, participants maintained schedule following with minimal errors that did not impede their abilities to maintain the correct sequence of tasks. In order to be scored as a correct trial, all four parts involving following the schedule had to be correct. Figure 9 and 10 show the percentage of independent cooperation instances throughout baseline. During baseline, Landon and Alana engaged in cooperation on 0% of all five presented opportunities. No spontaneous requests for help were
documented for Landon or Alana. During baseline, Joey and Dennis engaged in cooperation on 0% of all five presented opportunities. No spontaneous requests for help were documented for Joey and Dennis.

Figure 7. Line graph shows percentage of accurate schedule following for Landon (left) and Alana (right) throughout baseline and intervention.
Figure 8. Line graph shows percentage of accurate schedule following for Joey (left) and Dennis (right) throughout baseline and intervention.

**Intervention.** Figures 9 and 10 show the percentage of independent cooperation instances during intervention.

Figure 9. Line graph shows percentage of independent opportunities for accuracy, schedule following, cooperation, and baseline probe sessions for Landon and Alana throughout baseline and intervention. The first arrow indicates the first session where the instructor started to fade proximity away from the participant. The dot indicates where the instructor was faded completely. Follow up arrows show percentage of independent opportunities for accuracy, schedule following, and cooperation for 2 week and 1 month checks.
Figure 10. Line graph shows percentage of independent opportunities for accuracy, schedule following, cooperation, and baseline probe sessions for Dennis and Joey throughout baseline and intervention. The first arrow indicates the first session where the instructor started to fade proximity away from the participant. The dot indicates where the instructor was faded completely. Follow up arrows show percentage of independent opportunities for accuracy, schedule following, and cooperation for 2 week and 1 month checks.

Figure 9 depicts the percentage of opportunities for cooperation for Landon and Alana, with results indicating that the pair met criteria for cooperating on 100% of opportunities, maintaining when both the proximity of the instructor and the reinforcement schedule was faded out. Two week and one month follow up probes depict cooperation maintaining, in the absence of both the instructor and the tokens. Landon and Alana reached criteria, 100% cooperation across all five presented opportunities after one probe session, which was preceded by three teaching sessions. Following 100% cooperation in the probe session, Landon and Alana remained at criteria throughout the fading of both the proximity of the experimenter to across the room and the removal of the reinforcement system. During baseline probe conditions when the cue for help was removed, Landon and Alana engaged in 0% cooperation during the five-presented instances. Two week and one month follow-up probes depict cooperation maintaining at 100% throughout the five opportunities when the cue is present, with both the experimenter across the room and the reinforcement system removed. Throughout intervention, no spontaneous requests for help were made by either Landon or Alana.

The percentage of cooperation for Joey and Dennis is demonstrated in figure 10, with results indicating the pair met criteria for cooperating on 100% of opportunities, maintaining when both the proximity of the instructor and the reinforcement schedule was faded out. Two week and one month follow up probes depict cooperation maintaining, in the absence of both the instructor and the tokens. Joey and Dennis reached criteria of 100% cooperation across all five presented opportunities, after one probe session, which was preceded by three teaching sessions. Following 100% cooperation in the probe session, Joey and Dennis remained at criteria throughout the fading of both the proximity of the experimenter to across the room and the
removal of the reinforcement system. During the baseline probe conditions when the cue for help was removed, Joey and Dennis engaged in 0% cooperation during the five-presented instances. Two week and one month follow-up probes depict cooperation maintaining at 100% throughout the five opportunities when the cue is present, with both the experimenter across the room and the reinforcement system removed. Throughout intervention, no spontaneous requests for help were made by either Joey or Dennis.

**Generalization Probe.** Table 1 summarizes the results of the generalization probe across a novel setting, different activity, and a peer with whom they have not engaged before for all 4 participants.

Table 1.  
*Percentage of Cooperation with Novel Peer, Activity, and Location*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Cooperation</th>
<th>Return to Schedule</th>
<th>Peer Cooperative Response</th>
<th>Novel Peer Request For Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landon</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Alana</td>
<td>100</td>
<td>100</td>
<td>66</td>
<td>0</td>
</tr>
<tr>
<td>Joey</td>
<td>100</td>
<td>100</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>Dennis</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Landon and Alana both requested help from the novel peer assigned in their dyad in a different classroom, with a novel activity of cleaning the classroom, 100% of the time. The novel peer did not always reciprocate engagement in cooperative behavior. For Landon, he received the assistance of the novel peer 100% of the time. Landon returned back to his schedule 100% of the time, but the novel peer did not. Alana asked for help for 100% of all opportunities. She received help from the novel peer on 66% of possible opportunities. She returned back to her schedule accordingly on 100% of the opportunities. The novel peer did not. Joey and Dennis also cooperated on 100% of the opportunities presented with the novel peer. Joey had 80% assistance from the peer once requested, and returned to the schedule 100% of the time. Dennis had 100% of cooperation from the peer, and also returned to the schedule 100% of the time. Throughout the probe, the novel peer never asked for help when the cue was present.

**Social Validity.** Results of the survey given to the classroom teachers regarding the participants indicated no change in how teachers viewed cooperation within their classrooms from pre-test to post-test. Video clips were shown to viewers not familiar with the study to assess whether they felt the video clip demonstrated cooperative behavior on a scale from 1-not cooperative to 5-very cooperative. Videos 1, 4, and 6 all demonstrated instances of cooperation. Video clips 2 and 5 demonstrated no cooperation, and two participants working next to each other, but not together. Video clip 3 showed participants cooperating on 2 out of 5 potential opportunities, demonstrating minimal cooperation. Results of the video clips indicate that all four novel viewers agreed that videos 1, 4, and 6 were a score of 5-very cooperative. The video clips for video 1, 4, and 6 all demonstrated cooperation occurring. The scorers agreed 100% that videos 2 and 5 were a score 1-not cooperative. The video clips for 2 and 5 demonstrated no cooperation, and showed two participants working parallel to each other. Video 3 was a video clip that showed participants
minimally cooperating, on 2 out of 5 opportunities. Two of the scorers stated video 3 was a score of 3—neither cooperative nor not cooperative and two scored it as 2—not very cooperative. Overall, the results indicated a high level of agreement that cooperation did occur in the videos amongst all novel viewers.

Normative data specifically geared to the participants’ ages and genders were collected on two children, one 12-year-old male and one 13-year-old female. While cleaning the office, cooperation occurred on 4 out of 5 tasks; during cleaning the kitchen, cooperation occurred for 3 of 5 tasks; and while doing laundry cooperation occurred during 4 of 7 tasks. The results indicated similar results between the normative data and the participants throughout the intervention.

Discussion

To facilitate learning and improve education for students with ASD, it is necessary to investigate interventions that create more opportunities for students to gain independence, while moving away from one to one instruction, as appropriate. The results of this study indicate that using an activity schedule with a visual cue for cooperation, prompting, and feedback increases cooperation between two students with autism. Cooperative activity schedules offer two students the opportunity to collaborate on a task, thus increasing opportunities for social engagement and interactions, while decreasing the duration of the task (Betz, et. al., 2008). It is feasible that long term effects include achieving levels of independence that are necessary for improving the quality of life for individuals with ASD.

The results of this study indicate that adding a visual help cue to signal cooperation into an activity schedule increases cooperation among students with ASD in a classroom setting. The results of this study aligned with the results of Betz and colleagues (2008) as well as White and colleagues (2011) in demonstrating that cooperative activities schedules can increase cooperation amongst participants. As the results depict, the participants in this study rapidly acquired the skill of asking for help in the presence of a cue and maintained the skill at follow up. Both pairs acquired the skill after only three teaching sessions, allowing for the schedule of reinforcement to be thinned rapidly. The skill of asking for help maintained in both a two week and one-month follow-up, indicating that the use of a visual cue with prompting and feedback could be a viable treatment package for students with autism in classroom settings. Due to the staffing ratios in classrooms and the push for students to spend more time working in groups, having a treatment that is maintained once the presence of the instructor and the reinforcer is faded out is important for the long term.

As White and colleagues (2011) describe, prerequisite skills for following activity schedules vary from following cooperative activity schedules. Following independent activity schedules proficiently is definitely an important pre-requisite to following cooperative ones. White and colleagues (2011) noted the importance of the participant mastering the activities within the schedule prior to introducing it cooperatively. Within this study, participants were required to master the complete activity schedule individually prior to having the schedule introduced cooperatively.
In the current study, during baseline probes in which the visual cue was removed, instructions alone were not sufficient to increase cooperation. Although the experimenter’s instruction at the start of the activity was, “Let’s work together to clean the kitchen” (or other respective activity), during these sessions, the participants did not cooperate on tasks, and instead returned to completing the activities parallel to each other. This occurred for both dyads. Prior to prompting participants to ask for help in the presence of the cue, the participants did not attempt to help each other or complete the others respective tasks. With no cue present, cooperation did not occur across either pair of participants. Additionally, neither pair spontaneously requested for help throughout the study. A possible explanation for this is the fact that the response of requesting help was never systematically targeted for reinforcement. Additionally, the picture cue served as a prompt for the response, and was never faded; therefore, it is highly likely that the picture cue acquired stimulus control, thus the participants did not request help when the picture cue was not present.

There are limitations to this investigation. First, not knowing what specific variables(s) is responsible for the increase in cooperation among the participants. Participants were instructed to work together to complete a task, and the verbal directive alone was not enough to increase cooperation. It is unknown if the total package or selected parts of the intervention package is what increased responding. A component analysis would need to be done to fully determine which component(s) was responsible for the change in behavior. Specific consideration should be paid to the effect, if any, token reinforcement had on cooperation due to rapid acquisition but lack of demonstration of the skill in the absence of the visual cue.

A second limitation is that the results did not generalize for requesting help in the absence of the visual cue. Additionally, participants did not spontaneously request help from each other for activities in which the picture was absent. Although following a schedule with built in opportunities for cooperation is a skill, it is useful to look at how the skill of requesting help can be broadened to facilitate asking for help spontaneously or in the absence of a picture prompt, or when help is actually needed (e.g. requesting help because you want to finish sweeping faster versus requesting help because you cannot lift something alone).

A third limitation is that the results of the teacher survey indicated no change in teacher’s perceptions of cooperation within their classrooms following the end of the study. This may be due to the questions not specifically representing the goal of the questionnaire effectively. The questions may have been too vague, and did not necessarily represent the specific objectives of the study directly. Additionally, the questionnaire did not provide the definition of cooperation as used for this study. Thus, teachers may have defined cooperation differently and felt they had cooperative students prior to the study. However, it should be noted that in anecdotal discussions with the teachers following completion of the survey, they did report the students as being more cooperative in their day-to-day activities with peers following completion of the study.

To increase the number of spontaneous requests for help and generalization of the response in absence of the visual cue, future studies should look at establishing contingent reinforcement for engaging in the response of requesting for help, fading the visual cue, and increasing the response for requesting for help when it is actually needed. As discussed in the limitations, the response for requesting for help was never systematically targeted for reinforcement. Future
research might consider providing reinforcement contingent on requesting for help as this might strengthen the response in addition to providing a reinforcer at the end of the chain of cooperative behavior.

Within this study, all opportunities to request for help were generated to encourage cooperation between two participants, however help was not actually required to complete the activity (e.g. moving a heavy table). Future research might look at including opportunities for participants to ask for assistance throughout the schedule during times when it is actually needed. One of the ways in which to address this may be to select tasks where help will be required as opposed to instructed. This would likely increase the student’s motivation to ask for help in the moment.

In this study, the response of requesting for help was not demonstrated in the absence of the visual cue; therefore, it is likely that the cue served as a discriminative stimulus. Future research might consider strategies to fade the visual cue, as this would potentially serve to decrease prompt dependency on the cue. Furthermore, it would potentially increase independent and spontaneous requests for help since responding came under the control of the help stimulus rather than the actual tasks.

Future research might also consider including the ability to wait as a criterion for participant selection. White et al., (2011) mention that instructing students to wait may be an important area to target when tasks in the schedule must be completed in a specific order. For example, if the steps include washing the dishes and then drying the dishes, the dishes must be washed prior to being dried. In this study, the participants who were selected all demonstrated the ability to wait throughout the study, although this was not initially planned during participant selection.

In summary, teaching students with ASD in dyads and groups needs to become a focus of future research. Settings for children with autism are frequently no longer supporting ratios that sustain one to one instruction, thus, students are being expected to perform in groups without the proper pre-requisite skills. As the number of students assigned to therapists increases, so does the need for students to be able to work independently under lean schedules of reinforcement and without close proximity to instructors. These findings further the research on cooperative activity schedules, and continue to support the need for instruction to incorporate cooperation throughout group instruction.

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