THE EFFECTS OF NATURALISTIC LANGUAGE INTERVENTIONS ON
THE USE OF LANGUAGE IN CHILDREN WITH AUTISM

Brittany A. Degner, B.S.

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APPROVED:

Karen Toussaint, Major Professor
Einar Ingvarsson, Committee Member
Shahla Ala’i-Rosales, Committee Member
Jesús Rosales-Ruiz, Chair of the Department of Behavior Analysis
Tom Evenson, Dean of the College of Public Affairs and Community Service
Victor Prybutok, Vice Provost of the Toulouse Graduate School
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Several evidence-based procedures based upon operant learning principles have been developed to teach language, and for young children with autism spectrum disorder (ASD), naturalistic interventions are commonly implemented as they are both effective and developmentally appropriate. The current investigation compared contingent responsive intervention and combined intervention on the effects of language use in four children diagnosed with ASD. Results suggest that a combined intervention procedure increases target language and requests in children with simplified language (e.g., one-word phrase) as well as complex language (e.g., simple sentences).
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Individuals diagnosed with autism spectrum disorders (ASD) have difficulty with social-communicative behaviors to varying degrees (American Psychiatric Association, 2013). For example, some individuals with ASD may be nonverbal while other individuals have language yet are unable to appropriately reciprocate information. Several evidence-based procedures founded upon operant learning principles have been developed to teach language, and for young children with ASD, naturalistic interventions are commonly implemented as they are both effective and developmentally-appropriate (Wolery, 1994). Naturalistic intervention strategies are child-directed strategies which can be implemented within everyday contexts and have been demonstrated to improve communication, social interaction, and play of children with developmental disabilities (Noonan & McCormick, 2014).

One of the first skills taught in early intervention is to establish a repertoire for requesting (i.e., manding) so that individuals can access preferred stimuli (Weiss & Zane, 2010). Mands are communicative acts under the control of antecedent states (i.e., motivating operations) that specify the reinforcer in a given environment (Skinner, 1957; Sundberg & Michael, 2001; Michael, 1982). Naturalistic instructional procedures share consistencies with a verbal behavior approach, although there are some differences in terminology (e.g. mands vs. requests, see Leblanc, Esch, Sidener, & Firth, 2006). For example, a common goal across naturalistic strategies is to teach manding by taking advantage of the child’s interest in items and/or events and then providing access to child-preferred items appropriate contingent upon the appropriate request. (Carrow-Woolfolk, 1988; Ingersoll, 2010; Michael, 1993). This framework of incorporating stimulus-response-reinforcement sequences into natural environments to promote
spontaneous and more complex speech was first identified as incidental teaching (Hart & Risley, 1968, 1974, 1975). There have been various extensions of incidental teaching including Pivotal Response Treatment (Koegel, O’Dell, & Koegel, 1987) and enhanced milieu teaching (Kaiser & Hester, 1994).

Although there are variants of naturalistic interventions to teach manding, all maintain the following instructional progression: (1) the instructor arranges the environment with the child’s preferred items, (2) the child initiates towards an item of interest, (3) the instructor requires a target or elaborated communicative response and provides a prompt if necessary, and (4) the instructor provides specific praise and access to the desired item contingent on use of target language.

A different class of interventions to teach language to young children with ASD is considered responsive or developmentally-based language interventions. Similar to naturalistic interventions, responsive interventions are child-led and are conducted within the child’s everyday environment. However, a distinction between the two approaches is that responsive interventions do not contain direct prompting procedures to promote elaborated or target language; rather, the instructor focuses on responsiveness to facilitate social-communicative behavior. That is, the instructor provides models of target language contingent upon the child’s engagement with items, imitates child verbal and nonverbal behavior, and creates balanced turns between the instructor and child (Ingersoll, 2010).

Given the variety of language interventions for children, comparative research is needed to evaluate which language interventions are most effective for young children with autism and to identify which individual characteristics may allow a child to benefit from a particular language intervention. For example, results of Yoder et al. 1995 suggest that naturalistic
behavioral interventions produced greater gains in receptive and expressive language for children with minimal language, whereas responsive interaction interventions produced greater language gains for children with relatively higher levels of language.

Ingersoll (2010) compared the effects of three different language interventions that ranged in the amount of direct prompting and responsiveness with two preschoolers with autism. One participant communicated using one-word approximations and the other had more complex language and used simple phrases. The intervention with direct prompting (milieu teaching) produced the greatest increases in total language for the participant with lower language ability, but there was no differential effect on total language for the participant with more complex language. In addition, participants produced the greatest number of mands during interventions with direct prompting but produced the greatest number of comments during the responsive intervention. However, there are two limitations to these results. First, it is difficult to conclude what effects the language interventions had on participants’ language, as Ingersoll did not collect baseline measures of language. Thus, it is not clear if requests increased from baseline levels during the prompting conditions, if requests decreased from baseline levels during the responsive conditions, or some combination of the two. Second, Ingersoll utilized an adapted alternating treatment design to compare the interventions which may have led to carryover effects, especially since differential responding between conditions decreased over the course of the evaluation (Barlow & Hayes, 1979).

Although previous research suggests that interventions may be more or less beneficial dependent upon participant language, there may be additional skills that may be necessary for an individual to benefit from an intervention. Consideration of the contingencies in language interventions (regardless if they are derived from operant theory or not) may help to identify
which skills are required. For example, it is likely that a child will not benefit from responsive interactions if social attention is not preferred or if social attention does not function as a reinforcer. Given that social attention (or responsive interactions) are provided contingent upon child language during responsive interaction techniques, sensitivity to social attention may be a critical component for this type of intervention.

Both classes of interventions require learners to attend to and imitate auditory stimuli. Thus, vocal imitation is a requisite skill in both. Similarly, a generalized imitative repertoire may also facilitate the benefit of both language interventions as generalized imitative repertoire indicates that children readily attend to and observe others and have a see-do capability in their repertoire (Greer & Ross, 2008).

The purpose of the current evaluation was to evaluate the effects of two language interventions on language for toddlers and preschoolers with ASD. We evaluated whether sensitivity to attention, imitative skills, and language skills were related to outcomes of language interventions.

**Method**

**Participants**

Four children with an independent diagnosis of an Autism Spectrum Disorder participated in the current study. Participants attended an early intensive behavioral intervention program from a university-based autism center for 28 – 35 hours per week. We administered a variety of assessments at the onset of the evaluation to obtain measures of participants’ echoic, motor imitation, and language skills, as well as participants’ preference for social interaction, and a reinforcer assessment to assess if attention functioned as a reinforcer. Refer to Tables 1 and 2 for each participant’s name, age, and results of the pre-assessments.
Setting and Materials

All sessions were conducted in a classroom in the university-based autism center that contained sets of age-appropriate toys such as Play-Doh®, books, trains, and pretend play materials (see Appendix for a complete list of toys). The room also contained one child-sized table with two chairs and a collapsible wire shelf with 6 cubes along the opposite wall. Toys were placed on the table, in the wire shelf, and on the floor where the participants could always reach the items.

The primary author was a senior-level graduate student in behavior analysis and conducted all experimental sessions. All sessions were video-recorded by a second observer who did not interact with the participants.

Pre-Assessments

We administered seven different assessments at the onset of the study. We assessed motor and vocal imitation to ensure these requisite skills were present prior to their participation in language interventions that require both repertoires. Additional repertoires may be necessary for learners to benefit from aspects of naturalistic instruction such as having the therapist respond to all child communication, so we also assessed preference for social interactions as well as conducting a reinforcer assessment for social attention. Finally, we also assessed participant’s receptive and expressive language skills. The experimenter did not provide feedback on participant performance during any pre-assessments. Preferred items were delivered noncontingently and intermittently throughout the assessments to maintain participant responding and engagement.

Motor Imitation Scale (MIS). We assessed participants’ ability to imitate motor movements by modeling 16 one-step imitative actions in a structured setting (Stone, Ousley, &
Littleford, 1997). Half of the items on the scale require common items in order to complete the action and the other half consists of gross and fine motor movements. Actions are also divided into “meaningful” (e.g. walking a toy dog across a tabletop) and “non-meaningful” (e.g. walking a hairbrush across a tabletop). The experimenter provided up to three consecutive opportunities to imitate each action, and recorded the best trial. Each item was scored as either a “2” for exact imitation, a “1” for partial imitation or a “0” for no imitation; thus, total scores ranged from 0 to 32 on the MIS.

**Early Echoic Skills Assessment (EESA).** We assessed participant’s vocal imitative repertoire via the Early Echoic Skills Assessment (EESA) component of the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) (Sundberg, 2008). The EESA assesses participant’s ability to imitate a speech model from simple syllables to prosody and intonation. The experimenter presented a vocal model up to three consecutive times, and recorded the best trial. Each item was scored as either a “1” for exact imitation, a “1/2” for partial imitation or a “0” for no imitation; thus, total scores ranged from 0 to 105 on the EESA.

**Peabody Picture Vocabulary Test (PPVT).** The Peabody Picture Vocabulary Test (PPVT) is a norm-referenced test designed to measure receptive language (version IV), Dunn & Dunn, 1997, 2007). The test is comprised of training items followed by over 200 test items. The experimenter delivered the name of the test item and the participant was to select the corresponding picture of the item that illustrates what the experimenter requested. Scores from this test are norm-referenced. Trey did not meet the pre-test requirements and therefore could not be tested; no scores are represented for him.

**Expressive Vocabulary Test (EVT).** Like the PPVT, the Expressive Vocabulary Test (EVT; version II) is norm-referenced (Williams, 1997, 2007). It is designed to measure
expressive vocabulary through labeling and synonym testing. The test contains three examples followed by 190 test items. The experimenter presented the participant with a picture and the participant would then have to make a vocal-verbal response that either labeled the picture, answered a question about the picture, or provide a synonym for the picture. Trey did not meet the pre-test requirements and therefore could not be tested; no scores are represented for him.

**Social Attention Preference Assessments.**

*Reinforcer Assessment.* We conducted a reinforcer evaluation to determine if contingent social interactions functioned as a reinforcer. We first identified arbitrary responses for each participant (e.g., touching a colored index card on the back of a clipboard). The materials needed to complete the target response were always available and within close proximity to the participant. Prior to each session, the experimenter physically guided the participant to complete the first two responses. Following the completion of the two prompted responses, the experimenter conducted three-minute sessions and delivered the programmed consequences to evaluate responding under baseline and reinforcement conditions. During baseline, the experimenter did not provide any programmed consequence contingent upon a target response. During the reinforcement phase, the experimenter provided social praise contingent upon a target response. The participant’s scores are shown in Table 2 and represented with a yes, no, or neutral as to if responding indicated social attention to function as a reinforcer.

*Concurrent Operant Assessment.* During the concurrent operant assessment, a small treatment room was divided in half by a piece of red tape and identical items were spread across both halves of the room. The experimenter alternated between sessions which side of the room she was on to control for counterbalancing. The participant was then brought into the room and was prompted to stand on the tape. The timer was then started for five minutes and during that
time the participant had free access to all items in the room. If he designated his time on the half of the room that the experimenter was occupying, the experimenter would interact with him and the items without placing any demands or removing any items. If the participant was on the opposite side of the room as the experimenter, the experimenter did not engage with him or the items. The participant’s scores are shown in Table 2 and represented with a yes, no, or neutral as to if responding indicated social attention to function as a reinforcer.

**Multiple Stimulus with Replacement (MSW).** We conducted a modified preference assessment based on the procedures described by Windsor, Piche, & Loche (1994). We arranged three different 3x5 pictures on a table in front of the participant. The pictures consisted of: (a) a preferred item that the participant often engaged with (b) the same item but with the experimenter and (c) a blank picture that served as a distractor during the assessment. At the beginning of the assessment, the experimenter guided the participants to select the preferred-item only picture card and the preferred item + experimenter picture card twice. Following the four guided trials, the experimenter placed the three pictures in an array and instructed participants to “pick one.” If the participant selected the preferred item-only card, the participant gained access to the item for approximately 30 seconds. If the participant chose the preferred item + experimenter card, the experimenter engaged with the participant and the preferred item for approximately 30 s without placing any demands or controlling the item. If the participant selected the distractor card, the experimenter turned their back to the participant for approximately 30 s and did not provide access to the preferred items. After each trial, the three cards were positioned in an array and the process was repeated until four trials were conducted. Selection percentages were calculated by dividing the number of times a card was selected by the number of trials in which it was available (4) and multiplying by 100.
Dependent Measures and Data Collection

The experimenter and each participant’s case manager (a Board Certified Behavior Analyst, BCBA) determined the target level of responding for each participant. Target language was determined to be slightly above the child’s current level of language (e.g., if the participant could reliably use one-word to communicate, their target language would be expanded to two-word phrases). Trey and Jack’s spontaneous language during intake was in the form of babbling and approximations to one-word names of items. The target language for both Trey and Jack was one-word. Theo and Max had more sophisticated language and were already communicating with several-word phrases. The target language goal for Theo and Max was simple sentences with the correct sentence structure and order (i.e., subject + verb + object). We collected data on total language, spontaneous language, prompted language, target language, non-target language, requests, and comments (see Table 3 for behavioral definitions).

Interobserver Agreement (IOA) and Procedural Integrity

Partial interval agreement was calculated by dividing the sessions into 10-second intervals and averaging interobserver agreement across all intervals. The lower number of responses was divided by the higher number within each interval. Results were summed across intervals, divided by the number of intervals, and the result was multiplied by 100. Interobserver agreement scored for 30% of each intervention phase across all participants. Average IOA scores for Trey across intervention phases ranged from 89% - 96%, for Jack was between 89% - 97%, Theo’s average IOA was between 89% - 94%, and Max’s ranged between 92% - 94%. For the complete breakdown of IOA between sessions for each participant refer to Table 4.

Procedural integrity was also calculated using partial interval agreement into 10-second intervals and averaging agreement across all intervals. Procedural integrity was scored for 30%
of sessions. Average range of procedural integrity scores for Trey were between 98% - 99%, for Jack were between 98% - 100%, Theo’s average procedural integrity range was between 95% - 98%, and Max’s ranged between 94% - 99%. For the complete breakdown of procedural integrity averages and ranges across interventions and participants, refer to Table 5.

Procedure and Experimental Design

We evaluated the effects of a contingent responsive intervention and a combined intervention on language within a reversal design. All sessions were ten minutes in length and we conducted 1-3 sessions per day.

Baseline. During baseline sessions, the participants had free access to the session room. No demands were placed, no items were removed or withheld, and the experimenter never took control of the items the participant was engaged in. The only exception to this was if the experimenter assisted the participant in gaining access to items in order to functionally engage with that item (e.g., opening the lid to a playdoh container). The experimenter always remained at the participant’s level and within arm’s reach. Every 30 seconds, the experimenter would make a neutral statement directed at the client. A neutral statement was defined as a comment unrelated to what the participant is doing at that time. Examples include: “your shirt is really cool today” or “it looks like it could rain outside.” If the participant initiated towards the experimenter at any time, the experimenter responded with polite, friendly statements, such as “I see” or “how cool.” No items were delivered contingent on participant vocalizations during this condition. If challenging behavior or no engagement with session items for 30 s occurred, the experimenter would redirect the participant to another toy or activity providing minimal attention. If the participant went around the large rolling cabinets to the office area of the room,
the experimenter would guide the participant back to the session side of the room while giving the participant minimal attention.

**Contingent Responsive Interaction (CRI).** The contingent responsive interaction (CRI) condition focused primarily on modeling target language and expanding on spontaneous language. During sessions, the experimenter stayed at the participant’s level and within arm’s reach, and commented on the participant’s play at the participant’s target level of language. A related comment was made every 15 seconds. Related comments were defined as any comment that the experimenter makes that is directly related to what the participant is engaging with at that time. For example, if the participant was playing with playdoh and tools to cut out animal shapes, the experimenter could make the statement, “fish” (for Trey and Jack) or “you made a green fish” (for Theo and Max). Due to the nature of the room and having access to two sets of items, the experimenter could imitate the participant’s play while mapping language on top. If at any time during the session the participant requested attention by initiation of conversation or question the experimenter would appropriately respond. The experimenter never directly elicited language, placed demands, or withheld toys during this condition. The experimenter could assist the participant in gaining access to items (i.e., opening the lid of playdoh container) in order to functionally play with them but the experimenter never required a communicative response from the participant to gain access back. If challenging behavior occurred during this condition or no engagement with items in the session room for 30 s, the experimenter would redirect the participant to items in the room that they had previously shown interest in while providing minimal attention. If the participant went around the large rolling cabinets to the office area of the room, the experimenter would guide the participant back to the session side of the room while giving the participant minimal attention.
**Combined Interaction.** The combined interaction condition concentrated on eliciting the target language as well as using the principles described in the CRI condition. During each session, the experimenter would be at the participant’s level and maintain close proximity. The experimenter would comment on what the participant was engaged with as well as occasionally maintain control of the preferred items. If the experimenter took control of a preferred item, the participant was required to provide a target language sample to regain access to the item. For example, if the participant is playing with playdoh and tools to cut out animal shapes, the experimenter could withhold access to the animal shapes. The experimenter would then wait for the child to initiate toward the animal shapes or emit the language target. If the participant emitted a non-target language sample (e.g., “sh-” for Trey and Jack or “do some piece orange” for Theo and Max), the experimenter would provide a vocal model (e.g., “fish” for Trey and Jack or “can I have a piece of orange?” for Theo and Max). If the participant engaged in the same response as the provided model, the experimenter provided specific praise and emphasized the correct target response (e.g., Trey repeats “fish” after the model, the experimenter would respond, “fish! Here’s the fish”). If the participant did not engage in the target response after the model, the experimenter represented the model to them again. The model was provided up to three times. If the target language was not emitted after the third prompt, the experimenter would withhold access to the item until the participant initiated interest again or showed interest in another item and the prompting chain would begin again. If challenging behavior occurred during this condition or the participant was not engaged with session items for 30 seconds, the experimenter would redirect the participant to the items in the session room while providing minimal attention to challenging behavior. If the participant went around the large rolling
cabinets to the office area of the room, the participant was guided back to the other side by the experimenter.

**Results**

**Pre-assessment Scores**

Each participant’s pre-assessment results are represented in Tables 1 and 2 along with their age at the onset of the experiment.

**Motor Imitation Scale (MIS).** Three of the four participants (Jack, Theo, and Max) scored highly on the MIS with scores of 30, 28, and 31, respectively. Trey scored within the moderate range with a score of 15.

**Early Echoic Skills Assessment (EESA).** There was a greater range of scores on the vocal-verbal assessment compared to the MIS. Trey’s EESA score falls within group 1 (22) of imitating simple syllables. Group 2 encompasses 2-syllable combinations and represents Jack’s score (39) on the EESA. Both Theo and Max scored well into group 3 on the EESA (72 and 85, respectively).

**Peabody Picture Vocabulary Test (PPVT).** Each participant’s standard scores on the PPVT are represented in Table 1 with the exception of Trey who could not be tested. Jack and Theo’s scores both fall within the moderately low range on the PPVT (73 and 79, respectively). Max’s standard score is within the average range for his age (88).

**Expressive Vocabulary Test (EVT).** Like the PPVT, Trey could not be tested and no scores are represented. Jack’s EVT score fell within the extremely low range (59) and both Theo and Max’s scores are within the average range (89 and 87, respectively).

**Reinforcer Assessment.** The results of the reinforcer assessment are presented in Table 2. Three of the four participants (Trey, Theo, and Max) showed differential responding between
the attention and no attention sessions. Trey’s average number of responses when there was no contingent attention was 0.3 (range, 0-1) and increased to an average of 4.3 (range, 3-6) when contingent attention was delivered following a response. Jack’s average number of responses showed no change between no contingent attention and contingent attention sessions ($M = 0$ and $M = 0.3$, respectively). The average number of responses for Theo during the no attention sessions was 0.6 (range, 0-2) and increased to $M = 9.3$ (range, 5-16) when contingent attention was delivered after a response. Max’s average number of responses also increased across no contingent attention and contingent attention session $M = 3$, 2-4 and $M = 8.7$, 7-10, respectively.

**Concurrent Operant.** During the concurrent operant social attention assessment only two participants showed a preference towards social attention (Jack and Max). If the average amount of time spent on the side of the room with the experimenter was less than 40% it was scored as no and would represent a preference away from social attention. An average score between 40-60% was scored as neutral because no preference could be determined and an average score above 60% was scored as yes and represented a preference for social attention. Trey’s average percentage of time spent on the side of the room with the experimenter was 53% and scored as neutral. The average percentage of time Jack spent on the same side of the room as the experimenter was 66% and Max was 75%; both of which were scored as yes for a preference toward the experimenter. Theo showed a side bias toward the right side of the room regardless of where the experimenter was in the room and his average percentage of time spent with the experimenter was 59% and was scored as neutral.

**Multiple Stimulus with Replacement (MSW).** The scores during the MSW represent the percentage of selections made towards the card representing the experimenter and the item during the free-choice trials. Scores were represented a neutral if the participant chose the
distractor 50%, this represents Trey’s score during the MSW. The participants received a favorable score of yes if they chose the experimenter with the preferred item on more than 50% of the free-choice trials. Jack allocated all of his responding for the experimenter with the preferred item (100%) and his score represents a yes for preference towards social attention and the preferred tangible item. Both Theo and Max chose the experimenter plus the preferred item on 75% of free-choice trials.

The effects of intervention on total language and spontaneous language for all participants are shown in Figures 1-4. During the combined intervention condition, we distinguish between spontaneous and total language as total language is comprised of both prompted and unprompted language; there is no prompted language in the other conditions. The effects of intervention on target vs. non-target language is shown in in Figures 5-8, and the effects of intervention on requests vs. comments are shown in Figures 8-12.

**Total Language**

Trey’s average number of total responses was 30 words per session during baseline (Figure 1). His overall language decreased with the first implementation of the CRI (\( M = 17.5 \)) and remained low during the second exposure to baseline (\( M = 13.3 \), range 6-25). Total language increased to an average of 40.8 with implementation of the combined intervention. Trey’s total language was consistently higher during the combined intervention phases (panels 4, 6 and 9) compared to both baseline and CRI phases. There was no reliable, facilitative effect on spontaneous language session across phase.

Figure 2 depicts Jack’s total and spontaneous language results across intervention phases. During the first baseline phase, Jack’s average number of one-word responses was 10 (range 7-13) and increased to an average of 43.2 responses per session with the implementation
of CRI. Responding decreased with a return to baseline conditions ($M = 18.3$, panel 3) and increased to 38.8 (range 29-45) when the combined intervention was implemented. Jack’s total language was consistently higher during the combined intervention phases (panels 4, 6 and 9) compared to both baseline and CRI phase, and there was no reliable, facilitative effect on spontaneous language across phases.

Figure 3 displays the total language results for Theo. During baseline, Theo’s average number of simple sentences was 22.9 (range 9-43). His total language decreased slightly during the first implementation of CRI ($M = 10.6$, range 4-24) but during the second phase average responses increased to 27.3 (range 9-54). Theo’s total language increased to an average of 50.9 (range 26-69) during combined intervention. Theo’s responding was variable across intervention phases and there was no reliable, facilitative effect on spontaneous language.

Max’s average number of responses was 49.6 simple sentences during baseline (Figure 4). His overall language increased during the initiation of CRI phase ($M = 85.8$) but this effect was not replicated during the second implementation ($M = 59.8$). Max’s responding was also high during the first combined intervention phase ($M = 86.5$) but like CRI, was not replicated during the second phase ($M = 62.3$). Max’s responding was variable across all intervention phases and no reliable, facilitative effect on spontaneous language was shown.

**Total Target Language and Non-Target Language**

Figure 5 displays results for Trey’s total target and total non-target language across intervention phases. The average number of responses during baseline for target language was 11.9 (range 2-31). Throughout the CRI phases, Trey’s average number of total target responses was 17.8 (range 1-34). Trey’s total target language was consistently higher during the combined
intervention phases (panels 4, 6, and 9) compared to the other intervention phases. His total non-target language was low across all interventions ($M = 5.7$).

Jack’s total target and total non-target language is displayed in Figure 6. During baseline, his average number of one-word responses in the form of total target language was 14.4 (range 1-18). His average number of responses during the first CRI phase was 26 yet this effect was not replicated during the second implementation ($M = 4.3$). During all combined phases Jack’s total target responses increased to an average of 42. The average of Jack’s non-target language during all intervention phases remained low ($M = 5.6$).

Figure 7 displays Theo’s total target and total non-target language across all intervention phases. His average number of total target simple sentences during baseline was 10.9. Average responses maintained at low rates during the CRI phases ($M = 13$) although responding was continually increased during the second implementation of the CRI phase. Theo’s average number of responses during the combined intervention phases was 34.2. There was no direct effect on total non-target language during any intervention phases.

Max’s results displaying total target and total non-target language across intervention phases are displayed in Figure 8. His average number of total target simple sentences was 21.3 during the first baseline phase. Max’s average target responses maintained ($M = 29.6$) during the initiation of the first CRI phase. Target responding continually decreased during each subsequent baseline phase (panels 3, 5, and 7). During the first implementation of combined intervention, Max’s average number of target responses was 52.8 but decreased during the second implementation ($M = 37$). There was no direct effect on total non-target language across intervention phases.

**Total Requests and Total Comments**
The comparison of total requests and total comments made by Trey across intervention phases is represented in Figure 9. During baseline, his average number of requests was 2 (range 0-6) and remained low across subsequent baseline phases. During the first CRI phase, Trey’s average number of requests was comparable to baseline ($M = 2.7$). Requests increased across all combined intervention phases to an average of 31 responses per session. Trey’s average number of comments across all intervention phases was consistent with no direct effects observed.

Figure 10 displays the results of Jack’s total requests and total comments across all intervention phases. During the first baseline phase, his average number of requests was 3.3. The CRI followed baseline where Jack’s average number of requests increased slightly to an average of 8.6. Total requests decreased with a return to baseline condition ($M = 5.3$) and increased significantly when the combined intervention was implemented. Jack’s number of requests were consistently higher during the combined intervention phases (panels 4, 6, and 9) compared to baseline and CRI. There was no direct, replicated effect on total comments across intervention phases although responses during the first CRI phase and second combined intervention phase were higher compared to other phases ($M = 34.6$ and 19.3, respectively).

Theo’s total requests and total comments across sessions are shown in Figure 11. During the first baseline phase, his average number of requests was 6.3. Theo’s average number of requests maintained at 6.7 during the first CRI phase and showed a steady increase in requests during a return to baseline ($M = 12.4$). His average requests maintained during the second implementation of CRI ($M = 15.8$) and average requests increased significantly during the first implementation of combined intervention to 37.8 responses per session. There was no direct effect on Theo’s average number of comments across intervention types.
Figure 12 displays results for Max’s total requests and comments throughout the intervention phases. During his first baseline phase his average number of requests was 3.8. His overall requests increased slightly during the implementation of the first CRI phase ($M = 9$) and maintained during a replication of the phase ($M = 11.8$). Max’s total requests were consistently higher during the combined intervention phases (panels 4 and 6) compared to both baseline and CRI phases. There was no direct, reliable effect on total comments emitted across intervention phases.

**Discussion**

Prior research suggests that language interventions may differentially facilitate language depending upon child characteristics, such as language ability. The current study was designed to extend this research by assessing additional characteristics (sensitivity to social attention and imitation) and directly comparing two language interventions with four children with autism.

For Trey, Jack, and Theo, total language increased during each exposure to the combined intervention; however, intervention did not affect spontaneous language. This suggests that although total language increased during the combined intervention phases, a significant proportion was prompted language during those sessions. For Max, neither intervention increased total language. However, this may be due to ceiling effects as Max communicated at higher levels than the other participants during baseline conditions. Therefore, there may not have been much room for improvement in regards to total language for Max.

All participant’s target language increased during the combined intervention phase. This suggests that direct prompting techniques are necessary to increase language complexity, at least in the short term such as in the current evaluation.
We also evaluated the effects of interventions on requests vs. comments (comprised of both tacts and intraverbals). For all participants, mands increased significantly in the combined phases. Due to the nature of the combined sessions where the experimenter required an appropriate target level request or provided an appropriate target level model in order for the participant to gain access to some desired items this shift in responding is not surprising. It is interesting that CRI did not consistently produce increases in commenting across any participants. Although all participants showed sensitivity to social attention (via either a preference or reinforcer assessment), contingent responsiveness was insufficient to increase comments. It is possible that a language intervention with direct prompting methods, such as the Natural Language Paradigm, are necessary to increase comments.

Theo’s total requests and total comments are depicted in Figure 11. Potentially due to the fact that he had high levels of language coming into the study and attention appeared to be a functional reinforcer for him during pre-assessments, none of the intervention phases showed inhibiting effects. He was consistently labeling items and requesting items across intervention phases. Max also came into the study with functional communication and his target language goal was set as simple sentences. Max had high levels of comments across all phases of interventions and moderately low levels of requests in all phases except the combined phases (Figure 12).

These results are consistent with the Ingersoll (2010) study that suggests a combined intervention may be the most beneficial naturalistic intervention for young children diagnosed with autism. The current study’s results differ somewhat from past research for those participants who have more complex language. The literature suggests that children with higher language abilities may not have any differentiation in effects between combined and contingent responsive
interventions. The results from the current study suggest that combined intervention may also be effective for children with more complex language abilities (Table 6). Although not as clearly separated as the interventions were for Trey and Jack, the combined interaction also increased total language for Theo and both target language and requests for both Theo and Max. The results for increasing comments remained inconclusive for Jack due to higher level of comments in one combined intervention phase and one contingent responsive intervention phase but these effects were not replicated. Total comments were not applicable for the other participants because no direct change was observed between interventions.

A limitation to the current study is how prompts were used to model language to participants during the combined intervention. Hart and Risley (1975) suggest tailoring the level of prompts to the individual child as well as the environment. For the current study, the experimenter solely used a vocal-verbal model when prompting target level language for all participants. An appropriate alternative for the children with more complex language could have been to use verbal cues such as “What do you want” or “Tell me what you’d like” to permit more unprompted language.

Another limitation for the present investigation is the lack of control over what the participants engaged with during each session. Even though all items were present for each session, the participants would select varied items to engage with and it became apparent that some items promoted language more than others.

Future research should also investigate the comparison between the two naturalistic interventions further for children who already exhibit some complex language skills. The literature suggests that contingent responsive intervention could increase the complexity of language in children who already exhibit functional language skills (Ingersoll, 2010). Theo and
Max came into the current investigation with high levels of labeling and commenting on items they engage with. We did not tease these apart in our data collection process and it may be important to know how different verbal operants (i.e., intraverbals, tacts, mands) would be affected by the current interventions. Related to that, a more robust intervention where both requests and comments were directly targeted for increase would provide better insight as to which intervention would be more effective at promoting comments.
### Table 1

**Skill Pre-Assessment Scores**

<table>
<thead>
<tr>
<th>Participants</th>
<th>Age</th>
<th>MIS</th>
<th>EESA</th>
<th>PPVT</th>
<th>EVT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trey</td>
<td>2 y 5 mo</td>
<td>15</td>
<td>22</td>
<td>Not Testable</td>
<td>Not Testable</td>
</tr>
<tr>
<td>Jack</td>
<td>3 y 3 mo</td>
<td>30</td>
<td>39</td>
<td>73</td>
<td>59</td>
</tr>
<tr>
<td>Theo</td>
<td>4 y 4 mo</td>
<td>28</td>
<td>72</td>
<td>79</td>
<td>89</td>
</tr>
<tr>
<td>Max</td>
<td>3 y 6 mo</td>
<td>31</td>
<td>85</td>
<td>88</td>
<td>87</td>
</tr>
</tbody>
</table>
Table 2

*Social Attention Pre-Assessment Scores*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Reinforcer Assessment</th>
<th>Concurrent Operant</th>
<th>MSW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trey</td>
<td>Yes</td>
<td>Neutral</td>
<td>Neutral</td>
</tr>
<tr>
<td>Jack</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Theo</td>
<td>Yes</td>
<td>Neutral</td>
<td>Yes</td>
</tr>
<tr>
<td>Max</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Table 3

**Behavioral Definitions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total language</strong></td>
<td>Any communicative attempt made by the participant using their predetermined target language. Total language encompasses both spontaneous language and prompted language emitted by the participant. Language was further broken down into target and non-target as well as requests and comments.</td>
</tr>
<tr>
<td><strong>Spontaneous language</strong></td>
<td>When the participant made a vocal communicative attempt toward the therapist to either request an item or activity or comment on the current item or activity that they are engaged in. Spontaneous language did not have to be at the participant’s predetermined level of language.</td>
</tr>
<tr>
<td><strong>Prompted language</strong></td>
<td>When the participant made a vocal communicative attempt that followed a modeled vocal response from the therapist. Language was only prompted by the therapist during the combined interaction phase.</td>
</tr>
<tr>
<td><strong>Target language</strong></td>
<td>Slightly above the participant’s current spontaneous language level and is used to communicate with the experimenter. Target language may follow a prompt from the experimenter or be spontaneously initiated by the participant.</td>
</tr>
<tr>
<td><strong>Non-target language</strong></td>
<td>Any language production that falls below the set target language for that participant. For example, if the target language goal is one-word, an approximation to a word would be scored as non-target.</td>
</tr>
<tr>
<td><strong>Requests</strong></td>
<td>When the participant used their language to obtain a desired item or activity as well as to gain assistance.</td>
</tr>
<tr>
<td><strong>Comments</strong></td>
<td>When the participant used their language to label or make reference to what they are currently engaged with or interested in.</td>
</tr>
</tbody>
</table>
### Interobserver Agreement

<table>
<thead>
<tr>
<th>Participants</th>
<th>Baseline</th>
<th>Contingent Responsive Interaction</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trey</td>
<td>$M=94%$ (92%-96%)</td>
<td>$M=96%$ (94%-100%)</td>
<td>$M=89%$ (85%-96%)</td>
</tr>
<tr>
<td>Jack</td>
<td>$M=97%$ (95%-98%)</td>
<td>$M=94%$ (90%-98%)</td>
<td>$M=89%$ (85%-97%)</td>
</tr>
<tr>
<td>Theo</td>
<td>$M=94%$ (90%-98%)</td>
<td>$M=89%$ (87%-91%)</td>
<td>$M=90%$ (88%-93%)</td>
</tr>
<tr>
<td>Max</td>
<td>$M=94%$ (87%-96%)</td>
<td>$M=92%$ (89%-95%)</td>
<td>$M=93%$ (92%-94%)</td>
</tr>
</tbody>
</table>
Table 5

*Procedural Integrity*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Baseline</th>
<th>Contingent Responsive Interaction</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trey</td>
<td>$M = 99%$ (98%-100%)</td>
<td>$M = 99%$ (97%-100%)</td>
<td>$M = 98%$ (93%-100%)</td>
</tr>
<tr>
<td>Jack</td>
<td>$M = 100%$ (99%-100%)</td>
<td>$M = 98%$ (97%-98%)</td>
<td>$M = 98%$ (93%-100%)</td>
</tr>
<tr>
<td>Theo</td>
<td>$M = 96%$ (93%-100%)</td>
<td>$M = 95%$ (95%-97%)</td>
<td>$M = 98%$ (98%-99%)</td>
</tr>
<tr>
<td>Max</td>
<td>$M = 94%$ (94%-97%)</td>
<td>$M = 99%$ (97%-100%)</td>
<td>$M = 96%$ (95%-97%)</td>
</tr>
</tbody>
</table>
Table 6

Summary of Effective Interventions to Increase Language

<table>
<thead>
<tr>
<th>Participants</th>
<th>Total Language</th>
<th>Target Language</th>
<th>Requests</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trey</td>
<td>Combined</td>
<td>Combined</td>
<td>Combined</td>
<td>N/A</td>
</tr>
<tr>
<td>Jack</td>
<td>Combined</td>
<td>Combined</td>
<td>Combined</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>Theo</td>
<td>Combined</td>
<td>Combined</td>
<td>Combined</td>
<td>N/A</td>
</tr>
<tr>
<td>Max</td>
<td>Inconclusive</td>
<td>Combined</td>
<td>Combined</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Figure 1. Number of responses per session for Trey displayed as total language and spontaneous language.
Figure 2. Number of responses per session for Jack displayed as total language and spontaneous language.
Figure 3. Number of responses per session for Theo displayed as total language and spontaneous language.
Figure 4. Number of responses per session for Max displayed as total language and spontaneous language.
Figure 5. Number of responses per session for Trey displayed as total target and total non-target language.
Figure 6. Number of responses per session for Jack displayed as total target and total non-target language.
Figure 7. Number of responses per session for Theo displayed as total target and total non-target language.
Figure 8. Number of responses per session for Max displayed as total target and total non-target language.
Figure 9. Number of responses per session for Trey displayed as total requests and total comments.
Figure 10. Number of responses per session for Jack displayed as total requests and total comments.
Figure 11. Number of responses per session for Theo displayed as total requests and total comments.
**Figure 12.** Number of responses per session for Max displayed as total requests and total comments.
APPENDIX

MATERIALS PRESENT DURING EACH SESSION
2 baby dolls with bottles

2 Melissa & Doug® wooden farm chunky puzzle

2 Professor Poplar’s wooden numbers puzzle by Imagination Generation®

2 Fisher-Price® brilliant basics baby’s first blocks

2 Fisher-Price® laugh & learn smart stages piggy bank

2 Fisher-Price® brilliant basics boppin’ activity bugs

2 VTech® drop and go dump trucks

2 VTech® spin and learn color flashlights

2 Crayola® dry erase board with markers

2 PlanToys® plan preschool clatter music

2 Early melodies little drummer music set by Hape®

2 Gator Skin® dodgeballs

1 Playskool® explore ‘n grow busy ball popper

1 B.® one two squeeze blocks

1 VTech® Go! Go! Smart wheels carry-all cargo train

Hide ‘n squeak eggs by TOMY®

Play-Doh® with animal cutters and Play-Doh® Fun Factory

Assorted children’s costumes

A variety of 10 child’s books
REFERENCES


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