Further Evaluation of the Stimulus Pairing Observation Procedure with Children with Autism Spectrum Disorder

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Abstract

A large amount of learning occurs through the observation of stimulus-stimulus relations. One procedure that involves this sort of learning is the stimulus-pairing observation procedure (SPOP). The current study involves a systematic replication of Byrne, Rehfeldt, and Aguirre (2014). Tests for the emergence of tact and listener relations were conducted pre- and post-SPOP intervention, which consisted of a therapist presenting auditory-visual stimulus relations to participants. The SPOP intervention resulted in the establishment of tact and listener relations for all participants. The importance of assessing prerequisite skills is considered in the context of previous research.

Keywords Autism · Observational learning · Stimulus-pairing observation procedure · Verbal behavior

A large amount of intervention work has been conducted with children with autism spectrum disorders (ASD) within the field of applied behavior analysis (ABA). This has resulted in the development and dissemination of a number of technologies over the years, ranging from more structured (e.g., discrete-trial instruction) to more naturalistic teaching interactions (e.g., incidental teaching). The topic of language development, or verbal behavior, has specifically received a large amount of attention within the behavior-analytic literature on ASD. Largely impacted by the work of B. F. Skinner (1957), many research studies have focused on the development of early language skills using operant contingency-based instructional programs. This work rests upon the systematic use of prompting and differential reinforcement to develop verbal behavior.

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Although many verbal skills may develop through the use of contingency-based instruction, this form of instruction may be both inefficient and cumbersome. Moreover, research has shown that verbal behavior may also develop in the absence of a history of specific reinforcement (e.g., that a child may engage in the tact “tree” in the absence of a specific history of reinforcement for tacting “tree”). Indeed, a number of areas of research have examined this phenomenon, including that related to naming (Horne & Lowe, 1996) and the integration of speaker-listener repertoires (e.g., Greer & Speckman, 2009) and derived stimulus relations in general (e.g., Hayes, Barnes-Holmes, & Roche, 2001; Sidman, 1994). These research areas have direct implications for education (Rehfeldt, 2011), including the development of more complex language skills with learners with ASD and related developmental disabilities (e.g., Rehfeldt & Barnes-Holmes, 2009).

A number of procedures and interventions have been studied within the broad area of derived stimulus relations. One procedure, specifically developed within the stimulus equivalence literature, involves the presentation of stimulus-stimulus relations in the absence of any specific response on the part of the learner or provision of reinforcement for responding. If learning occurs through this procedure, it would mean that specific responses may develop in the absence of a history of reinforcement for those specific responses. This learning arrangement is conceptually interesting as it questions the necessity of a specific history of reinforcement for responding as is often involved in other procedures in the equivalence literature (e.g., match-to-sample procedures). Moreover, there are also applied implications, as this procedure seems to involve processes that are involved in the large amount of learning that occurs in most educational and social environments through the observation of stimulus-stimulus relations (e.g., observing a parent pointing at a shoe and saying “shoe,” or a teacher modeling a skill in front of a group of students).

This procedure, termed *respondent-type training* early on and more recently the *stimulus-pairing observation procedure* (SPOP), has received a fair amount of attention from researchers in behavior analysis over the years (e.g., Leader & Barnes-Holmes, 2001; Leader, Barnes-Holmes, & Smeets, 1996; Smyth, Barnes-Holmes, & Forsyth, 2006). More recently, applied researchers have also begun to examine SPOP, specifically toward the development of emergent language (e.g., Byrne et al., 2014; Rosales, Rehfeldt, & Huffman, 2012; Vallinger-Brown & Rosales, 2014).

One recent study was conducted by Byrne et al. (2014), who evaluated the effectiveness of SPOP and multiple-exemplar instruction (MEI) on tact and listener responses with three elementary school-aged children diagnosed with ASD and language delays. During SPOP instruction, a therapist held up a picture while saying its corresponding name (e.g., saying “gum” while holding up a picture of gum). The dependent variables were the percentage of correct tact and listener responses during pretest and posttest probes. Echoic responses were also examined to determine their relationship to both tact and listener responses. If participants failed to meet the mastery criterion during the posttests that followed SPOP instruction, MEI was conducted. Remedial SPOP (which was identical to SPOP) was implemented if participants did not demonstrate emergent tact and listener responding with the original stimuli following MEI.

Consistent with the results of other research (Rosales et al., 2012), SPOP and MEI proved to be effective in improving emergent tact and listener responding (though the effects for one participant were minimal). Byrne et al. (2014) noted that SPOP may be

more effective with children who already possess certain prerequisite skills. For example, the participant who benefited the least from the intervention also had expressive and receptive communication skills that were lower than the other participants. Furthermore, this participant also engaged in challenging behavior, which may also have impacted results. Finally, as only one 45-trial SPOP session was conducted with the initial set of stimuli in this study, it seems possible that additional exposure to SPOP may also facilitate the emergence of tact and listener responses in the absence of other interventions. This may have practical implications, as SPOP instruction is relatively easy to implement.

Given the importance of understanding how to facilitate the development of verbal behavior, and the implications for social development and inclusion in less intrusive learning environments, more research on SPOP seems warranted. Moreover, although researchers have begun to assess SPOP with learners with ASD and related developmental disabilities, more research is needed to replicate and extend upon this work. As such, the present study aims to systematically replicate the procedures of Byrne et al. (2014), specifically by providing additional exposure to SPOP instruction if initial exposure is not effective and by including participants with additional prerequisite skills and who do not engage in challenging behavior. Moreover, maintenance probes will be conducted to better understand the extent to which behavior change endures over time.

Method

Participants

Three children diagnosed with ASD by psychologists and developmental pediatricians participated in the study. All three participants received in-home behavioral services based upon ABA. Blair displayed sophisticated language skills appropriate for her age (6 years old). Her tact and listener skills were beyond those specified on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008). Due to this, the VB-MAPP was not used to assess her language skills. Blair fell in the 5- to 6-year-old developmental range in communication and cognition on the Battelle Developmental Inventory (BDI; Newborg, 2005). Scores for the Preschool Language Scale, Fifth Edition (PLS-5; Zimmerman, Steiner, & Pond, 2011), showed Blair to be at the age equivalent of 6 years 10 months for auditory comprehension and expressive communication. Jhené also displayed language skills appropriate for her age (8 years old) and thus the VB-MAPP was not used to assess her language skills. Jhené fell in the 7- to 8-year-old developmental range on the BDI in communication and cognition. Scores for the PLS-5 showed Jhené to be at the age equivalent of 7 years 9 months for auditory comprehension and 7 years 11 months for expressive communication. Noel (7 years old) displayed tact and listener skills consistent with those specified in Level 2 (developmental level of 18–30 months) on the VB-MAPP. On the BDI, Noel fell in the 2- to 3-year-old developmental range for communication and cognition. Scores for the PLS-5 showed Noel to be at the age equivalent of 3 years 6 months for auditory comprehension and 3 years 7 months for expressive communication.

Setting and Stimulus Materials

Data collection occurred two to three times per week for 45–60 min in a private area where the participants typically participated in ABA-based instruction. During each visit, four to six sessions were conducted. The participants were provided with 3–5 min breaks between the sessions and were provided with reinforcers on a variable-interval schedule of 5 min for attending and sitting appropriately (i.e., praise was provided for looking at stimuli and attending to the therapist but was not contingent on correct responding). Before the start of each session, participants selected small items or activities with which to engage in during breaks. A timer was used to monitor breaks and schedules of reinforcement and to assist the participants' transition between sessions and breaks. As described in Table 1, instructional stimuli consisted of three stimulus sets, each containing three 5 in. × 6 in. (12.7 cm × 15.24 cm) picture cards (i.e., one stimulus set of three for each participant). The items targeted for instruction were selected based on each participant's skill, age, and grade level and/or per parent request. Vocabulary word lists were also consulted, which were put together from an analysis of words that appear in textbooks or reading books taught in the third to fifth grades. These vocabulary lists are available through the systematic vocabulary development program, the Word Up Project (Flocabulary, 2017). Words from these lists were probed until words that were not already in the child's repertoire were identified and assessed more formally during pretest conditions.

Response Measurement

The dependent variables were the percentage of correct tact and listener responses on pretest and posttest probes. During tact probes, the participant was presented with a picture card followed by the question, "What is it?" If the participant correctly labeled the stimulus within 5 s, a correct tact response was recorded. If the participant did not respond within 5 s or labeled the stimulus incorrectly, an incorrect response was recorded. During listener probes, three picture cards were presented in front of the participant followed by the instruction, "Point to the [stimulus]." If the participant pointed to the correct stimulus within 5 s of the instruction, a correct listener response was recorded. If the participant did not respond within 5 s or selected an incorrect stimulus, an incorrect response was recorded.

Table 1 Stimulus sets for each participant

Participant	Stimulus Set
Blair	Coast
	Crew
	Marsh
Jhené	Aurora
	Jacaranda
	Sea anemone
Noel	Folder
	Ruler
	Stapler

Interobserver agreement (IOA) was calculated using the trial-by-trial method by dividing the number of agreements by the total number of agreements and disagreements and multiplying by 100 to obtain a percentage. IOA data were taken for 35% of pretests and posttests (24% of pretests and 56% of posttests). Specifically, IOA data were taken for 35% of sessions for Blair ($M = 94\%$; range 89%–100%), 33% of sessions for Jhené ($M = 100\%$), and 36% of sessions for Noel ($M = 94\%$; range 89%–100%).

Treatment integrity was assessed using task analyses for each of phase of the experiment, which included assurance of participant attention, presentation of stimuli, presentation of an instruction (or additional verbal stimulus during SPOP instruction), an opportunity to respond (during pretests and posttests), and removal of the stimuli and preparation for a new trial. Treatment integrity was calculated by dividing the number of correct steps performed by the clinician by the total number of possible steps and multiplying this number by 100 to obtain a percentage. Treatment integrity was taken for 38% of pretests and posttests (26% of pretests and 61% of posttests), and 100% of SPOP instruction. Treatment integrity was taken for 35% of sessions for Blair ($M = 94.5\%$; range 89%–100%), 33% of sessions for Jhené ($M = 94.5\%$; range 89%–100%), and 36% of sessions for Noel ($M = 100\%$).

Experimental Design

A multiple-baseline across-participants design was used to evaluate the effectiveness of SPOP. The sequence of conditions was as follows: pretests, SPOP, posttests, and maintenance probes. Additional SPOP sessions were planned for participants who did not meet criteria during posttests. No more than two tact or listener sessions were conducted in a row across participants and phases, and researchers attempted to avoid sequence effects by changing the sequence of tact and listener sessions.

Pretests Pretest sessions consisted of nine-trial blocks to probe for both tact and listener relations. Before the start of pretests, the clinician made sure the participant was attending appropriately by either making eye contact with the clinician or the stimuli presented. If the participant was not looking at the picture, the therapist prompted the participant by saying, “Look at the picture.” The clinician then asked the participant, “What is it?” Listener trials began similarly by the clinician placing three stimuli (picture cards) directly in front of the participant. Once the clinician ensured that the participant was attending, the clinician instructed the participant to “point to the [stimulus].” Participants were given 5 s to respond, at which time the stimuli were removed from the table. Neutral praise was delivered for attending and sitting appropriately, and there were no consequences for correct or incorrect responses.

SPOP Instruction Before the start of each SPOP session, the clinician made sure the participant was attending appropriately by sitting upright and looking and/or touching the stimuli presented. If the participant was not attending (not looking at the stimulus, not sitting upright, etc.), the clinician would redirect the participant by saying, “Look at the picture,” or “Sit up nicely,” or move the stimulus to his or her sight line. Instruction did not continue until the participant was attending. The clinician then presented a stimulus (picture card) while labeling the picture. For example, the clinician held up a picture of a stapler and

then said the word “stapler.” Stimuli were presented in random order with an intertrial interval of 2–3 s. SPOP instruction consisted of five 9-trial blocks, with each of the three stimuli being presented three times during each 9-trial block. In total, SPOP training consisted of 45 trials, 15 trials of each of the three target stimuli.

Posttests Posttest sessions followed SPOP sessions and were conducted in the same manner as pretests. Mastery criterion was met if the participant responded correctly to eight of nine (89%) listener and tact probes across three consecutive sessions. If the mastery criterion was not reached after three to four probes for both tact and listener relations, an additional 45-trial SPOP instructional session would be implemented. This would continue until participants failed to meet mastery criteria three times, at which point MEI would be implemented. (This did not need to happen, as all participants met the mastery criteria.)

Maintenance Maintenance sessions were identical to pretest and posttest sessions and were conducted 1 week after the termination of the final posttest sessions.

Results

Figure 1 depicts the percentage of correct tact and listener responses during pretest, posttest, and maintenance phases for each participant. During pretest sessions, Noel performed with 0% accuracy for tact relations and an average of 12.5% correct for listener relations (range 11%–22%). Following SPOP instruction, Noel’s scores increased to criterion ($M = 94.4\%$ correct; range 89%–100%) and remained at high levels during maintenance sessions ($M = 96.3\%$ correct; range 89%–100%). Jhené performed with 0% accuracy during both tact and listener pretest conditions. Following SPOP instruction, Jhené’s scores increased to criterion ($M = 100\%$) and remained at high levels during maintenance sessions ($M = 94.4\%$; range 89%–100%). During pretest sessions, Blair performed with 0% accuracy for tact and listener relations. Following SPOP instruction, Blair’s scores increased to criterion ($M = 90.7\%$; range 89%–100%) and remained at high levels during maintenance probes ($M = 96.3\%$; range 89%–100%).

Discussion

The goal of this study was to add to our understanding of SPOP with children with ASD and related developmental disabilities. Previous studies have determined that SPOP and MEI can facilitate the development of derived stimulus relations (e.g., emergent tact and listener responding). The current study showed that emergent behavior occurred readily after one SPOP instructional session (i.e., without additional SPOP or MEI); all three participants met mastery criterion for both tact and listener relations after one SPOP instructional session consisting of 15 presentations of each of the three target stimuli and continued to respond accurately during maintenance. These results are inconsistent with Byrne et al. (2014), where participants did not meet

Fig. 1 Percentage correct during pretests, posttests, and maintenance phases across the three participants

mastery criteria after a single 45-trial exposure to SPOP instruction alone. It is possible that participant characteristics (e.g., prerequisite skills) explain the differences between the present study and the results of Byrne et al. (2014). Table 2 provides an overview of the participants in the present study and those in Byrne et al.

From a conceptual standpoint, it is possible that the participants in the present study already had a history of reinforcement for responding with respect to stimulus-stimulus relations, such that this responding now readily occurred in the absence of a specific history of reinforcement. If this were the case, we may begin to understand the developmental progression of learning, and verbal behavior development more specifically. Indeed, it seems possible that more structured, direct contingency-based learning

Table 2 Assessment scores across participants

Participant	Age	BDI	PLS-5	VB-MAPP
Current study				
Blair	6 years	5–6 years	6 years 10 months	
Jhené	8 years	7–8 years	7 years 9 months (AC) 7 years 11 months (EC)	
Noel	7 years	2–3 years	3 years 6 months (AC) 3 years 7 months (EC)	8–30 months
Byrne et al. (2014)				
Jackson	7 years	22 months	3 years 4 months (AC) 2 years 7 months (EC)	1–48 months
Jenna	7 years			1–48 months
Sophia	7 years	5–6 months	2 years 6 months (AC) 2 years (EC)	1–48 months

AC, Auditory comprehension; EC, Expressive communication

is most useful prior to an individual having a history of reinforcement for responding with respect to various stimulus-stimulus relations, prior to establishing this as a generalized repertoire. After such a repertoire has developed, learning may begin to occur more quickly, as it tends to do in less structured social and educational environments. Future research should explore both prerequisite skills and participant instructional histories more systematically to develop an increasingly more sophisticated understanding of which prerequisite skills and instructional histories facilitate learning from SPOP. It is also possible that literature related to SPOP, such as that on bidirectional naming, can inform research and practice in this area (Greer & Ross, 2008; Greer & Speckman, 2009).

Byrne et al. (2014) also noted the challenging behavior exhibited by one participant, who looked away from stimuli, laid on the floor, and refused to respond. This participant did not meet mastery criterion despite additional instructional efforts. The participants in the current study did not engage in challenging behavior, which may further explain why SPOP proved to be effective. It would be difficult to determine whether individuals who failed to benefit from the intervention and also engaged in challenging behavior struggled because of the challenging behavior or if the intervention is ineffective for other reasons. Therefore, in addition to possessing certain prerequisite skills, controlling for variables such as challenging behavior may also increase the effectiveness of SPOP as an instructional procedure for children with ASD. Future researchers may wish to explore the extent to which learners benefit from SPOP before and after effective intervention for challenging behavior is implemented.

Future researchers should also conduct formal stimulus generalization probes, both pre- and post-SPOP intervention, to better understand the extent to which behavior change generalizes as a result of SPOP. In addition, although the present study assessed maintenance 1 week after SPOP instruction, the extent to which skills may endure over longer periods of time is unclear. Additional research might also explore the emergence of equivalence classes through the use of SPOP, as well as the use of SPOP to facilitate more advanced academic skills with learners who have more developed verbal

repertoires. Finally, as many learning environments involve groups of students and a single teacher, additional research is needed to understand the effects of SPOP and related interventions with groups of learners and in various contexts.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest to report.

Ethical Approval This study was approved by the institutional review board and conducted in accordance with the 1964 Helsinki declaration.

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