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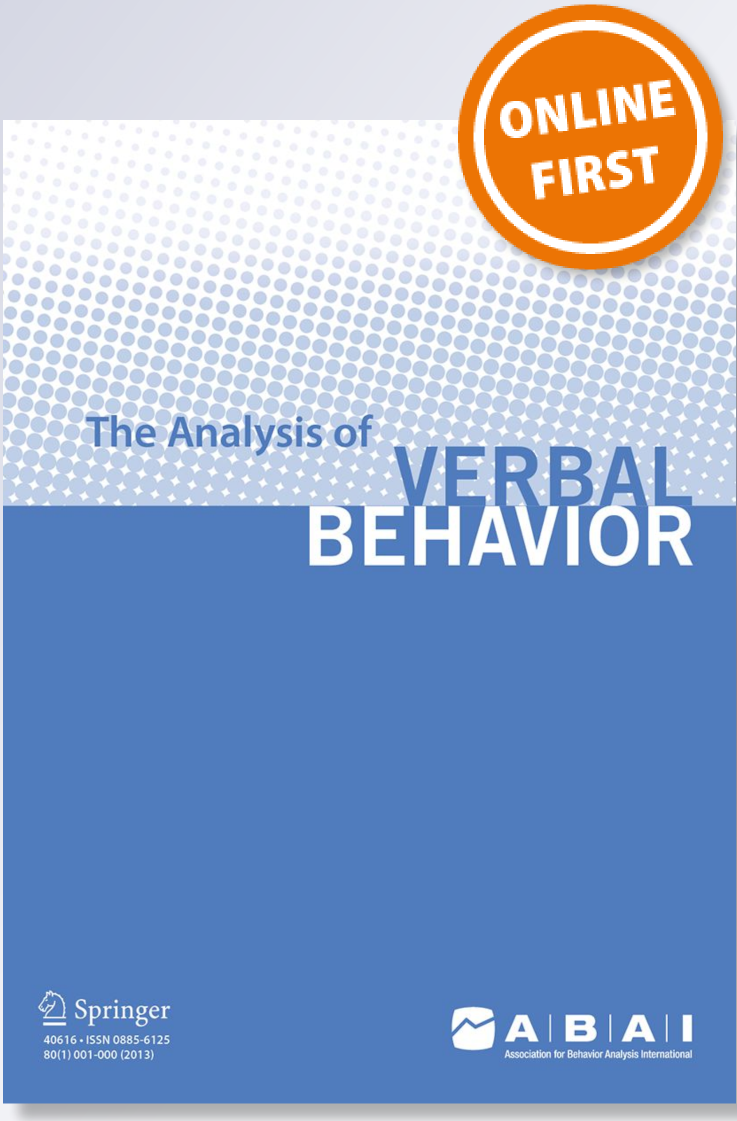

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BRIEF REPORT

Stimulus-Stimulus Pairing of Vocalizations: A Systematic Replication

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Abstract The current study replicated an enhanced stimulus-stimulus pairing (SSP) procedure used by Esch et al. (Journal of Applied Behavior Analysis 42: 42–225, 2009) for increasing vocalizations in children with autism. The enhanced SSP procedure consisted of pairing target vocalizations with high-preference items, interspersed target and nontarget trials, an observing response, and the presentation of the vocalizations in "motherese" speech. Results showed substantial increases in target vocalizations above baseline levels and above nontarget vocalizations for two of three participants.

This study is based on a thesis submitted by the first author, under the supervision of the second author, to the Psychology Department at Caldwell College for the Master of Arts in Applied Behavior Analysis.

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Introduction

For children with developmental disabilities who emit a variety of vocalizations, an array of instructional methodologies exists to promote the development of language (e.g., Lovaas 2002). However, few interventions have been evaluated for children who do not exhibit vocal play and vocal imitation. Recently, a stimulus-stimulus pairing (SSP) procedure has emerged in the literature as a way to produce temporary increases in some children's vocalizations, thus creating a larger variety of phonemes available during subsequent teaching. Sundberg et al. (1996) provided the first empirical demonstration in the literature examining the effects of SSP on the emergence of vocal behavior with children with and without language delays. During the pairing condition, the experimenter emitted a target sound, word, or phrase while concurrently delivering an established reinforcer to the child. This procedure resulted in an increase in target responses across all participants without the use of direct reinforcement, echoic training, or prompts to respond.

Since Sundberg et al. (1996) study was published, 11 studies have evaluated the effects of SSP on vocalizations. In eight studies, SSP resulted in a temporary increase in at least one target vocalization with 18 of the 25 participants, both with and without language delays (i.e., Miguel et al. 2002; Carroll and Klatt 2008;

Esch et al. 2009; Smith et al. 1996; Ward et al. 2007; Yoon and Bennett 2000; Yoon and Feliciano 2007). In three studies, SSP did not result in an increase in target vocalizations for any participants (i.e., Esch et al. 2005; Normand and Knoll 2006; Stock et al. 2008). Taken together, these studies suggest that SSP is an effective treatment for increasing vocalizations for at least some learners. The reason for the discrepant findings across participants is currently unknown; however, some authors have suggested participant variables (e.g., verbal repertoire; Yoon and Bennett 2000) or methodological differences (e.g., target vocalizations, pairing procedures, manner of target sound presentation, experimenter familiarity, type of high-preference items, number of pairing trials, and number of sounds per pairing trial; Normand and Knoll 2006; Stock et al. 2008; Sundberg et al. 1996) as potential variables that may result in the variable effects of SSP.

Esch et al. (2009) evaluated the effects of an enhanced SSP procedure on vocal responses of three children diagnosed with autism and severe language delays. Target vocalizations were selected from phonemes or phoneme combinations that were not under echoic control and were observed to occur in less than 25 % of 30-s intervals during a 30-min free play period. The Esch et al. (2009) study represented an important step in SSP research because of its rigorous methodology and extensive measurement of participant verbal repertoires. In particular, this was the first study to include interspersed target and nontarget trials, allowing the researchers to demonstrate that pairing of vocalizations and high-preference items (and not mere exposure to high-preference items) produced the increase in vocalizations. An observing prompt (e.g., "look") was included prior to the initiation of any trial to increase the salience of the subsequent auditory stimuli. The S + and S − stimuli were presented in "motherese" speech, which has a singsong rhythm, slower tempo, and varied intonations (Falk 2004). Motherese speech was used to differentiate target and nontarget vocalization models from other auditory stimuli during session breaks. Within-session data collection and analysis allowed immediate and short-lived effects of SSP to be detected. Results showed substantial increases in target vocalizations above baseline for all participants. The purpose of the current study was to replicate the enhanced pairing procedure methodology used in Esch et al. (2009) to demonstrate the generality of this enhanced SSP intervention.

Method

Participants and Setting

Three children diagnosed with autism by an independent specialist prior to the study participated: Mary (7 years, 0 months; also diagnosed with chromosome 15 duplication), Paul (4 years, 6 months), and Aaron (6 years, 6 months; also diagnosed with fragile X syndrome). All participants were enrolled in a full-day applied behavior analysis school program and were selected for the study because prior attempts to teach manding and vocal imitation were unsuccessful. Results of the Behavioral Language Assessment (Sundberg and Partington 1998) interview with caregivers suggested that all participants emitted a low frequency of vocal play. None of the participants emitted echoics during the Early Echoic Skills Assessment (Esch 2008). During a 30-min free play period, Mary and Paul emitted five (of 42 possible) English phonemes, and Aaron emitted six English phonemes.

Sessions were conducted in a conference room or office at the participants' school, which contained a table or desk, chairs, edibles, and toys. Toys ranked low or moderate during a stimulus preference assessment were available between sessions. High-preference edibles and toys were kept in an opaque container for use during SSP trials.

Preexperimental Procedures

One week prior to the study, the topography and frequency of each participant's vocal play were recorded in 30-s intervals from a videotape of a 30-min free play period. Target and nontarget vocalizations were selected from phonemes or phoneme combinations that occurred during 25 % or less of these intervals. Target and nontarget vocalizations for each participant can be seen in Fig. 1. Additionally, caregivers completed a preference assessment questionnaire to identify items that the participants seemed to prefer. Eight items were included in a paired stimulus preference assessment (Fisher et al. 1992) and were subsequently used, based on preference, during the study (described below). Prior to baseline, the experimenter interacted with each participant for 15 min in the experimental setting with high-preference toys to establish rapport.

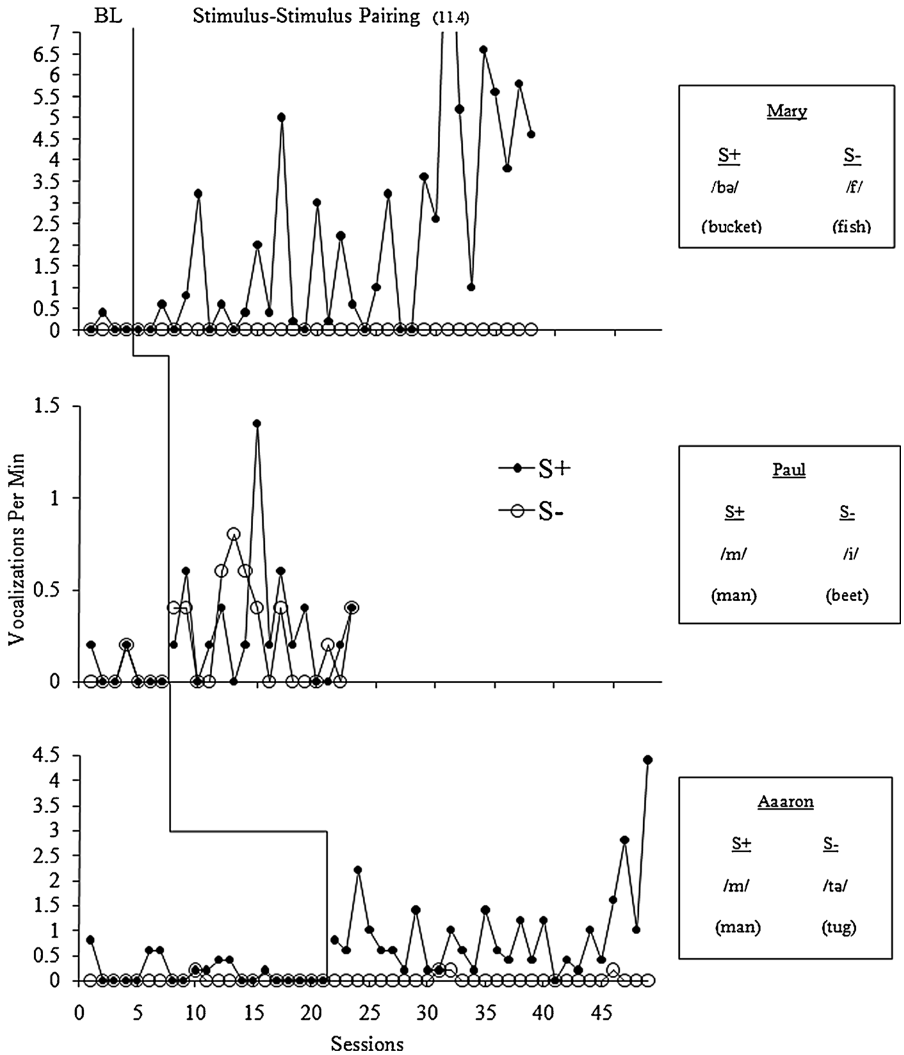

Fig. 1 Within-session data on rate (per minute) of target and nontarget vocalizations for Mary (*top panel*), Paul (*middle panel*), and Aaron (*bottom panel*)

Response Measurement and Reliability

Any vocalization emitted by the participant that was followed by a 1-s interval without vocalizations was counted as one response. If the participant emitted the vocalization more than once with a 1-s interval in between each vocalization, each was scored as a separate response. Target vocalizations were defined as the participant's production of any vocalization that matched or was acoustically similar to the vocalization emitted by the experimenter (e.g., uh for buh). Interobserver agreement (IOA) data were collected during at least 50 % of randomly selected sessions across all conditions for each participant, and agreement was calculated using the total frequency method. An agreement was defined as the primary and secondary data collectors scoring the same number of target vocalizations and nontarget vocalizations per session. Mean IOA for Mary was 93.5 % (range 89 to 100 %), for Paul was 95 % (range 85 to 100 %), and for Aaron was 94.42 % (range 88 to 100 %).

Experimental Design and Procedure

A multiple-baseline design across participants was employed to demonstrate experimental control and

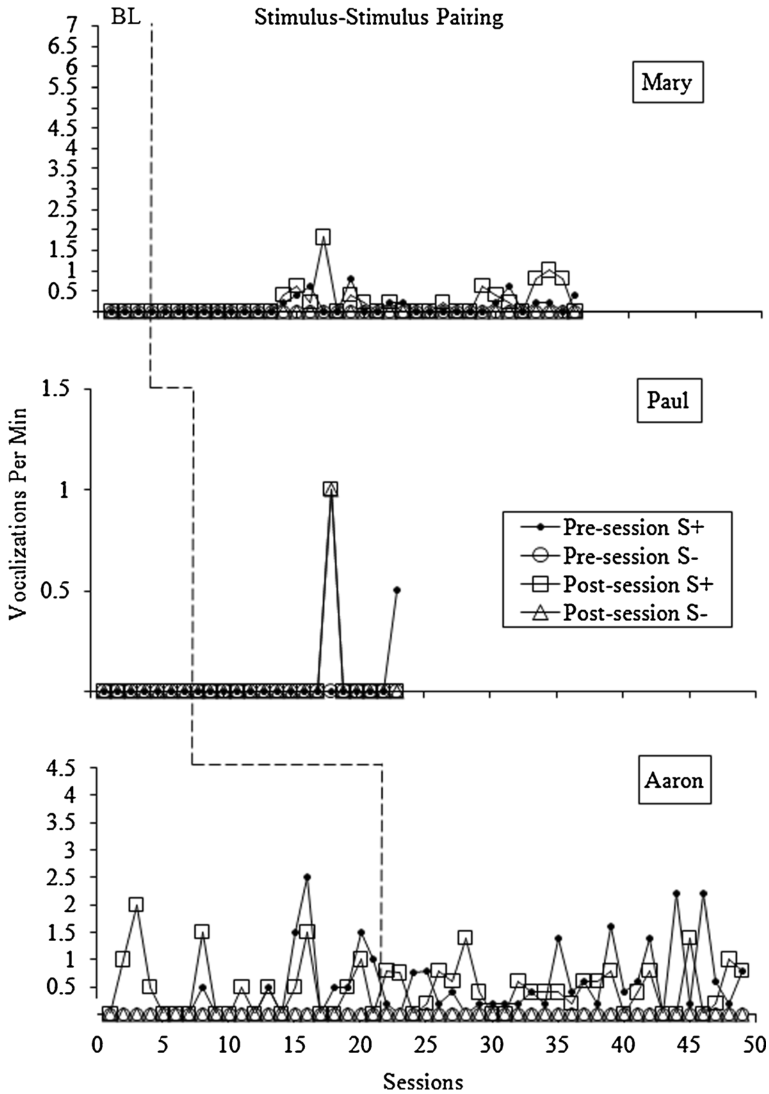

Fig. 2 Target and nontarget vocalizations during presessions and postsessions for Mary (*top panel*), Paul (*middle panel*), and Aaron (*bottom panel*)

compare the rate of target (S+) and nontarget (S−) vocalizations within each treatment condition.

Experimental sessions were conducted in quasi-random order 3 to 5 days per week and lasted approximately 5 to 15 min. Each session consisted of a prerandomized order of 20 trials (10 S + and 10 S−), with no more than 2 consecutive trials of either a target vocalization or a nontarget vocalization emitted by the experimenter. All trials were preceded with a prompt to attend (i.e., "look" for Paul and Aaron and "Mary, look" for Mary). If the participant did not visually attend, the experimenter held the high-preference item for that session in front of her eyes. Target and nontarget vocalizations were presented in triads by the experimenter (e.g., "buh, buh, buh"), at a rate of one syllable per second. Trials were separated by an intertrial interval that varied from 5 to 30 s (Esch et al. 2009).

During both S + and S − trials in baseline, the experimenter emitted the target vocalization but did not deliver a preferred item; thus, S + and S − trials during baseline were identical except for the auditory characteristics of the vocalizations presented by the experimenter. The SSP condition was similar to baseline except that prior to each session, the experimenter presented the three items that were identified as highly preferred in the stimulus preference assessment. The item selected by the participant was delivered immediately after presentation of the target (S+) vocalization during that session. A high-preference item was never delivered contingent upon a participant's response. If the participant emitted the target vocalization between the presentation of the auditory stimulus by the experimenter and the delivery of the high-preference item, a 20-s correction delay was implemented to control for adventitious reinforcement of the target vocalization. Responses emitted during the 20-s correction delay were not counted when calculating the rate of target and nontarget vocalizations. During presession and postsession, participants had access to low and moderately preferred toys for 2 min. There were no programmed consequences for target or nontarget vocalizations.

Procedural integrity data were collected during at least 50 % of randomly selected sessions across all conditions for each participant and were 100 % for all participants. Baseline trials were counted as correct if (a) the orientation prompt preceded each presentation of target and nontarget vocalization, (b) three scheduled syllables were emitted within 5 s, and (c) no high-preference items followed presentations. During SSP, a trial was scored as correct if (a) the orientation prompt preceded each presentation of target or nontarget vocalization, (b) three scheduled syllables (either target or nontarget vocalization) were emitted within 5 s, (c) high-preference items followed target vocalization presentations within 5 s and no high-preference items followed nontarget presentations, (d) there was an intertrial interval of 5 to 30 s, and (e) a correction interval of 20 s followed any target response that occurred between presentations of target vocalization and high-preference item.

Results and Discussion

The present study replicated the enhanced SSP procedures reported by Esch et al. (2009) with three children diagnosed with autism. As can be seen in Fig. 1, for two participants (Mary and Aaron), the mean increase in the rate (per minute) of the target vocalization from baseline to treatment was substantial (Mary 2.06 and Aaron 0.79), while the mean increase in the rate of nontarget vocalizations was negligible (Mary 0 and Aaron 0.01), showing that exposure alone did not produce an increase in vocalizations. Interestingly, during SSP, Mary's target vocalizations per minute reached 11.4 during one session but became stable at a mean of 5.3 vocalizations per minute during the last five sessions (range 4 to 6.5). This may be related to Mary consistently choosing bubbles as her preferred item prior to these sessions; that is, her vocalizations may have begun to be controlled by establishing operations or the presence of the bubble container.

For Paul, the mean increase from baseline to treatment was minimal and similar for the target vocalization (M=0.29 vocalizations per minute) and nontarget vocalization (M=0.23 vocalizations per minute). Although the reason for the ineffectiveness of SSP for Paul is unclear, it is possible that it is due to occurrences of problem behavior. Paul had a history of crying and hitting maintained by access to tangibles. Similarly, he engaged in these problem behaviors when preferred items were removed at the end of S + trials. This problem behavior may have resulted in fewer target vocalizations because the establishing operation (EO) for tangibles may have been stronger than the EO for auditory stimulation from vocalizations.

Presession and postsession data for Mary, Paul, and Aaron are shown in Fig. 2. For Mary, there was a slight increase in the rate (per minute) of target vocalization from baseline to SSP in both presessions (mean 0.27, range 0 to 2.0) and postsessions (mean 0.52, range 0 to 4.5). This finding replicates other studies that have found higher rates of the target vocalization emitted immediately after pairing sessions (e.g., Miguel et al. 2002). There was no systematic increase in rate (per minute) of target vocalizations from presessions to postsessions for Paul (presession mean 0.02, postsession mean 0.04) or Aaron (presession mean 1.5, postsession mean 1.18).

The current findings should be interpreted in light of several limitations. Although specific vocalizations were randomly assigned to S + and S − conditions, it is not known whether all of the responses were equivalent in terms of difficulty for each participant. Also, because the high-preference stimuli were not presented during baseline, it is possible that access to the high-preference items rather than the pairing procedure produced the changes in target vocalizations. However, we consider this unlikely because the participants had access to the high-preference items prior to the study during mand and echoic training, which did not result in an increase in vocalizations. Differential increases in Mary's and Paul's S + vocalizations also provide evidence that mere access to the high-preference items produced an increase in their vocalizations.

In conclusion, the results of this study add to the growing body of literature on the efficacy of SSP procedures and support the use of this procedure with children who have failed to respond to other teaching procedures to increase vocalizations. Although it is unknown why SSP was effective when mand training and echoic training were not, there are at least two plausible explanations. First, the type of response presumably taught during SSP is vocalizations maintained by automatic reinforcement. This type of responding may be easier to learn, as it has also been observed in infants who have not yet acquired more complex language. Second, if a child engages in some stereotypic vocalizations (maintained by automatic reinforcement), but not mands or tacts, the vocalizations learned during SSP are similar to the repertoire of vocalizations already learned. That is, engaging in target vocalizations maintained by automatic reinforcement is more similar to vocal stereotypy than vocalizations maintained by social reinforcement. Future studies might compare different variations of SSP to identify the most effective components. For example, studies might compare different types of pairing (e.g., delay, simultaneous, and establishing the target vocalization as an SD), different types of prosody, or different numbers of presentations of the model per trial. Studies might also incorporate more frequent preference sampling to verify the value of the stimulus used as a reinforcer (Esch et al. 2009) and use of social and physical interaction (a review of SSP studies reveals that the delivery of social stimuli is associated more often with a pairing effect than tangible stimuli; Stock et al. 2008). Additional research is also needed demonstrating progression from SSP to mand training (e.g., Yoon and Feliciano 2007).

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