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The Effects of Presession Attention on the Acquisition of Tacts and Intraverbals

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THE EFFECTS OF PRESESSION ATTENTION ON THE ACQUISITION OF TACTS AND INTRAVERBALS

by

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This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

The Effects of Presession Attention on the Acquisition of Tacts and Intraverbals

by

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Advisor: Daniel M. Fienup

This study examined the effects of presession attention on the acquisition of tacts (Experiment 1) and intraverbals (Experiment 2) in children with Autism Spectrum Disorders. There were 3 conditions in each experiment. In the first 2 conditions, the experimenter first exposed the participants to a 15-min interval of either presession attention (PA) or no presession attention (NPA), then immediately conducted a teaching session. The third condition was a control condition, which involved no pressession interval or teaching procedures. The consequence for emitting tacts and intraverbals consisted of different forms of attention (e.g., praise and clapping). Across experiments, all participants acquired the tacts and intraverbals assigned to the NPA condition, whereas only four of the six participants acquired the tacts and intraverbals assigned to the PA condition. Five of the six participants required fewer sessions to criterion and a shorter cumulative duration of training for the tacts and intraverbals assigned to the NPA condition as compared to the PA condition. The percentage of errors per condition was idiosyncratic across participants. An assessment of controlling variables confirmed that the newly acquired responses functioned as tacts or intraverbals, respectively. These outcomes suggest that antecedent manipulations traditionally reserved for mand training can positively affect the acquisition of other verbal operants, and support the notion that there are unconditioned motivating operations associated with attention.

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The Effects of Presession Attention on the Acquisition of Tacts and Intraverbals

Attention is possibly the most frequently used reinforcer[1] with humans, therefore the more we understand about its formal and functional characteristics, the more likely we are to produce effective behavior change (Vollmer & Hackenberg, 2001). This is especially important for individuals with Autism Spectrum Disorders (ASD), who have communication deficits that are often accompanied or caused by reduced interest in social interaction as compared to their typically-developing peers (American Psychiatric Association, 2013); that is, attention may be a less potent reinforcer, or may not function as a reinforcer (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). In addition, individuals with ASD are the primary beneficiaries of behavior-analytic interventions, which highlights the importance of developing an effective technology of teaching for this population (Rosenwasser & Axelrod, 2001). For these reasons, the purpose of this study is to examine the role that attention as a reinforcer plays in the acquisition of verbal behavior for children with ASD.

Skinner was the first to discuss attention as a function of phylogenetic and ontogenetic selection. According to Skinner (1953):

> It is easy to forget the origins of the generalized reinforcers and to regard them as reinforcing in their own right. We speak of the "need for attention, approval, or affection," (….) as if they were primary conditions of deprivation.

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[1] For the purpose of this paper, attention will be discussed primarily with respect to its reinforcing properties. It is important to note that attention could also function as punishment, depending on its formal characteristics, history, contextual control, or other variables.

> But a capacity to be reinforced in this way could scarcely have evolved in the short time during which the required conditions have prevailed. Attention, affection, approval, and submission have presumably existed in human society for only a brief period, as the process of evolution goes. (p. 80).

Where phylogenetic selection fails, ontogenetic selection compensates. Skinner (1953) noted that during the process of ontogenetic selection, different forms of attention (e.g., smiles, statements of praise, high fives) are paired with different unconditioned and conditioned reinforcers and, as a result, they become generalized reinforcers. This sets these different forms of attention free of any motivational sources of control[2]. Translated to modern behavior-analytic terminology, there should be no unconditioned motivating operations (UMOs) associated with these form of attention, in that preexposure to attention should not (a) affect its reinforcing potency, or (b) change the current frequency of behaviors that have in the past resulted in access to attention (Michael, 2000). Further, Michael suggested that in infants, it is possible that some forms of attention (e.g., touching) are unconditioned reinforcers and, thus, are associated with UMOs. However, attention must also become a conditioned reinforcer, since it is a necessary condition for many other reinforcers to come. As such, Michael suggested that one type of conditioned motivating operation (CMO) namely, the transitive conditioned motivating operation (CMO-T), is the source of control for attention. Procedurally, this means that behavior maintained by attention should be sensitive to an arrangement whereby another stimulus establishes attention as a reinforcer, such as a child wanting to go to the park but needing

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[2]Skinner (1957) also noted that truly generalized reinforcers are rare outside of the experimental setting, therefore it is possible that there are some MOs related to generalized reinforcers.

the mother's attention (i.e., in the form of approval) in order to do so.

To date, the status of attention as an unconditioned, conditioned, or generalized reinforcer is unclear, which makes it difficult to identify its proper motivational source of control (i.e., UMO, CMO-T, or none). Differentiating between these sources of control is important, in that each involves different procedural preparations that are effective in changing behavior. For example, if attention functions as an unconditioned reinforcer, one could teach a child to tact using a UMOs preparation, such as scheduling presession intervals of restricted access to attention prior to tact training. In contrast, if attention functions as a conditioned or generalized reinforcer, one could teach a child to tact using a CMO-T preparation, where the individual would teach the child to tact park, provide praise (or other forms of attention), which would function as a discriminative stimulus for the child to mand to go to the park, followed by approval to go there. In the latter example, deprivation of stimuli and activities that are available in the park functions as a CMO-T for tacting, by making attention a conditioned reinforcer, and a UMO for manding. Differentiating between these different sources of control (UMO, CMO-T, none) has direct implications for verbal behavior interventions, as all verbal operants, with the exception of the mand, are controlled by generalized reinforcement during the early acquisition stages (Skinner, 1957). According to Eby and Greer (2017), the most potent form of generalized reinforcement, and the one that plays the most important role in verbal behavior acquisition is attention (also called educational reinforcement; Skinner, 1957).

Despite the fact that, according to Skinner (1953) and Michael (2000) there are no UMOs associated with attention, Greer and Ross (2008) proposed that learners be briefly deprived of attention prior to conducting tact training. In order to investigate this proposal, Cengher, Jones, and Fienup (2014) examined the effects of presession attention on tacting. The participants were three typically-developing children. First, the experimenter taught the participants to tact colors in an unknown foreign language, in order to have a controlled history of antecedents and consequences with respect to those tacts. Then, the experimenter scheduled 15 min presession intervals, during which the participants were either exposed to PA (attention provided on a fixed time 20-s schedule of reinforcement, at minimum) or NPA (no attention). Immediately after these pressesion intervals, the experimenter conducted a progressive ratio of reinforcement procedure, where the consequence consisted of praise statements (e.g., "Great job!"). The results showed that, for two participants, the break points were higher following NPA as compared to PA. For the third, participant responding was nondifferentiated across conditions. These results support the notion that, for some participants, attention is sensitive to UMO manipulations.

To our knowledge Cengher et al. (2014) is the only study examining the effects of UMOs on tacting. However, the same effects have long been observed with other behaviors maintained by attention, including motor activities (Gerwitz & Baer, 1958a, Gerwitz & Baer, 1958b), problem behavior (Berg et al., 2000; Fischer, Iwata, & Worsdell, 1997; McComas, Thompson, & Johnson, 2003; McGinnis, Houchins-Juárez, McDaniel, & Kennedy, 2010; O'Reilly, 1999; O'Reilly et al., 2006, O'Reilly et al., 2007a, O'Reilly et al., 2007b; O'Reilly et al., 2008; Vollmer & Iwata, 1999; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Worsdell, Iwata, Connors, Kahng, & Thompson, 2000), and play (McCoy & Zigler, 1979).

The aforementioned studies built the foundation for examining the effects of UMOs related to attention, but more research is needed to increase external validity and to clarify the best parameters of behavior change. In order to accomplish that, this study investigated the effects of UMOs on response acquisition (in Experiment 1 and 2), and with respect to a verbal operant not yet investigated in the presession attention literature (the intraverbal; in Experiment 2). The population consisted of children with ASD.

Experiment 1

Cengher et al. (2014) examined the effects of UMOs on the emission of tacts that were already in the participants' repertoire. The purpose of Experiment 1 was to assess the effects of UMOs on tact acquisition. The experiment entailed three conditions: PA, NPA, and control. The following procedures were implemented in succession: social interaction preference assessment, target identification, tact training, maintenance, and functional analysis. In accord with Cenger et al.'s findings that attention is sensitive to UMO manipulations, we evaluated whether an UMO manipulation would cause participants to acquire tacts more efficiently (in terms of sessions to criterion, duration of training, and percentage of errors) following presession intervals of NPA as compared to PA. We included a control condition to demonstrate that tact acquisition is the result of the tact teaching procedures (in the PA and NPA conditions), as opposed to other variables, such as history, maturation, or testing. That is, in the absence of tact teaching procedures, it is only other variables that could account for any potential increase in responding in the control condition.

Method

Participants. Three boys (Michael, John, and Leon) diagnosed with ASD participated in this study. The participants attended a private preschool program that provided full-day educational services and followed a behavior-analytic model. All participants were in the same classroom that included twelve students, one teacher, and two teacher assistants. At the onset of the study, Michael and John were 4 years old, and Leon was 3 years old. They could all communicate vocally, in sentences. Michael's sentence length was three to five-words long, whereas John and Leon communicated in five to 10-word-long sentences. All participants had a generalized echoic repertoire, tacted over 300 items, and had basic intraverbal skills, such as answering age-appropriate questions (e.g., “What do you want to play with?”). The clinical director and the teachers from the preschool identified these children as potential participants because they initiated social interaction frequently (e.g., “Do you want to play with me?”), and because the teachers frequently used praise as a consequence for correct responding on Individualized Education Plan goals, which resulted in steady response acquisition. This suggested that attention (e.g., praise) could function as a reinforcer for these participants. In addition, potential participants did not select the control card as one of the top three options in the social interaction preference assessment (described in the Procedure section). This inclusion criterion was added in order to screen participants for whom attention might potentially function as a reinforcer, as suggested by the fact that they chose social interaction over no social interaction during the preference assessment.

Experimenter. The experimenter was a graduate student, enrolled in the Behavior Analysis Training Area program at the Graduate Center of the City University of New York. The experimenter is a Board Certified Behavior Analyst®, and at the time of the study had 10 years of experience working with individuals with ASD and other developmental disabilities.

Setting. The experimenter conducted the study at the participants’ school, in a quiet room, where only the participant and the experimenter were present. The room was 2 m by 4 m, and contained one table, three chairs, a tripod with a video camera, and space to store toys. No additional people other than the experimenter and the participant were in the room to control for extraneous sources of social interaction, which might have interfered with the independent variables (i.e., PA and NPA).

Materials. The experimenter used a timer to record the duration of the sessions and a Motivaider® (vibrating timer), which prompted the delivery of response-independent comments a minimum once every 20 s in the PA condition (fixed-time schedule of reinforcement). The experimenter prepared seven 15 cm by 10 cm laminated color pictures; each picture depicted a photograph of the experimenter engaging in a single topography of social cue with a child (e.g., a close up of the experimenter giving a child a high five). The experimenter selected seven social cues: clapping, high five, holding hands, talking, thumbs up, tickles, and back pat. The same child was depicted in all photographs, and she did not attend the same school as the participants in this study. The experimenter also created a control card that depicted the experimenter and the child turned away from each other, not making eye contact (i.e., no social interaction). The experimenter prepared six cards for tact training, each depicting one of the following colors: red, yellow, blue, orange, purple, and green. The cards were 10 cm by 10 cm. During intervals of PA and NPA and assessment of controlling variables, the experimenter presented toys that were drawn from the participants' classroom. The experimenter selected the toys because (a) the participants could play with the toys independently and with a partner (e.g., Play Doh), and (b) the toys did not involve any simulated social interaction; for example, smartphones or tables were not used, to avoid exposing participants to clips or apps that display social interaction, which might interfere with the independent variable. Finally, the experimenter used data sheets and treatment integrity checklists for all the conditions in the study, described in the Procedure section.

Dependent variables. The following dependent variables were included: accuracy of matching pictures with in vivo social interactions, number of choice responses of social consequences, and tact responses (several dimensions of this dependent variable, described below). For baseline and training of matching in vivo social interaction with pictorial cues, a correct response consisted of pointing to or placing the hand(s) over the card which depicted the social cue demonstrated by the experimenter, within 5 s of the presentation of the discriminative stimuli (i.e., the in vivo demonstration of a social cue and the question “Which one is that?”, further described in the Procedure section). An incorrect response consisted of pointing to or placing the hand over a card which did not correspond to the social cue demonstrated by the experimenter, pointing to or placing the hand over two or more cards concurrently, or failure to respond within 5 s of the presentation of the discriminative stimuli. For the preference assessment of social consequences, the experimenter collected data on the number of choice responses of social consequences. A choice response was emitted within 5 s of the discriminative stimulus (i.e., “Do you want [first social cue] or [second social cue]?”), and consisted of stating the name of the social cue, pointing to the picture depicting the social cue, placing the hand over the picture depicting the social cue, or a combination of these (e.g., pointing and stating the name of the corresponding social cue). For each social cue, the experimenter calculated the number of times it was chosen, and then she ranked them in a hierarchy of preferences.

For tact baseline, training, and maintenance probes the dependent variable was the tact. Several dimensions of response acquisition were assessed: sessions to criterion, percentage of errors, and duration of training (described below). A correct tact was recorded when a participant vocally stated the color in the corresponding foreign language within 5 s of the experimenter presenting the color card and question. During tact baseline, training, and maintenance probes, the experimenter presented the nonverbal discriminative stimulus (picture card) first, and within 1 s she presented the verbal discriminative stimulus (asked “What is the name of this color in [name of foreign language]?”); as such, during these procedures the participants did not have the opportunity to respond to the nonverbal discriminative stimulus alone. Correct tact responses consisted of a single word (e.g., "Rojo"), or a sentence (e.g., "It is rojo") that corresponded to the color depicted on the card. Incorrect responses consisted of saying anything other than the correct response, or failing to respond within 5 s of the discriminative stimulus. The experimenter collected data on: (a) the percentage correct tact responses per session, (b) mean percentage of errors per condition, and (c) cumulative duration of training per condition. Percentage of correct tact responses per session was calculated by dividing the number of correct independent responses by the total number of responses per session and multiplying by 100. A session had 14 trials. For mean percentage of errors per condition, the experimenter recorded the total number of errors per condition and divided it by the total number of sessions. For the cumulative duration of training per condition, the experimenter collected data for each session, and summed up the cumulative duration per condition, in minutes and seconds. The observer began recording the duration of the session when the experimenter started delivering the first verbal discriminative stimulus, and ended recording the duration of the session once the participant completed the last response in the respective session (baseline), or when the experimenter finished providing the last consequence in the session (tact training and maintenance assessment). Given that the number of trials per session was consistent across sessions and conditions, any differences in duration of training could be a function of (a) time allocation between procedures (i.e., prompting or reinforcement), and (b) any problem behavior that the participant engaged in (e.g., noncompliance, elopement, disruption).

For tact training, data were interpreted in terms of effectiveness and efficiency. Effectiveness was defined as meeting the predetermined mastery criterion (i.e., 90% or greater correct independent responding for two consecutive sessions), and it was measured as sessions to criterion. Efficiency was defined as the amount of resources (described below) required to meet the predetermined mastery criterion, and it was measured as percentage of errors and cumulative duration per condition.

For the assessment of controlling variables, the experimenter collected data on the number of vocal responses regarding colors in a foreign language per session. The vocal responses assessed during the functional analysis were the previously mastered tacts. The color pictures were available at all times during the tact test condition, as described in the Procedure section. A correct tact was recorded when the participant vocally stated the color depicted in one of the pictures in sight, irrespective of whether the experimenter provided the verbal discriminative stimulus or not. That is, for the assessment of controlling variables, a tact could be controlled by the nonverbal discriminative stimulus alone, or a combination of nonverbal and verbal discriminative stimuli.

Procedure. Participants completed the following phases: social interaction preference assessment, tact baseline and training, maintenance probes, and assessment of controlling variables. An outline of these procedures is provided in Figure 1.

Social interaction preference assessment. The purpose of this phase was to assess preference for specific topographies of social interaction for use in subsequent phases. Social interactions were pictured on cards and the participants completed baseline and training phases with the social interaction cards to ensure that they associated the pictures with real-world social interactions delivered by the experimenter. Baseline and training were conducted in a match-to-sample format. During baseline, the experimenter placed three cards on the table in front of the participant: two cards displayed different social cues (e.g., high fives and tickles) and one was a control card that pictured the experimenter and a child looking away from each other (i.e., no social interaction). The purpose of the control card was to verify whether the participants prefer social interaction (displayed in all other cards) over no social interaction, and this was used as a selection criterion for participation in the study. The cards were equally spaced from each other. Then, the experimenter modeled one social cue (e.g., high five) and asked “Which one is that?” Following correct responses (i.e., pointing or placing the hand over the corresponding card within 5 s), the experimenter provided behavior-specific praise (e.g., “Nice job, that is a high five!”) and smiled. There were no programmed consequences for incorrect responses, the experimenter simply began the next trial. Following each trial, the experimenter replaced the card targeted in the previous trial, added a new card, and then changed the order of the cards on the table. A session consisted of 7 trials, and during each trial a different social cue (excluding the control card) was targeted. The experimenter conducted training for social cues similar to baseline, with the exception that following incorrect responses she provided verbal prompts and, contingent on prompted responses, she stated in a neutral voice “That’s right, that is [name of social cue]” without smiling or providing any additional social consequences. Prompts consisted of vocally stating the correct response and asking the participant to echo the correct response. If the participant failed to respond to this prompt, the experimenter represented the prompt until the participant responded correctly. Training was conducted until each participant met the mastery criterion, which consisted of 6 out of 7 trials correct for 2 consecutive sessions.

The experimenter assessed the participants’ preference for social cues once it was established that the participants associated the cards with in vivo social interactions. The experimenter conducted a paired-stimulus preference assessment using the pictures depicting social interactions. The procedures replicated those reported by Kelly, Roscoe, Hanley, and Schlichenmeyer (2014), who identified the paired-stimulus preference assessment as the most predictive of reinforcing effectiveness for social consequences. The experimenter presented two pictures during each trial, so that across trials each picture was presented in combination with all others (28 total trials). The cards were equally spaced from each other. The experimenter asked "Which one do you want, [first social cue] or [second social cue]?", while pointing to each. Following choice responding, the experimenter delivered the respective social consequence for 5 s and removed the cards from the table. When the participant concurrently pointed to or placed his hand over two pictures depicting social cues, stated the name of one social cue while pointing to another, or failed to point to or state the name of a social cue within 5 s of the discriminative stimulus, the experimenter represented the trial until a choice response was made. The preference assessment was conducted three to six times with each participant, as needed to obtain steady choice responding across 3 consecutive sessions.

Tact baseline. The baseline phase was conducted in order to ensure that the participants do not have color vision deficiency as demonstrated by their tacting colors in English, and to identify tact responses in a novel foreign language, unknown to the participants. First, the experimenter asked the teacher and parents whether the participants are exposed to Spanish in the home or school setting. The experimenter chose Spanish as the first option because it is a commonly used language in the geographic area where the participants resided. None of the participants were exposed to foreign languages in the school setting. The teacher and parents reported that Michael and John were not exposed to Spanish at home, whereas Leon's family spoke Spanish at home. Therefore, the experimenter selected Spanish for Michael and John, and Japanese for Leon. The experimenter selected six colors, and the corresponding tacts were subjected to baseline and subsequently tact training or control procedures: blue, yellow, red, green, purple, and orange. Two types of probes were conducted; first, the experimenter assessed whether participants could tact the colors in English. To initiate a trial, the experimenter presented a color card and the verbal discriminative stimulus “What is the name of this color in English?” Then, the experimenter waited 5 s for the participant to respond. The experimenter provided praise and preferred social consequences contingent on correct responses, but there were no programmed consequences for incorrect responses. After 5 s, regardless of the participant’s response, the experimenter initiated a new trial until all 6 trials in a session were completed. One session was conducted with each participant, and all participants responded 100% correct to this probe. Following the English probe, the experimenter assessed whether the participants tacted the colors in the respective foreign language. These probes were identical to the probes in English, with the exception that the verbal discriminative stimulus was “What is the name of this color in [name of foreign language]?” One session was conducted with each participant, and none of the participants responded correctly to this probe (0%). Once the experimenter established that the participants could not tact the colors in a foreign language, she randomly assigned colors to conditions for each participant (Table 1).

***Presession social interaction manipulation*.** The experimenter implemented two conditions of presession social interaction (i.e., PA, NPA), and a control condition. Tact training and maintenance assessment probes (described below) were implemented immediately following the presession arrangements of PA and NPA. In the control condition, tact probes were implemented in the absence of a presession interval. The experimenter randomized the order of implementation of these conditions. There were no constrains to randomization.

The PA and NPA conditions lasted 15 min. In the PA condition, the experimenter announced that it was time to play. Preferred toys were available on the table and the experimenter allowed the participant to choose what he wanted to play with. The experimenter made a comment (e.g., "I love how you're playing!", "Batman is hungry!", "That's a great move!") at minimum once every 20 s (fixed-time schedule). In addition, the experimenter engaged in one of the social cues identified as preferred during the preference assessment (e.g., tickles, clapping, high five) at minimum once every minute. The experimenter responded to all of the participant's verbal initiations. The experimenter terminated the session whenever a fire drill occurred and when the participant asked to use the bathroom; in all other instances, the experimenter continued with the session.

During NPA, preferred toys were available on the table, and the experimenter allowed the participant to choose a toy to play with. The experimenter informed the participant that she is busy, but that he can play during this time. The experimenter sat across the table, and pretended to do paperwork. At no time did the experimenter face or make eye contact with the participant, regardless of the participant's behavior, with four exceptions: (a) when the participant engaged in behaviors that could put him or others in danger (e.g., placing small toys in the mouth) the experimenter intervened and the session was terminated, (b) when the participant asked to use the bathroom the experimenter complied with the request and the session was terminated, (c) when there was a fire drill the experimenter and the participant exited the building and the session was terminated, and (d) when the participant asked questions or made comments three times within 20 s, the experimenter made a neutral statement (i.e., "I am a little busy, please play by yourself and we can talk when I finish") and continued with the session. The latter intervention was implemented to avoid the occurrence of more severe topographies of behavior due to a potential extinction burst (Cooper, Heron, & Heward, 2007). Instances where the experimenter had to terminate the session or when she had to respond to repeated communicative attempts occurred rarely and primarily at the beginning of tact training (first sessions), when the participants were still learning the contingencies associated with the schedules of reinforcement in place. After 15 min, the experimenter thanked the participant for waiting and let him know that she finished her work and that she is ready to look at colors (e.g., “Thank you for waiting, you did such a great job playing all by yourself! I finished work, now let’s look at some colors.”).

In the control condition there was no presession manipulation; the experimenter initiated tact probes as soon as the control condition was scheduled. The experimenter presented the color card and the verbal discriminative stimulus, “What is the name of this color in [name of foreign language]?” and waited 5 s for the participant to respond. Following a correct response, the experimenter smiled and provided praise (e.g., “Great job!”) and one of the preferred social consequences identified through the preference assessment (e.g., high five, talking, tickles). There were no programmed consequences for incorrect responses or failure to respond within 5 s of the presentation of the discriminative stimulus (i.e., no tact teaching procedures). Each session consisted of 14 trials, with two colors (e.g., blue and yellow), each presented seven times in block-randomized order (block size of two, consisting of the two colors).

Tact training. This training was conducted to teach participants to tact foreign color words following conditions of PA and NPA. Following the presession social interaction conditions, the experimenter removed all the toys from the table. Tact training was conducted similar to tact probes described above, with the exception that the experimenter implemented error correction following incorrect responses, or failure to respond within 5 s of the verbal discriminative stimulus. Error correction consisted of a verbal prompt (e.g., “Say *azul*!”). When the participant responded as a result of the error-correction procedure, the experimenter provided behavior-specific feedback (e.g., “That’s right, that is *azul*.”) in a neutral tone, without smiling or providing preferred social consequences identified through the social interaction preference assessment. The mastery criterion was 90% or greater correct independent responding for 2 consecutive sessions. Once the mastery criterion was reached for the set of colors assigned to a condition, the experimenter conducted 50% more training sessions with the sets of colors assigned to the remaining conditions. If the participant did not meet the mastery criterion with the additional sessions and if there was no clear ascending trend, training was discontinued. Once the experimenter completed data collection for the sets assigned to the PA and NPA conditions, she did not conduct any more sessions for the set of colors assigned to the control condition. For example, if a participant met the mastery criterion for the set assigned to NPA condition in 10 training sessions, the experimenter conducted 5 (50% of 10 sessions) additional sessions with the sets assigned to the PA and control conditions.

Maintenance assessment. The experimenter conducted maintenance probes to assess participants' retention of the previously mastered color tacts. The experimenter continued implementing presession conditions of PA and NPA and reinforcement of correct independent responses, but removed the error-correction procedure. The experimenter conducted 2 maintenance assessment probes, at 2- and 4-week intervals after the participant met the mastery criterion during tact training. Maintenance assessment probes were conducted separately for each condition where the mastery criterion had been met (i.e., PA and NPA). The experimenter presented the verbal discriminative stimulus (e.g., "What is the name of this color in [name of foreign language]?") and waited 5 s for the participant to respond. The experimenter provided praise and one of the three preferred social consequences contingent on correct responses. The experimenter did not provide any programmed consequences for incorrect responses, or if the participant failed to respond within 5 s of the verbal discriminative stimulus. Instead, the experimenter proceeded to the next trial, and after the last trial terminated the session.

Assessment of controlling variables. An assessment of controlling variables was conducted in order to verify that the newly acquired words meet the definition of the tact. The procedures replicated Lerman et al. (2005). The analysis was conducted for all responses that had been mastered, across conditions. For example, if a participant met the mastery criterion for a total of four color words (two in the NPA and two in the PA conditions), responding to all of these color words was assessed collectively, in randomized order, under testing and control conditions (described below). Each test condition was alternated with the control condition three times. During both conditions, the participant had free access to preferred toys. The control condition excluded the controlling variables (i.e., antecedents and consequences) of the test condition. A function was identified if the participant produced reliably more responses in the test condition as compared to the control condition. Sessions were 10 min long.

During the tact test condition, the experimenter only presented pictures of the colors that the participant had mastered during tact training. The participant had free access to pictures depicting colors for 15 min before the session, and also during the 10-min long session. The experimenter provided a verbal discriminative stimulus every 20 s (e.g., “What is the name of this color in Spanish?”). The participant could respond to the nonverbal discriminative stimulus alone (i.e., the sight of the color cards), or to the combination of nonverbal and verbal discriminative stimuli (i.e., the sight of the color card and the question “What is the name of this color in [name of foreign language]?”). Irrespective of these different antecedent sources of control, when the participant responded correctly the experimenter delivered praise within 5 s of the vocal response, but did not repeat the participant’s response. The experimenter provided preferred social consequences along with praise contingent on correct responding in a non-systematic manner. There were no programmed consequences for other behavior; instead, the experimenter collected data, not making eye contact with the participant.

During the tact control condition, the participant had free access to pictures of colors for 15 min before the session, but not during the session. In the control condition, there were no programmed consequences for any behavior; instead the experimenter pretended to do paperwork and did not make eye contact with the participant.

Experimental design. An adapted alternating treatment design (Sindelar, Rosenberg, & Wilson, 1985) was used to evaluate the participants' acquisition of tact responses following conditions of PA, NPA, and control. In the adapted alternating treatment design, the experimenter assigned a set of stimuli to each condition, and these sets of stimuli were functionally equivalent with respect to response effort. Experimental control was determined by the difference in level (i.e., percentage correct per session, across sessions within a condition) between the control and the other conditions (PA and NPA). This ruled out threats to internal validity (e.g., history, maturation, testing) and provided a measure of effectiveness. Experimental control was also determined by the difference in performance between conditions of PA and NPA, such as when one procedure resulted in response acquisition in fewer sessions to criterion as compared to the other. This provided a measure of efficiency. The differences in level and performance between conditions can be determined based on the visual inspection of the graph.

An alternating treatment design was used to assess the functions of the vocal responses for the assessment of controlling variables. Experimental control was determined by the difference in the levels of responding (i.e., number of correct responses) for the test and the control conditions.

Interobserver agreement. Data on interobserver agreement (IOA) were collected for the social interaction preference assessment, tact baseline and training, assessment of controlling variables, and maintenance assessment. The first observer was the experimenter, and the second observer was an undergraduate student, who received training from the experimenter prior to coding for this study (both for Experiment 1 and 2). The same observer collected treatment integrity and magnitude of reinforcement data (described in the following paragraphs). For all conditions, the observers independently recorded the participants' behavior. For the social interaction training, the observers recorded the participants' response as correct or incorrect on a trial-by-trial basis. An agreement consisted of having both observers record the same response (i.e., as correct or incorrect) for each trial. IOA was calculated by dividing the number of agreements by the total number of trials and multiplying by 100. The observers collected IOA for 43% of the sessions, and the overall IOA was 92% (range, 29 to 100%). For the social interaction preference assessment, the observers recorded the selection of social cues and an agreement consisted of having both observers record the same selection for each trial. IOA was calculated by dividing the number of agreements by the total number of trials and multiplying by 100. The observers collected IOA for 54% of the sessions, and the overall IOA was 100%. For tact baseline, tact training, and maintenance assessment the observers recorded the participants' responses (as correct or incorrect) on a trial-by-trial basis. IOA was calculated by dividing the trials with agreement by the total number of trials and multiplying by 100. For duration of training, the observers recorded the duration of each session, and IOA was calculated by dividing the smaller count by the larger count. Across the different dimensions of the dependent variable, the observers collected IOA for 67% of the session. For percentage correct responding, the overall IOA was 99% (range, 72 to 100%). For percentage of errors, the overall IOA was 99%

(range, 78 to 100%). For training duration, the overall IOA was 98% (range, 92 to 100%). For the assessment of controlling variables, the observers recorded the number of tact responses per session. IOA was calculated by dividing the smaller count by the larger count. The observers collected IOA for 28% of the sessions. The overall IOA was 98% (range, 91 to 100%). Even though the overall IOA scores were high (range, 98 to 100% across phases of the experiment), there were several outliers below 80% agreement. Four of these (i.e., 71, 29, 71, and 57% agreement) occurred in the social interaction training phase, and two other outliers (72% and 78% agreement) occurred in the tact training phase. Considering the fact that the social interaction training is not critical to this experiment, as its only role was to ensure that the participants had the prerequisite skills for the social interaction preference assessment, the IOA outliers might not represent a threat to measurement reliability.

Treatment integrity. Data on treatment integrity were collected for each phase of the experiment (i.e., preference assessments, tact baseline and training, maintenance assessment, and assessment of controlling variables). For each condition, the observer coded every step implemented correctly as “1,” each step performed incorrectly as “0,” and each step which did not apply for the condition in place as “Non applicable.” Treatment integrity was reported as the percentage of steps performed correctly. Treatment integrity scores were calculated by dividing the number of steps implemented correctly by the total number of steps and multiplying by 100. For the social interaction training, the observer recorded treatment integrity data for 43% of the sessions, and the overall treatment integrity score was 98% (range, 88 to 100%). For the social interaction assessment, the observers recorded treatment integrity data for 54% of the sessions and the overall treatment integrity score was 100%. For tact training, the observer recorded treatment integrity data for 67% of the sessions and the overall treatment integrity score was

97% (range, 87 to 100%). For the assessment of controlling variables, the observer recorded treatment integrity data for 28% of the sessions and the overall treatment integrity score was 99% (range, 97 to 100%).

In order to evaluate the magnitude of social reinforcement across conditions, an independent observer coded the experimenter's intonation and enthusiasm on a 5-point Likert scale for each trial where social reinforcement was provided. The datasheet included a description of each Likert point on the scale. These scores were calculated for 67% of the sessions. For the PA condition, the average magnitude of reinforcement score was 4.9 (range, 4.4 to 5), the mode was 5, the median was 4.9, and the standard deviation was .2. For the NPA condition, the average magnitude of reinforcement score was 4.9 (range, 4.5 to 5), the mode was 5, the median was 5, and the standard deviation was .2. Overall, the magnitude of reinforcement was relatively equal, with little variability within and across conditions.

Results and Discussion

Preference assessment for social interaction. During baseline, the experimenter conducted 4 to 5 baseline sessions with each participant, and the range of responding was 0 to 5 correct responses per session, with no ascending trend for any participant. With training, Michael, Leon, and John met the mastery criterion in 18, 24, and 19 training sessions, respectively.

The experimenter assessed the participants' preference for social cues once it was established that the participants associated the cards with in vivo social interactions. Table 2 displays the top three preferences for each participant; these preferred social cues were used as consequences for correct responding in subsequent steps of the experiment (i.e., during PA, tact training, maintenance assessment, and assessment of controlling variables).

Tact acquisition. The experimenter measured the participants' accuracy of tacting colors in foreign languages before the tact training phase and all participants responded with 0% accuracy. Figure 2 display post-baseline tact acquisition data for Michael (top panel), Leon (middle panel), and John (bottom panel). Separate data paths represent the different presession manipulations of attention and the control condition. None of the participants emitted any correct responses in the control condition, which provides some evidence that tact training accounts for the observed increase in performance in the remaining conditions.

The top panel of Figure 2 displays Michael's performance during tact training, showing that he met the mastery criterion for the tacts assigned to the NPA condition in 3 training sessions. The experimenter conducted 2 maintenance assessment probes for the set assigned to the NPA condition, and the scores were 100% and 93% correct. For the tacts assigned to the PA condition, Michael met the mastery criterion in 5 training sessions. The experimenter conducted 2 maintenance assessment probes for the tacts assigned to the PA condition, and the scores were 100% and 79% correct.

The middle panel of Figure 2 displays Leon's performance during tact training, showing that he met the mastery criterion for the tacts assigned to the NPA condition in 8 training sessions. The experimenter conducted 2 maintenance assessment probes for the set assigned to the NPA condition, and the scores were 93% and 100% correct. For the tacts assigned to the PA condition, the experimenter conducted 13 sessions (50% plus one more session than what was conducted for the NPA condition), and Leon did not meet the mastery criterion. Responding for the tacts assigned to the PA condition was variable, with no systematic trend (range, 0% to 79% correct). The experimenter did not conduct maintenance assessment probes because Leon did not reach the mastery criterion with these tacts.

The bottom panel of Figure 2 displays John's performance during tact training, showing that he met the mastery criterion for the tacts assigned to the NPA condition in 10 training sessions. Because responding to the first 2 maintenance assessment probes was low (14 and 29% correct, respectively), the experimenter conducted 2 additional probes, resulting in a total of 4 probes. John's scores during the final two maintenance assessment probes was 86 and 93% correct. For the tacts assigned to the PA condition, John met the mastery criterion in 17 training sessions. The experimenter conducted additional sessions in the PA condition beyond the 50% rule because responding was on an ascending trend. The experimenter conducted two maintenance assessment probes for the tacts assigned to the PA condition, and the scores were 93% and 100% correct.

Table 3 displays the duration of training and percentage of errors for all participants. For all participants, the duration of training was shorter for the tacts assigned to the NPA condition as compared to the tacts assigned to the PA condition (range, 4.5 min to 22.5 min difference in duration between conditions). Leon committed a considerably higher percentage of errors for the set assigned to the PA condition as compared to the set assigned to the NPA condition (difference of 49.8%), whereas Michael and John committed a slightly higher percentage of errors (difference of 2.8 and 6%) during the NPA condition, which is probably an artifact of the fact that for PA there was a higher accuracy of intermediate correct responding before mastery. It is important to note that, for Leon, the cumulative duration of training and the percentage of errors in the PA condition were truncated by the discontinuation criterion (i.e., after meeting the mastery criterion in one condition, 50% more sessions were conducted with the other procedures and then data collection was terminated). Overall, across participants there was a clear advantage in terms of duration of training for the NPA condition, whereas the percentage of errors was idiosyncratic across participants.

Assessment of controlling variables. Figure 3 displays the number of correct responses observed during the assessment of controlling variables for Michael (top panel), Leon (middle panel), and John (bottom panel), respectively. Different data paths represent the test and the control conditions. None of the participants emitted any correct responses during the tact control condition. During the tact test condition, Michael emitted an average of 20.3 (range 19 to 22) correct responses per session, Leon emitted an average of 31.7 (range 29 to 37) correct responses per session, and John emitted an average of 29.3 (range 26 to 31) correct responses per session. Overall, all participants emitted more correct responses in the test condition as compared to the control condition, indicating that participants' vocal utterances of color-names in a foreign language functioned as tacts.

Summary. None of the participants demonstrated any correct tact responses for the stimuli assigned to the control condition, which suggests that the tact teaching procedures (i.e., echoic prompts) were responsible for the increase in correct responding observed in the PA and NPA conditions. Michael and John acquired tacts following both PA and NPA conditions, while Leon only met the mastery criterion following the NPA condition. Across participants, the mastery criterion was reached in fewer sessions and there was a shorter overall duration of training for the tacts assigned to the NPA condition as compared to the ones assigned to the PA condition. Leon had a lower percentage of errors for the set assigned to the NPA condition as compared to the set assigned to the PA condition, whereas the opposite outcome was recorded for Michael and John, albeit to a lower degree. Maintenance scores were similar across the PA and NPA conditions for the two participants who acquired tacts in both UMO manipulation conditions. The assessment of controlling variables confirmed a higher rate of responding in the test condition as compared to the control condition, demonstrating that the acquired responses functioned as tacts.

This experiment demonstrated a functional relation between the efficiency of tact acquisition and presession exposure to social interaction: when the participants did not receive attention for 15 min before tact training, they acquired tacts more rapidly (Michael, Leon, and John) and efficiently (with respect to duration; Michael and John) as compared to when they received presession attention. Participants in this experiment learned new tacts in 41% fewer sessions and 36% less time following NPA as compared to PA, which supports the notion that UMO preparations affect the efficiency of tact acquisition. In order to increase the external validity of this experiment, Experiment 2 was conducted with other participants and focused on the acquisition of another dependent variable, the intraverbal. In addition, several procedural modifications were made to address some limitations of Experiment 1 (e.g., limited participant characteristic data).

Experiment 2

Experiment 1 demonstrated that UMOs affect the acquisition of tacts in children with ASD. The purpose of the second experiment was to increase the external validity of Experiment 1 by focusing on the acquisition of another verbal operant, the intraverbal. In this new experiment, more pre-assessment data were collected on the participants' language and social skills. The following procedures were implemented in succession: preference assessment for toys, social interaction preference assessment, target identification, intraverbal baseline and training, maintenance, generalization, and assessment of controlling variables. Based on the outcomes of Cengher et al. (2014) and Experiment 1, we evaluated whether a UMO instructional procedure would cause participants to acquire intraverbals more efficiently following intervals of

NPA as compared to PA. We expected to observe no response acquisition for the set of intraverbals assigned to the control condition, which was meant to rule out threats to internal validity (e.g. maturation, history, testing).

Method

Participants. The participants were three children diagnosed with ASD (Martin, Damien, and Sam), who were recruited from the same preschool as the participants in Experiment 1. All participants were in the same classroom, with twelve students, one teacher, and two teacher assistants. All participants were 4 years old at the onset of the experiment. The experimenter used the *Preschool Language Scale* (PLS-V, Zimmerman, Steiner, & Pond, 2012) to assess the participants' language skills. The assessment was conducted in one session, and lasted between 30 and 60 min. Martin had a total standard score of 88 (21st percentile), which corresponds to the age equivalent of 4 years 2 months old. Damien had a total standard score of 78 (7th percentile), which corresponds to the age equivalent of 3 years 4 months old. Sam had a total standard score of 85 (16th percentile), which corresponds to the age equivalent of 3 years 11 months old. These age-equivalent scores were below the participants' chronological ages. The detailed scores for each participant can be found in Table 4.

The experimenter used the *Assessment of Basic Language and Learning Skills-Revised* (ABLLS-R, Partington, 2008) to obtain information about participants' verbal behavior that was then used as selection criteria. The selection criteria were as follows: participants communicated vocally, demonstrated a generalized echoic repertoire (by scoring 2 to 4 on all items on the ABLLS-R Verbal Imitation section), tacted more than 300 items, demonstrated an emerging listener responding repertoire (by scoring 1 to 4 on items C1 to C17 on the ABLLS-R Receptive Language section), and demonstrated some intraverbal behavior (by scoring 2 to 4 on all items below H13 on the ABLLS-R Intraverbal section). In addition, potential participants did not select the control card as one of the top three options in the social interaction preference assessment (described in the Procedure section). Of the nine potential participants whose parents provided consent, only three met the inclusion criteria and were included in this experiment.

Experimenter and Setting. The experimenter and the setting were the same as in Experiment 1. The only modification was that during generalization probes (described below) there were three individuals present in the experimental room: the experimenter, an assistant, and the participant. For all other conditions, the experimenter and the participant were alone in the experimental room.

Materials. The following materials were the same as the ones described for Experiment 1: a video camera, a Motivaider©, and a stopwatch. The following materials were new or modified for the current experiment: language assessment checklists, laminated cards depicting social cues, laminated cards of relevant objects for the intraverbal associations, sheets for interobserver agreement, treatment integrity checklists, and toys. The experimenter used the same seven social cues as in Experiment 1, but she prepared different stimuli for the social interaction preference assessment. Seven 15 cm by 10 cm laminated color pictures were prepared; each picture depicted a social cue (e.g., two people giving each other a high five). In addition to the pictures depicting social cues, the experimenter used a 15 cm by 10 cm white laminated card as a control card (described in the Procedure section). The experimenter used thirty 15 cm by 10 cm laminated pictures for the assessment of controlling variables, and each picture depicted a relevant object for the intraverbal association (described in more detail in the Procedure section). There were specific data sheets for each of the conditions of the experiment (i.e., preference assessments, target identification, intraverbal training, and assessment of controlling variables), used both for data collection and for interobserver agreement. In addition, the observers used treatment integrity checklists for all measurements described above, and social validity questionnaires. The experimenter used 10 toys consistently throughout the experiment.

Dependent variables. The following dependent variables were included: number of choice responses of toys, number of choice responses of social consequences, and intraverbal responses (several dimensions of this dependent variable; described below). For the preference assessment of toys, choice responses consisted of touching, pointing, stating the name of a toy (e.g., “Candyland!”), or a combination of these. A choice response was marked only if emitted within 5 s of the discriminative stimulus (i.e., “Which one do you want?” or “Choose one!”). Preference was determined by the selection of toys; that is, the sooner an item was selected, the more preferred it was considered to be. For the social interaction preference assessment, the experimenter used the same operational definitions as in Experiment 1.

For intraverbal baseline, training, maintenance, and generalization probes, the following measures of the intraverbal response were assessed: sessions to criterion, percentage of errors, and cumulative duration of training (as described in Experiment 1). Data were interpreted in terms of effectiveness (sessions to criterion) and efficiency (percentage of errors and cumulative duration of training) as described in Experiment 1. The intraverbal response was thematically related to the verbal discriminative stimulus, but there was no point-to-point correspondence between the verbal discriminative stimulus and the intraverbal response (e.g., for the antecedent “The opposite of hot is…,” the response is “Cold”; Skinner, 1957). Only intraverbal responses emitted within 5 s of the verbal discriminative stimulus were coded as correct responses. For each intraverbal association, the discriminative stimulus consisted of the statement “The opposite of [feature] is…," and the response consisted of the opposite feature (e.g., for cold, the opposite is hot). A session consisted of 10 trials.

For the assessment of controlling variables, the experimenter collected data on the number of correct responses per session. The vocal responses assessed during the assessment of controlling variables were the previously mastered intraverbal associations.

Procedure. The procedures entailed the following procedures, presented in succession: language assessment, preference assessment for toys, social interaction preference assessment, target identification, generalization probes, intraverbal training, maintenance probes, and assessment of controlling variables. Generalization probes were conducted pre and post intraverbal training. Figure 4 depicts a flowchart of the procedures in this experiment.

Preference assessment for toys. A multiple stimulus without replacement preference assessment (DeLeon & Iwata, 1996) was conducted to determine each participant's preference for toys. The experimenter placed 10 toys on table. The toys were equally spaced from each other. The experimenter instructed the participant to choose one. If the participant attempted to choose more than one toy at a time the experimenter physically prompted him to put his hands in his lap and said "You can only choose one at a time!" Five s later the experimenter initiated another trial. If the participant did not make a choice response within 5 s of the verbal discriminative stimulus ("Choose one!"), the trial ended and another trial was initiated 5 min later. When a choice was made, the experimenter gave the item to the participant within 2 s of the choice response, or allowed the participant to take it from the array. The experimenter did not replace the selected toy with another one. No social consequences (e.g. "Good job!", smiles, high fives) were delivered contingent on making a choice. The participants were allowed to engage with the selected toy for 30 s. After 30 s, the experimenter removed the toy, and initiated a new choice trial. This procedure was repeated until there was only one toy available on the table. At this point, the experimenter gave the item to the participant or allowed the participant to take it, and allowed the participant to play with it for 30 s. In between each trial, the experimenter rotated the toys by placing the item on the left end to the right end and by changing the position of the other items so that they would all be equally spaced. The experimenter conducted 4 sessions with each participant, until the participant demonstrated reliable responding across sessions. The experimenter identified the top five preferences for each participant and used them during subsequent steps of the experiment (i.e., PA and NPA intervals, assessment of controlling variables).

Social interaction preference assessment. The paired-stimulus preference assessment was conducted as described in Experiment 1. The only procedural modification was that the experimenter conducted forced-exposure trials instead of the matching-to-sample training as described in Experiment 1. For the forced-exposure trials, the experimenter presented one card at a time. The card depicted one of the seven social cues (e.g., clapping, high five, back pat), or the control card. The experimenter used least-to-most prompting to have the participant touch or point to the card. Contingent on pointing to or touching the card, the experimenter stated the name of the social consequence (e.g., “Tickles”), and delivered the respective social consequence for 5 s. When the participant pointed to or touched the control card, the experimenter removed the card from sight, turned away from the participant, and ignored the participant for 5 s. One forced-exposure trial was conducted for each social cue and for the control card, resulting in a total of 8 forced-exposure trials. These forced-exposure trials were conducted before each preference assessment session. The experimenter conducted 4 sessions with each participant, until the participant responded reliably across sessions. The experimenter used the top three preferences for each participant as consequences for correct responding in subsequent steps of the experiment (i.e., during PA and NPA conditions, as described below).

Target identification. This phase was similar to the target identification phase reported in Experiment 1; however, the experimenter identified unknown intraverbal responses to be used in the subsequent phases of the experiment. Thirty intraverbal associations were selected; these consisted of intraverbal associations with opposites from *ABLLS-R (*Partington, 2008), and others identified in various curricula for children. The experimenter randomly assigned intraverbal associations to three sets, with 10 intraverbal associations per set. The experimenter probed responding for one set at a time, and there was a 5 to 10 min break in between sets. For each set, the experimenter assessed responding to four discriminative stimuli (e.g., "The opposite of cold is…", "What is the opposite of cold?", "The opposite of hot is…?", and "What is the opposite of hot?"). This resulted in a total of four probes for each set. To initiate a trial, the experimenter presented the verbal discriminative stimulus (e.g., "What is the opposite of hot?"). Then, the experimenter waited 5 s for the participant to respond. The experimenter provided nonspecific praise contingent on correct responses (e.g., "Good job!"), but there were no programmed consequences for incorrect responses. After 5 s, regardless of the participant's response, the experimenter initiated a new trial until all 10 trials in a set were completed. Because Sam responded correctly to numerous intraverbals associations that were initially probed, the experimenter conducted more probes with him until she identified 15 intraverbal associations with 0% correct responding. Once probes were completed, the experimenter asked the participants' teachers to review the intraverbal associations and confirm that they are not part of the participants' past or current school curriculum. None of the identified intraverbals associations were part of the participants' curriculum. The experimenter selected 15 intraverbal associations with 0% correct responding for each participant, and then provided a list and instructed the classroom teachers not to work on them or probe responding until the experiment is complete. Then, the experimenter randomly assigned five intraverbal associations to each experimental condition (i.e., PA, NPA, and control; Table 5). There were no constraints to randomization.

Presession manipulation of social interaction. The experimenter manipulated presession social interaction in the same manner as in Experiment 1.

Generalization assessment. The experimenter conducted 1 pre-training generalization probe and 3 post-training generalization probes. An individual other than the experimenter (hereafter, called assistant) conducted the generalization probes. The assistant was a Board Certified Assistant Behavior Analyst®, and at the time of the study had 17 years of experience working with individuals with ASD and other developmental disabilities. Both pre and post intraverbal training, the assistant probed responding for each condition separately (i.e., PA, NPA, and control). For each condition, a probe consisted of 10 trials, with five intraverbal associations presented in randomized order. There were no constrains to randomization. The intraverbal associations in each condition were the same as the one used for intraverbal training and maintenance probes. Following the presession manipulation of social interaction, the assistant presented the verbal discriminative stimulus (e.g., “The opposite of hot is…”), and waited 5 s for the participant to respond. There were no programmed consequences for any vocal responses, but the assistant provided praise intermittently contingent on appropriate sitting and attending behavior.

Intraverbal baseline and training. The experimenter collected baseline data prior to conducting intraverbal training and after conducting generalization probes. Baseline sessions were similar to generalization probes (described above), except that the experimenter conducted sessions and provided praise and preferred consequences contingent on correct independent responding. The experimenter conducted 3 baseline sessions per condition with each participant. For the set assigned to the control condition, sessions were conducted as during baseline throughout the experiment (i.e., no error correction for incorrect, or no responses within 5 s of the presentation of the discriminative stimulus).

Intraverbal training was implemented concurrently for the sets assigned to the PA and NPA conditions. The session structure (i.e., number of trials, order of stimulus presentation) was the same as described for generalization probes. During intraverbal training, the experimenter presented the verbal discriminative stimulus (e.g., “The opposite of hot is…”). A time delay prompting procedure was used. For the first 2 sessions of each condition, the experimenter provided the discriminative stimulus (e.g., “The opposite of hot is…”), then immediately provided an echoic prompt (e.g., “Say *cold*!”). During these 2 sessions, the participants received praise and a preferred social consequence (e.g., tickles, high five, clapping) within 5 s of emitting a prompted response. After these sessions, the echoic prompt was presented with a 5-s delay. The experimenter used the same differential reinforcement procedure, mastery criterion, and discontinuation criterion as in Experiment 1.

Maintenance assessment. The experimenter conducted maintenance probes as described in Experiment 1, 2 weeks and 1 month following mastery of the intraverbal associations (Damien, for the set assigned to the NPA condition), or following the termination of the assessment of controlling variables (Martin and Sam, for both sets).

Assessment of controlling variables**.** Following training, the experimenter conducted an assessment of controlling variables with all responses that had been mastered, across conditions.

The discriminative stimuli for these responses were presented in randomized order. During both the intraverbal test and control conditions, the participant had free access to pictures depicting relevant objects for 15 min before the session, but not during the session. Relevant objects were the ones specified in the intraverbal response (e.g., a picture of an ice cube, when the discriminative stimulus was “The opposite of hot is…”). During the intraverbal test condition, the experimenter initiated an intraverbal association every 20 s (e.g., “The opposite of hot is…”). When the participant responded correctly, the experimenter delivered praise within 5 s of the vocal response, but did not repeat the participant’s response. The experimenter provided preferred social consequences in conjunction with praise in a non-systematic manner. There were no programmed consequences for other behavior.

During the intraverbal control condition, the experimenter delivered discriminative stimuli which were not thematically related to the targeted verbal response, and which did not include the targeted vocal response (e.g., “You cry like a…,” when the target responses were *big, happy, tall,* and *full*) every 20 s. There were no programmed consequences for any responses. The purpose of this control condition was to verify whether the participants’ responses were controlled by the specific verbal discriminative stimuli that were part of the trained intraverbal associations (e.g., for “The opposite of hot is…” the response is “Cold”), as opposed to other verbal antecedent stimuli that were not thematically related to the target responses.

Experimental design. An adapted alternating treatment design (Sindelar et al., 1985) was used to evaluate the participants’ acquisition of intraverbal responses following conditions of PA, NPA, and control. An alternating treatment design was used to assess the functions of the vocal responses for the assessment of controlling variables. Experimental control was determined as described in Experiment 1.

Interobserver agreement. IOA data were collected for the preference assessment for toys, social interaction preference assessment, target identification, generalization probes, intraverbal training, maintenance probes, and assessment of controlling variables. The observes were undergraduate research assistants, who received training prior to coding for this study (both for Experiment 1 and 2). The same observers collected treatment integrity and magnitude of reinforcement data (described below). For all conditions, the observers independently recorded the participants' behavior. For the preference assessment for toys and social interaction, the observers recorded the selection of social consequences and an agreement was considered having both observers record the same selection for each trial. IOA was calculated by dividing the number of agreements by the total number of agreements and disagreements and multiplying by 100. For the preference assessment for toys, IOA was calculated for 92% of the session, and the overall IOA was 100%. For the social interaction preference assessment, IOA was calculated for 83% of the sessions, and the overall IOA was 100%. For target identification, generalization probes, language training (percentage correct and number of errors), and maintenance probes, the observers recorded the participants' responses (i.e., as correct or incorrect) on a trial-by-trial basis. IOA was calculated by dividing the trials with agreement by the total number of trials and multiplying by 100. For the target identification phase, IOA was calculated for 100% of the sessions and the overall IOA was 98% (range, 90 to 100%). For generalization probes, IOA was calculated for 47% of the session, and the overall IOA was 99 (range, 80 to 100%). For language training and maintenance probes, IOA was calculated for 52% of the sessions. For both percentage correct and number of errors, the overall IOA was 100%. For duration of training, the observers recorded the duration of each session, and IOA was calculated by dividing the smaller count by the larger count. The overall IOA was 98% (range, 89 to 100%). For the assessment of controlling variables, the observers recorded the number of intraverbal responses per session. IOA was calculated by dividing the smaller count by the larger count. IOA was calculated for 67% of the sessions, and the overall IOA was 100%.

Treatment integrity. Treatment integrity data were collected for each condition of the second experiment (i.e., preference assessments, target identification, intraverbal baseline and training, maintenance probes, generalization probes, and assessment of controlling variables). For each condition, the observer coded every step implemented correctly as “1,” each step performed incorrectly as “0,” and each step which did not apply for the condition in place as “N/A.” Treatment integrity scores were calculated by dividing the number of steps implemented correctly by the total number of steps and multiplying by 100. For the preference assessment for toys, treatment integrity data were collected for 92% of the sessions, and the overall treatment integrity score was 99% (range, 90 to 100%). For the social interaction preference assessment, treatment integrity data were calculated for 83% of the sessions, and the overall treatment integrity score was 99% (range, 99 to 100%). For the target identification phase, treatment integrity data were collected for 100% of the sessions, and the overall treatment integrity score was 99% (range, 94 to 100%). For generalization probes, treatment integrity scores were calculated for 47% of the sessions, and the overall treatment integrity score was 99% (range, 95 to 100%). For intraverbal baseline, training, and maintenance probes, treatment integrity scores were calculated for 52% of the sessions, and the overall treatment integrity score was 99% (range, 91 to 100%). For the assessment of controlling variables, treatment integrity scores were calculated for 67% of the sessions and the overall treatment integrity score was 99% (range, 98 to 100%).

In order to evaluate the magnitude of social reinforcement across conditions, an independent observer coded the experimenter's intonation and enthusiasm as described in Experiment 1. These scores were calculated for 52% of the sessions. For the PA condition, the overall magnitude of reinforcement score was 4.5 (range, 3.9 to 5), the mode was 5, the median was 4.5, and standard deviation was .3. For the NPA condition, the overall magnitude of reinforcement score was 4.5 (range, 4 to 5), the mode and median were 4.3, and standard deviation was .3. Overall, the magnitude of reinforcement was relatively equal between conditions, with little variability within and across conditions.

Social validity. Questionnaires were designed to assess the social utility of this experiment. The social validity questionnaire assessed the level of agreement with goals, procedures, and outcomes of the experiment. Separate social validity questionnaires were designed for parents of the children with ASD who received behavior-analytic intervention, and for the participants' teacher and teacher assistants. The parents and teachers were asked to complete the questionnaires at the end of the experiment. In order to ensure that the parents and teachers are familiar with the procedures and with the scope of the experiment, the experimenter provided ample description in the consent forms (i.e., signed before the onset of the experiment), and talked to each one individually. In addition, the social validity questionnaire had a brief description of the experiment to remind parents and teachers of its scope. The description and the questionnaires were designed to meet the level of scientific understanding of each population addressed. The experimenter calculated the average score for goals, procedures, and outcomes, on a 5-point scale where 0 represents *disagreement* and 5 represents *agreement* on a five-point Likert scale (i.e., disagreement, partial disagreement, neutral, partial agreement, agreement). Then, the experimenter averaged the scores separately for parents and teachers.

Results and Discussion

Preference assessment for toys and social interaction. The experimenter identified the top five preferred toys (Table 6) and top three preferred social consequences (Table 7) for each participant. The top five preferred toys were used during PA, NPA, and assessment of controlling variables conditions. The top three preferred social consequences were used contingent upon correct responding during intraverbal training, maintenance probes, and assessment of controlling variables.

Intraverbal baseline, training, and maintenance. Figure 5 displays the intraverbal baseline and acquisition data for Martin (top panel), Damien (middle panel), and Sam (bottom panel). Different data paths represent different presession manipulations and the control condition. Martin did not respond correctly (0%) during baseline across conditions. He met the mastery criterion (i.e., 90% or greater correct independent responding for 2 consecutive sessions) for the each of the sets assigned to the PA and NPA conditions in 6 training sessions. The experimenter conducted two maintenance probes: for the set assigned to NPA, maintenance scores were 90 and 100% correct, and the maintenance score for the set assigned to PA was 90% across probes, respectively. Martin did not meet the mastery criterion for the stimuli assigned to the control condition in 6 sessions, and responding ranged from 0 to 20% correct with a slight ascending trend that had stabilized prior to discontinuing data collection.

The middle panel of Figure 5 displays the intraverbal baseline and acquisition data for Damien. Damien did not respond correctly (0%) during baseline across conditions. He met the mastery criterion for the set assigned to the NPA condition in 12 training sessions. The experimenter collected two maintenance probes for the set assigned to the NPA condition, and the scores were 100 and 90% correct. For the set assigned to the PA condition, Damien did not meet the mastery criterion in 22 training sessions. Four additional training sessions were conducted beyond the 50% rule because responding was on an ascending trend; however, with the additional sessions responding stabilized in the range of 40 to 60% correct. Because Damien did not meet the mastery criterion for the set assigned to the PA condition, the experimenter did not collect maintenance data. Damien did not meet the mastery criterion for the stimuli assigned to the control condition in 22 sessions, and responding ranged between 0 to 20% correct across sessions.

The bottom panel of Figure 5 displays the intraverbal acquisition data for Sam. Sam did not respond correctly during baseline across conditions. Sam met the mastery criterion for the set assigned to the NPA condition in 4 training sessions. The experimenter collected two maintenance probes the set assigned to the NPA condition, and the scores were 100% correct on both probes. Sam met the mastery criterion in PA condition in 6 sessions. The experimenter conducted two maintenance probes for the set assigned to the PA condition, and the scores were 90% and 100% correct. Sam did not meet the mastery criterion for the stimuli assigned to the control condition in 6 sessions, and did not emit any correct responses (0%).

Table 8 displays the duration of training and the percentage of errors for all participants. For two participants (Damien and Sam), the cumulative duration of training was shorter for the intraverbals assigned to the NPA condition as compared to the ones assigned to the PA condition (range, 3.1 min to 15.1 min difference in duration between conditions). Damien committed a higher percentage of errors for the set assigned to the PA condition as compared to the set assigned to the NPA condition (difference of 21%), whereas Martin and Sam committed a slightly higher percentage of errors (difference of 6, and 7% respectively) during the NPA condition. Overall, for two of the three participants (Martin and Sam) there was an advantage in terms of duration of training for the NPA condition, whereas in terms of percentage of errors the results were idiosyncratic across conditions.

Generalization probes. Figure 6 reflects the generalization data post intraverbal training for Martin (top panel), Damien (middle panel), and Sam (bottom panel). Damien and Sam did not respond correctly (0%) during pre-training generalization probes, whereas Martin did not respond correctly (0%) for the sets assigned to NPA and control, but responded 10% correct for the set assigned to PA. On the average, Martin responded 93% correct in the NPA condition (range, 90 to 100% correct), and 87% correct in the PA condition (range, 80 to 90% correct). Damien responded 67% correct in the NPA condition (range, 0 to 100% correct). Since Damien did not meet the mastery criterion in the PA condition, post-training generalization probes were not conducted for the respective set. Sam responded 100% correct across conditions and post-training probes. Overall, Martin demonstrated slightly better generalization for the intraverbal associations assigned to the NPA condition as compared to the ones assigned to the PA condition or control, while Sam performed equally across conditions.

Assessment of controlling variables. Figure 7 displays the number of responses during the assessment of controlling variables for Martin (top panel), Damien (middle panel), and Sam (bottom panel). Different data paths represent the test and the control conditions. None of the participants emitted any target responses during the control condition. During the intraverbal test condition, Martin emitted an average of 21 responses per session (range, 18 to 24). Damien emitted an average of 14 responses per session (range, 12 to 18). Sam emitted an average of 28 responses per session (range, 27 to 28). Overall, all participants emitted more responses in the test condition as compared to the control condition.

Social validity. All the participants' teachers and parents (*N*=6) completed the social validity questionnaire. The participants' parents gave a maximum score (5) for the goals, procedures, and outcomes of the experiment. The participants' teachers rated the goals as 5, procedures as 4.6 (range, 4 to 5), and outcomes as 4.6 (range, 4 to 5). The two items on the questionnaire that one of the teachers partially agreed with (score of 4 out of 5) referred to the ease of implementation of antecedent-based interventions in the classroom, and to the likelihood that he would implement the respective procedures. Partial agreement was possibly influenced by the fact that the teachers work in a classroom with 12 learners, one teacher, and two teacher assistants. In this type of setting, learners do not typically receive one-to-one instruction. Instead, the teachers provide instruction in groups that range in size from three to 12 students, depending on the nature of the goals they were working on (i.e., all 12 learners participate in circle time, whereas groups of three learners participate in pretend-play activities). It is likely that interventions such as the ones used in this experiment are more easily implemented in a more restrictive teaching environment, where learners receive individualized intervention or work only in smaller groups. Future studies should investigate the feasibility of using such antecedent-based interventions when working with larger groups of learners.

Summary

In summary, Martin and Sam acquired intraverbals following conditions of PA and NPA, while Damien only acquired the set of intraverbals assigned to the NPA condition. For Damien and Sam there was a shorter overall cumulative duration of training for the intraverbals assigned to the NPA condition as compared to the ones assigned to the PA condition. For percentage of errors, results were idiosyncratic across participants. Martin and Sam emitted some correct responses (range, 0 to 20%) in the control condition; however, given the low percentage of correct responding in this condition, it is reasonable to assume that the intraverbal teaching procedures were primarily responsible for the increase in performance in the PA and NPA conditions. In this experiment, participants acquired intraverbals in 17% fewer sessions and in 16% less time following NPA as compared to PA, which provides evidence that UMOs can affect the efficiency of intraverbal acquisition. The assessment of controlling variables reflected a higher rate of responding in the test condition as compared to the control condition, demonstrating that the responses functioned as intraverbals.

General Discussion

This study demonstrated that, for some participants, there is a functional relation between the UMO manipulation and tact and intraverbal acquisition: after an interval of NPA, participants learn new tacts and intraverbals more effectively and efficiently as compared to after an interval of PA. Specifically, five of the six participants in the two experiments demonstrated greater speed of acquisition for tacts or intraverbals in the NPA condition as compared to the PA condition, whereas for the remaining participant (Martin) responding was undifferentiated between conditions. In the control condition, participants emitted no tacts[3] (Experiment 1), or few intraverbals (range 0 to 20% correct; Experiment 2), demonstrating that extraneous variables (e.g., maturation, history, testing) were to a large extent controlled for, and thus played a

[3]Given the fact that in the first experiment the participants learned to tact colors in a foreign unknown language that they were presumably not exposed to in the home or school settings, it is highly unlikely that they would have acquired these tacts incidentally.

minimal role in tact and intraverbal acquisition. This study adds to the existing behavior analytic literature which supports the notion that verbal behavior maintained by attention is sensitive to manipulation of UMOs (Cengher et al., 2014; Greer & Ross, 2008).

The current study provides some preliminary evidence that antecedent-based interventions traditionally reserved for mand training, such as manipulating UMOs, could enhance the acquisition of verbal operants maintained by non-specific reinforcement, such as tacts and intraverbals. Even though MOs affect the momentary effectiveness of a reinforcer, if one were to include such antecedent-based manipulations consistently across a number of programs and years, the gains in efficiency would be meaningful. On the reverse side, it is likely that in the absence of such antecedent-based interventions, response acquisition is hindered; for example, if a teacher only conducts tact or intraverbal training after a period of intense social interaction, the child might have a slower acquisition rate, or not meet the mastery criterion at all, as was the case with Lucas (Experiment 1) and Damien (Experiment 2). On a similar note, inconsistent manipulation of presession exposure to social interaction might cause within-subject variability in responding. If the source of such variability is not correctly identified and controlled for, as would be the case when one does not manipulate MOs for social interaction, one might continue to implement instruction that produces a low and variable rate of learning. Incorporating MOs could simply involve programming tact or intraverbal training specifically when the student is more likely to be socially deprived (e.g., after a bus ride from school if it is known that the child does not interact with other children on the bus, after a period of independent play, etc.). Given the simplicity of this procedure, it is likely that it can be implemented with high treatment integrity, after conducting minimal staff or parent training.

An observation that has implications both for theory and practice is that *attention* is a broad umbrella term, that covers multiple stimulus topographies, which possibly serve both as reinforcers and punishers (Vollmer & Hackenberg, 2001), depending on conditioning history, contextual control, MOs, or other variables. At this point, we know little about all these variables that affect attention as a consequence (Vollmer & Hackenberg, 2001). Component and parametric analyses of social consequences could further help clarify the reinforcing or punishing valence and effectiveness of different forms of attention, and should be used in clinical practice as a supplement to traditional preference assessments, such as the one used in this study. An example of component analysis was provided by Kazdin and Klock (1973), who found that vocal and nonvocal social consequences (e.g., smiles, nods, physical contact) were a more potent reinforcer as compared to vocal approval alone. An example of parametric analysis that would have important clinical applications is assessing the effects of different magnitudes of reinforcement (e.g., duration of reinforcer access) on responding. Studies assessing the role of contextual control (e.g., different sources of audience control) on the effectiveness of attention as a consequence could also contribute to a more effective technology of teaching.

Another observation that has implications for both theory and practice is that MOs have a transitory effect. To illustrate, if after a period of restricted access to attention a child responds to a teacher's question and receives attention (e.g., "That's right, great job!"), all things being equal, the MO for attention will be reduced during the next opportunity to respond the teacher's question. Therefore, during tact and intraverbal acquisition, each teaching trial is conducted under slightly different levels of the same MO, and it is likely that no level of the same MO can be replicated exactly in the same way. Because of that, incorporating MOs in tact and intraverbal acquisition likely results in generalization across different levels of the same MO, and possibly across MOs (Miguel, in press). While generalization across MOs has received some attention (Groskreutz, Gorskreutz, Bloom, & Slocum, 2014; Lechago, Carr, Grow, & Almason, 2010; Lechago, Howell, Caccavele, & Peterson, 2013; Taylor & Harris, 1995), to our knowledge no studies have directly investigated generalization across different levels of the same MO. It would be important to investigate this phenomenon, given its direct implications for clinical practice.

The main theoretical implication of this study is that, for some participants, verbal behavior maintained by attention is sensitive to UMO manipulations, which suggests that some forms of attention (e.g., smiles) can serve as unconditioned reinforcers for children beyond the early developmental stages (infancy). It is possible that some forms of attention, such as smiles, have unconditional properties, while others (i.e., that involve vocal behavior, such as praise) gained reinforcing valence as a result of a conditioning history (Vollmer & Hackenberg, 2001). As an alternative, some forms of attention may function both as unconditioned and conditioned or generalized reinforcers concurrently. For example, a smile might be reinforcing on its own right, but it could also serve as a conditioned reinforcer when it indicates that other reinforcers are available (e.g., the mother's smile signifies approval to open a box of chocolates). It is possible that in this study, as well as in most real-life situations, attention is associated with both UMOs and CMO-Ts, and that these different types of motivational variables interact with one another (Michael, 2000). Finally, it is possible that attention is indeed controlled exclusively by CMO-Ts, and that CMO-Ts modulate the value of conditioned or generalized reinforcers in the same way as they do with unconditioned reinforcers. This latter possibility, if confirmed empirically, would require modifications of the current conceptualization of CMO-Ts. In summary, given the ubiquitous nature of attention as a consequence (Vollmer & Hackenberg, 2001), it is important to clarify its relationship with MOs.

There are variables in addition to MOs that might have played a role in the acquisition of tacts and intraverbals. One such variable is reinforcement history. Research has demonstrated that pre-exposure to one schedule of reinforcement affects subsequent performance on another schedule of reinforcement, a phenomenon called reinforcement history effect (Okouchi & Lattal, 2006). With one exception (Martin), when the participants had first been exposed to lean schedules of reinforcement (NPA), they had a quick acquisition rate during subsequent rich schedules of reinforcement (tact or intraverbal training). In comparison, when the participants had first been exposed to rich schedules of reinforcement (PA), they had a slower acquisition curve during subsequent leaner schedules of reinforcement (tact or intraverbal training). The relationship between MOs and history effects warrants further investigation. Another stimulus that may play a role in such presession arrangements of attention is silence; Skinner (1957) noted that, when two or more people are within close proximity, silence may function as a punisher, which may result in verbal behavior that is negatively reinforced (e.g., one may tact to fill the silence). This is probably the result of a conditioning history; as such, it is possible that this is more likely to occur in individuals older than the participants in this study. However, in order to avoid such confounds altogether future research could attempt to leave the participant alone in the room during the NPA condition.

There are some limitations to this study. First, in the first experiment the tact teaching procedures included error correction. The decision to use error correction over other prompting procedures that benefit from more empirical support and that are typically incorporated in verbal behavior interventions (e.g., errorless learning; Touchette & Howard, 1984) was informed by pilot data. However, it is recommended that errorless learning be used over error correction in clinical settings, given that fact that such procedures have been demonstrated to be effective and result in few if any incorrect responses during acquisition. Second, in the first experiment the experimenter only taught the participants to tact two colors per condition. This may have resulted in control by the negative stimulus (Sidman, 1987), whereby a participant learned the association between a discriminative stimulus and a response (e.g., when the discriminative stimulus is a blue card, the response is “azul”), and when presented with the other discriminative stimulus (e.g., red card) his response was controlled by the absence of the first discriminative stimulus (blue card) rather than by presence of the second one (red card; e.g., if the card is not blue, say “rojo”). In this study, control by positive stimuli was demonstrated during the assessment of controlling variables, where experimenter presented all previously mastered discriminative stimuli within a session and participants responded correctly to all. However, in order to avoid potential control by negative stimuli, future studies should attempt to include at minimum three stimuli per condition.

In both experiments, there was between-subject variability in the rate of response acquisition (e.g., in Experiment 2, Sam required 4 sessions to reach the mastery criterion in the NPA condition, while Damien required 12 sessions). Such variability is to be expected when conducting between-subject replications, and does not represent a limitation as long as effects of the independent variable have been demonstrated consistently across participants (i.e., NPA was more efficient than PA in 5 of 6 participants). However, future studies should examine the variables that may account for this variability, in order to develop more effective teaching procedures. In the context of this study, two variables that may account for the between-subject variability are the duration of the presession interval and number of discriminations taught concurrently. The duration of the presession interval was determined based on the existing literature on the topic (Cengher et al., 2014; Edrisinha et al., 2011; Gewirtz & Baer, 1958a;

Gewirtz & Baer, 1958b; Lewis & Richman, 1962; McComas et al., 2003; McCoy & Zigler, 1979; Miller & Kirschenbaum, 1979; O'Reilly, 1999; Stevenson & Odom, 1962). However, this literature is still in its inception and it is possible that 15 min is not sufficient to produce meaningful changes in reinforcer effectiveness for some participants. For example, it is possible that the duration of the presession interval was too short for Martin, as he had the same rate of response acquisition across the PA and NPA conditions in Experiment 2. One could conduct parametric analyses with different conditions consisting of different durations of presession interval (e.g., 5, 15, 30 min) in order to identify the optimal arrangement for each participant, which could be quantified in number of targets to acquisition per condition.

Between-subject variability could also be caused by the number of discriminations that are taught concurrently. In the context of this study, performance could be a function of the learner's instructional history and current linguistic skills. For example, for an advanced learner, learning five intraverbal associations concurrently might be relatively easy, whereas for a less sophisticated learner learning as many intraverbals concurrently might be relatively difficult. If few discriminations are taught concurrently, participants may acquire the discriminations at a very quick pace (ceiling effects), as potentially was the case with Michael (Experiment 1), Martin (Experiment 2), and Sam (Experiment 2). On the reverse side, if too many discriminations are taught concurrently, participants might acquire the discriminations at a very slow pace, or not at all. What constitutes too few or too many discriminations to learn concurrently is likely idiosyncratic across participants, and could be identified experimentally through parametric analyses. For example, one might attempt to teach two, five, or 10 discriminations concurrently and assess the arrangement that is most likely to result in effective and efficient response acquisition, quantified in duration of training to mastery per target discrimination. Such parametric analyses would have important implications for clinical practice.

Finally, Skinner (1957) noted that, during early acquisition stages, educational reinforcement (e.g., attention in the form of praise or encouragement) is possibly the maintaining reinforcer. However, as one's verbal behavior repertoire expands, other, subtler forms of generalized reinforcement may come to control responding. For example, a child may learn to tact car because the mother provided praise and follow-up conversation contingent on responding (educational reinforcement). Later on, the child may tact car in order to inform the mother that a car is fast approaching and might hit her. In this case, it is likely that the mother's attention was not the controlling reinforcer, as much as the mother's behavior of moving away to avoid being the victim of an accident. In this way, the tact becomes more beneficial to the listener as compared to the speaker. Given the fact that such subtle forms of generalized reinforcement play an important role in the verbal behavior of a mature typically developing speaker, it is important to learn whether they are equally effective for individuals with ASD, and, if not, how to condition them so that they can come to control the emergence of tacts and intraverbals.

This study provides some preliminary evidence that UMOs for attention affect the acquisition of tacts and intraverbals. Research has already reliably demonstrated the effects of UMOs on problem behavior maintained by attention (Berg et al., 2000; Fischer et al.1997; McComas et al.2003; McGinnis et al.2010; O'Reilly, 1999; O'Reilly et al., 2006, O'Reilly et al., 2007a, O'Reilly et al., 2007b; O'Reilly et al., 2008; Vollmer & Iwata, 1999; Vollmer et al.1993; Worsdell et al.2000), which has important implications for the development of functional analysis methodologies. Future research should extend the external validity of this phenomenon with respect to other socially significant dependent variables, such as the acquisition of verbal operants maintained by attention. If research supports this notion, antecedent-based interventions typically reserved for mand training could be used to teach other verbal operants maintained by attention. Incorporating such antecedent-based interventions to tact and intraverbal training could result in a more effective and efficient teaching technology.

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Table 1

Assignment of Colors to Conditions for Experiment 1

	Michael	Leon	John
Presession Attention	Red Green	Purple Blue	Green Yellow
No Presession Attention	Blue Yellow	Yellow Red	Purple Blue
Control	Orange Purple	Orange Green	Orange Red

Table 2

Preference Assessment for Social Interaction Results for Experiment 1

Michael	Leon	John
Clap	Clap	Clap
Tickles	Back pat	Back pat
Talking	Tickles	Tickles

Table 3

Duration of Training, Percentage of Errors, and Sessions to Criterion in Experiment 1

		Presession Attention	No Presession Attention	Control
Michael	Training Duration	11.5 min*	7 min*	7.3 min
	Difference in Training Duration between PA and NPA	4.5 min*		
	Percentage of Errors	18.6*	21.4*	100
	Difference in Percentage of Errors between PA and NPA	-2.8*		
	Sessions to Criterion	5*	3*	5
Leon	Training Duration	42.6 min	20.1 min*	17.4 min
	Difference in Training Duration between PA and NPA	22.5 min		
	Percentage of Errors	65.9	16.1*	100
	Difference in Percentage of Errors between PA and NPA	49.8		
	Sessions to Criterion	13	8*	13
John	Training Duration	46.1 min*	30.3 min*	18.2 min
	Difference in Training Duration between PA and NPA	15.8*		
	Percentage of Errors	26.9*	32.9*	100
	Difference in Percentage of Errors between PA and NPA	-6*		
	Sessions to Criterion	17*	10*	17

Note. A star (*) denotes that the participant met the mastery criterion in the respective condition.

Table 4

Preschool Language Scale Results for all participants in Experiment 2

Participant	Chronological Age	Scale	Raw Score	Standard Score	Percentile Rank	Age Equivalent
Martin	4 years 7 months 16 days	Auditory Comprehension	44	83	13	3 years 10 months
		Expressive Communication	49	95	37	4 years 6 months
		Total Language Score	93	88	21	4 years 2 months
Damien	4 years 9 months 5 days	Auditory Comprehension	46	87	19	4 years 1 month
		Expressive Communication	36	72	3	3 years 0 months
		Total Language Score	82	78	7	3 years 4 months
Sam	4 years 7 months 6 days	Auditory Comprehension	48	91	27	4 years 3 months
		Expressive Communication	41	81	10	3 years 7 months
		Total Language Score	89	85	16	3 years 11 months

Note. The chronological age reflects the participants' age at the time of testing.

Table 5
Assignment of Intraverbal Associations to Conditions in Experiment 2

	Martin	Damien	Sam
Presession Attention	Easy-difficult	Near-far	Easy-difficult
	Tall-short	Easy-difficult	Brave-scared
	High-low	Strong-weak	Blunt-sharp
	Here-there	Brave-scared	Wide-narrow
	True-false	Tall-short	Sink-float
No Presession Attention	Same-different	Sweet-sour	Young-old
	Sweet-sour	Same-different	Right-wrong
	Brave-scared	Here-there	Same-different
	Full-empty	More-less	Tall-short
	Strong-weak	Young-old	Sweet-sour
Control	Sink-float	Full-empty	Near-far
	More-less	Heavy-light	Strong-weak
	Near-far	High-low	Fat-thin
	Heavy-light	True-false	Shiny-full
	Young-old	Sink-float	Rough-smooth

Table 6

Preference Assessment for Toys Results for Experiment 2

Martin	Damien	Sam
Slinky	Slinky	Slinky
Play Doh	Legos	Legos
Cars	Trains	Superheroes
Legos	Book	Play Doh
Superheroes	Teddy bear	Trains

Table 7

Social Interaction Preference Assessment Results for Experiment 2

Martin	Damien	Sam
Hold hands	Clap	Clap
Thumbs up	Thumbs up	Thumbs up
Tickles	Tickles	Tickles

Table 8

Duration of Training, Percentage of Errors, and Sessions to Criterion in Experiment 2

		Presession Attention	No Presession Attention	Control
Martin	Training Duration	9.3 min*	9.3 min*	4.8 min
	Difference in Duration between PA and NPA	0 min*		
	Percentage of Errors	47%*	53%*	92%
	Difference in Percentage of Errors between PA and NPA	-6%*		
	Sessions to Criterion	6*	6*	6
Damien	Training Duration	42.7 min	27.6 min*	19.5 min
	Difference in Duration between Pa and NPA	15.1 min		
	Percentage of Errors	65%	44%*	97%
	Difference in Percentage of Errors between PA and NPA	21%*		
	Sessions to Criterion	22	12*	22
Sam	Training Duration	9.9 min*	6.8 min*	6.5 min
	Difference in Training Duration between PA and NPA	3.1 min*		
	Percentage of Errors	43%*	50%*	100
	Difference in Percentage of Errors between PA and NPA	-7%*		
	Sessions to Criterion	6*	4*	6

Note. A star (*) denotes that the participant met the mastery criterion in the respective condition.

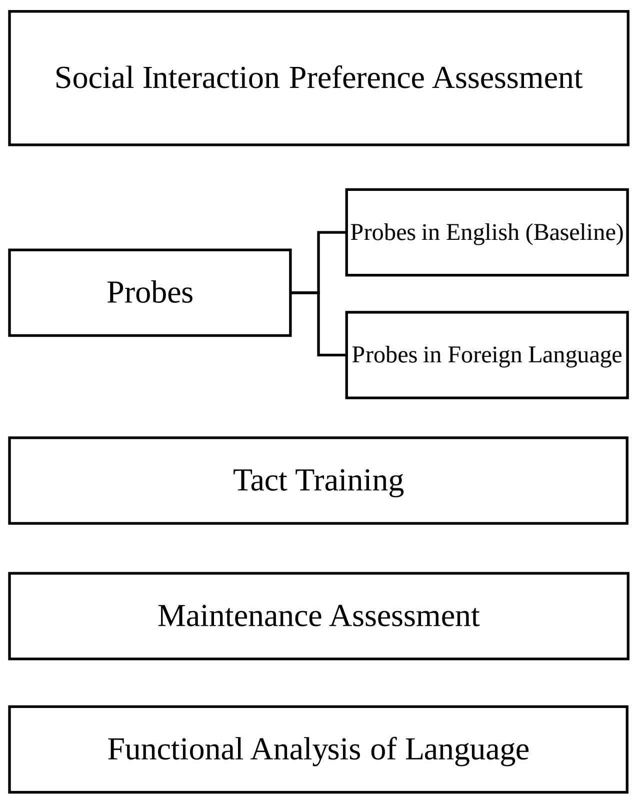

Figure 1. Flowchart of the procedures in Experiment 1.

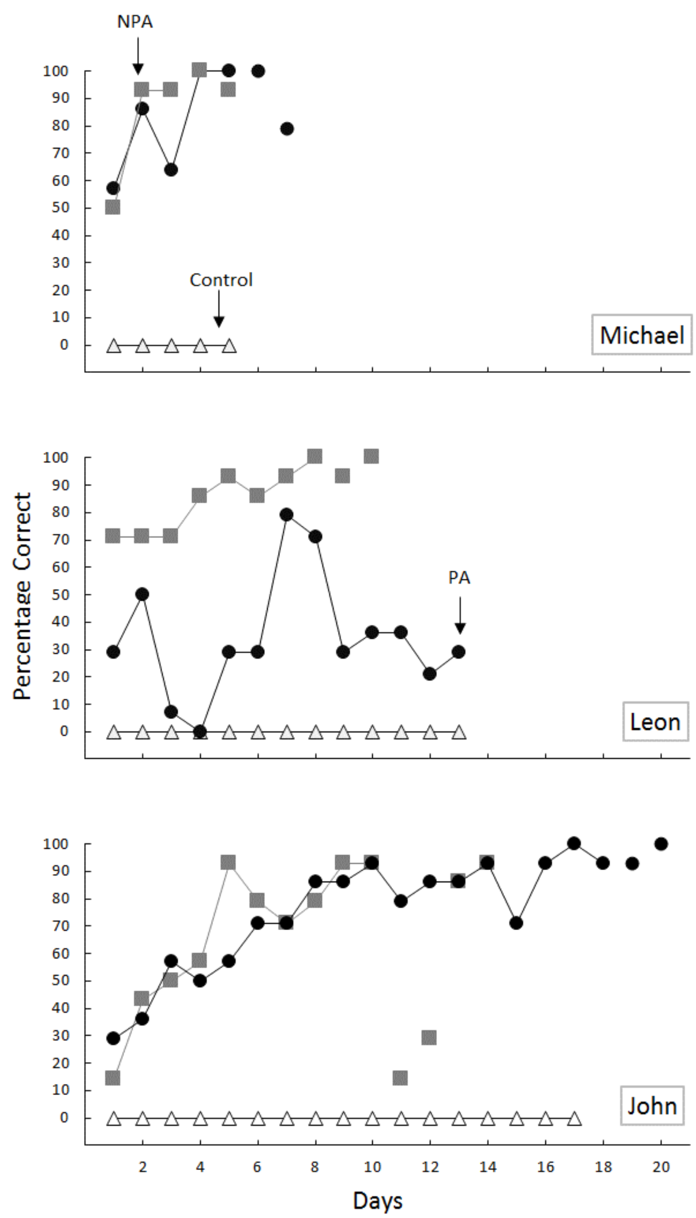

Figure 2. Tact acquisition data for all participants in Experiment 1. The top panel displays Michael's data, the middle panel represents Leon's data, and the bottom panel represent John's data. The black circles represent the PA condition, the gray squares represent the NPA condition, and the open triangles represent the control condition. The data points that are not connected with lines represent the results for maintenance probes.

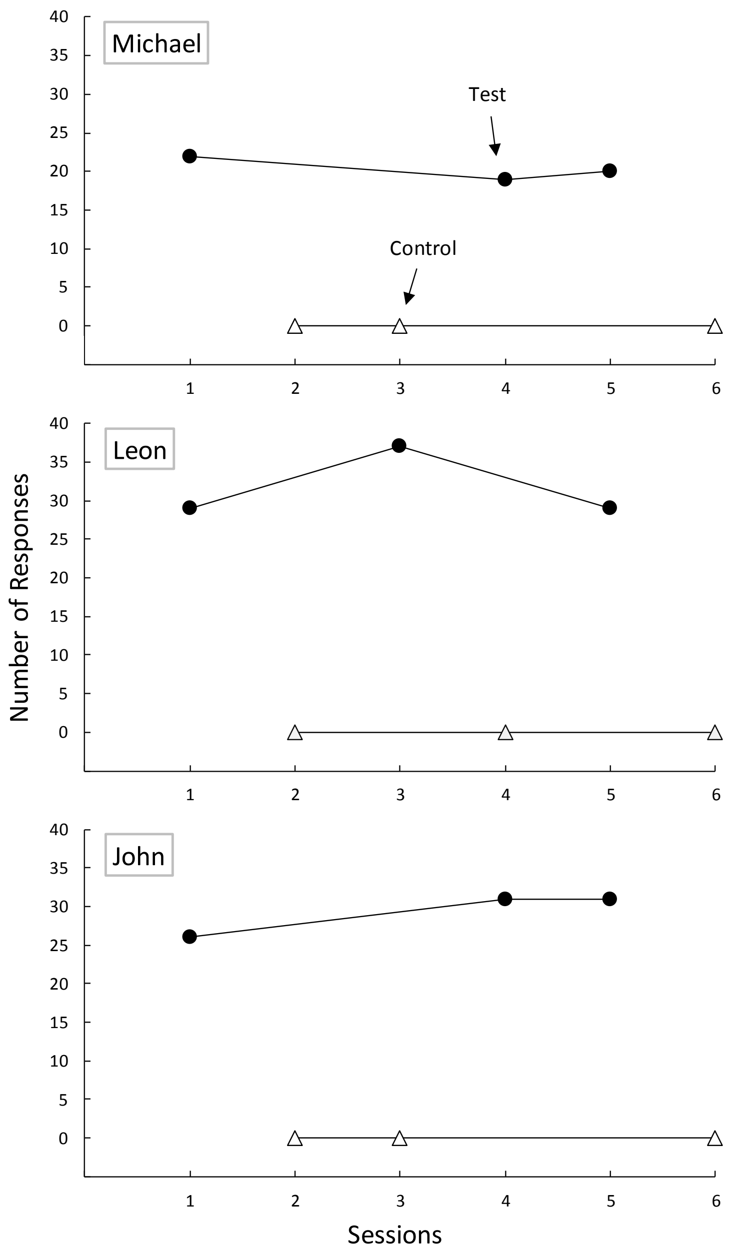

Figure 3. Assessment of controlling variables data for all participants in Experiment 1. The top panel displays Michael's data, the middle panel displays Leon's data, and the bottom panel displays John's data. The black circles represent responding in the test condition, and the open triangles represent responding in the control condition.

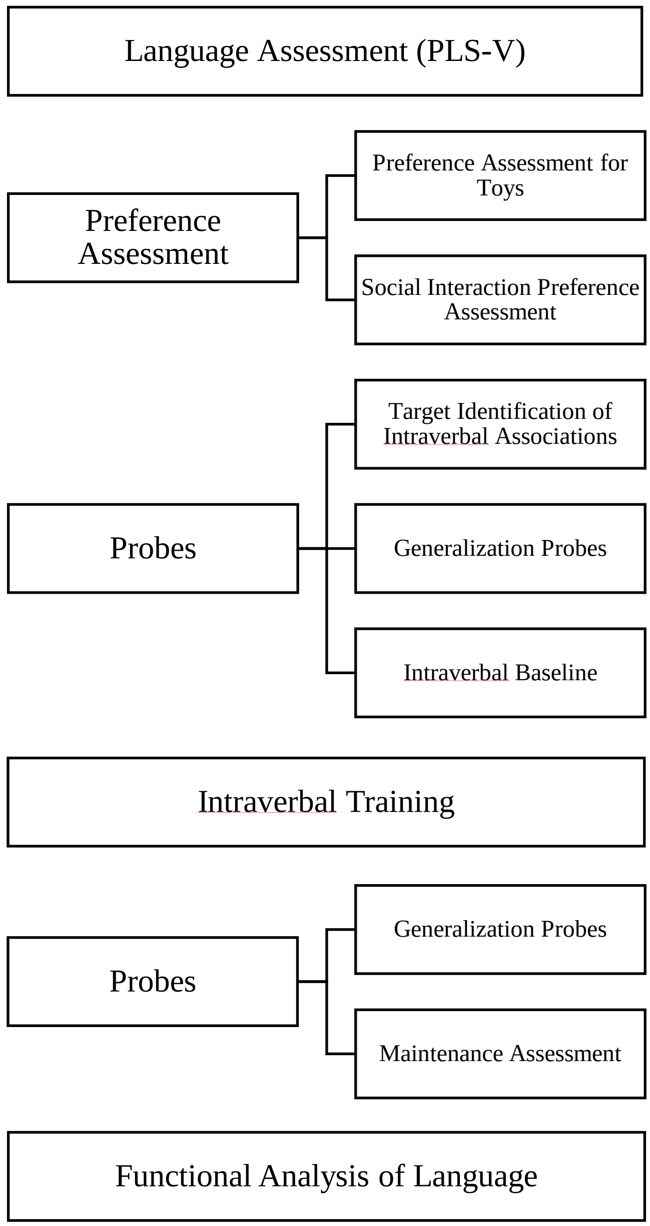

Figure 4. Flowchart of the procedures in Experiment 2.

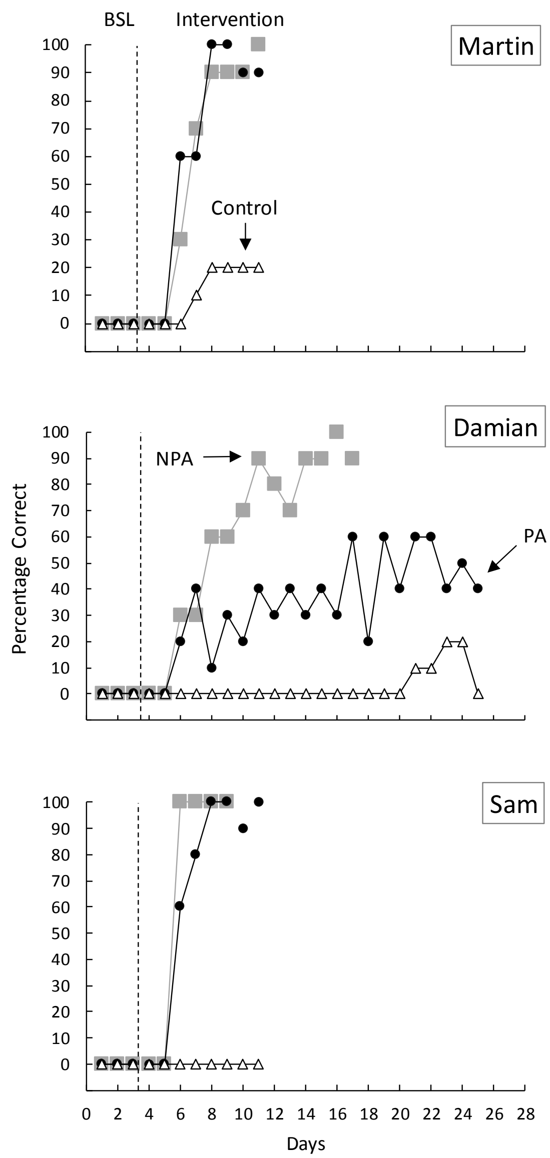

Figure 5. Intraverbal acquisition data for all participants in Experiment 2. The top panel displays Martin's data, the middle panel represent Damien's data, and the bottom panel represent Sam's data. The black circles represent the PA condition, the gray squares represent the NPA condition, and the open triangles represent the control condition. The data points that are not connected with lines represent the results for maintenance probes.

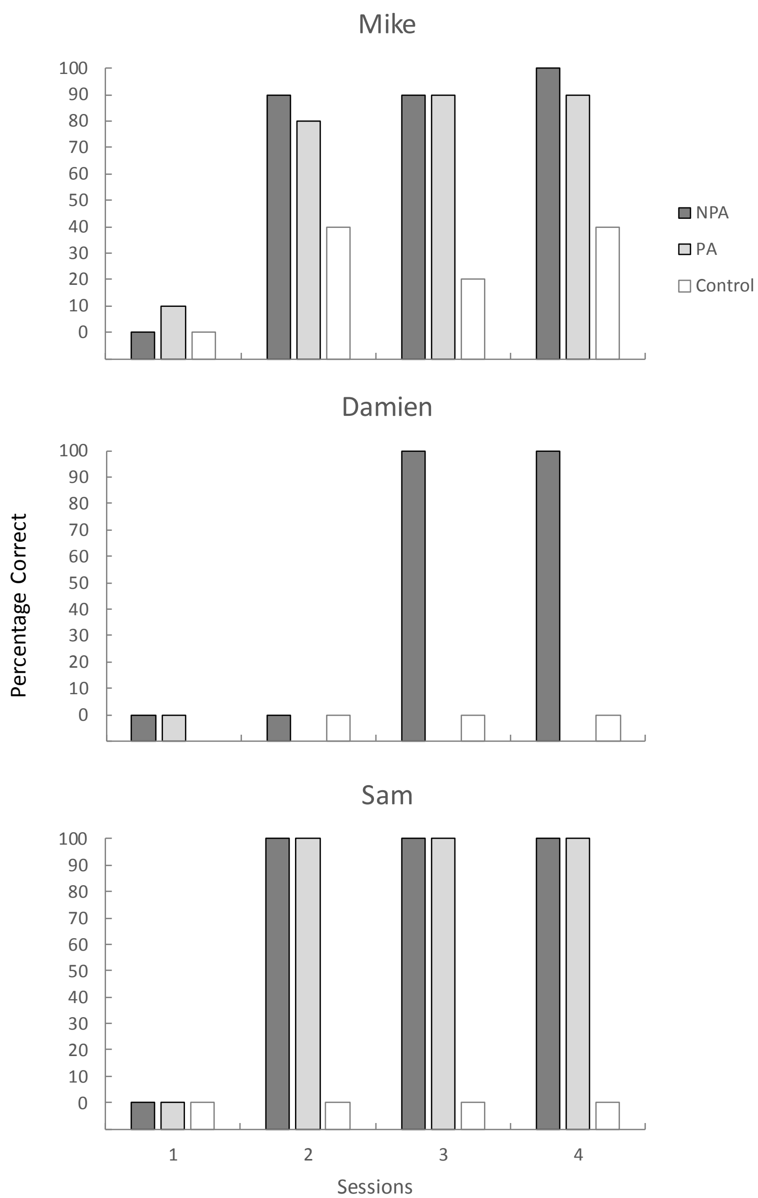

Figure 6. Generalization data for all participants in Experiment 2. The top panel displays Martin's data, the middle panel displays Damien's data, and the bottom panel displays Sam's data. The first session was conducted prior to intraverbal training, and the last 3 sessions were conducted post intraverbal training. The light gray columns represent responding in the PA condition, the dark gray columns represent responding in the NPA condition, and white columns represent responding in the control condition.

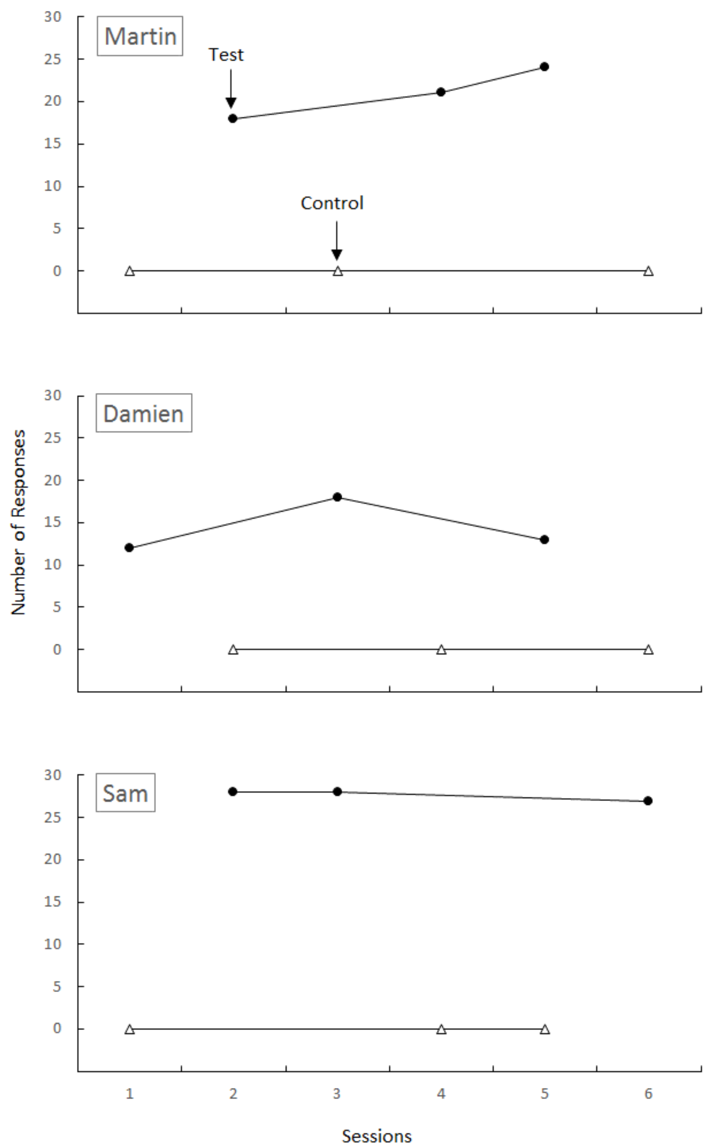

Figure 7. Assessment of controlling variables data for all participants in Experiment 2. The top panel displays Martin's data, the middle panel displays Damien's data, and the bottom panel displays Sam's data. The black circles represent responding in the test condition, and the open triangles represent responding in the control condition.