THE REHABILITATION OF VERBAL OPERANTS FOLLOWING ACQUIRED BRAIN INJURY

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by

Kimberly A. Magat

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Abstract

of

THE REHABILITATION OF VERBAL OPERANTS FOLLOWING ACQUIRED BRAIN INJURY

by

Kimberly A. Magat

Although verbal deficits are major concerns for individuals following an acquired brain injury (ABI), behavior-analytic research on language training in neurorehabilitation settings is extremely limited. The purpose of the current study was to systematically replicate the work of Sundberg, San Juan, Dawdy, and Arugelles (1990) in which the authors evaluated the acquisition and functional interdependence of verbal operants for adults following ABI. We used slightly modified procedures (e.g., inclusion of high preference activities, progressive prompt delay) and compared acquisition rates of tacts, mands, and intraverbals with three adult ABI survivors. We also assessed if directly training one verbal operant led to the emergence of untrained, topographically similar verbal operants. We found mand training was successful for all participants and led to the greatest amount of transfer under tact conditions, contrary to Sundberg et al. Potential

explanations for the differences between our results and those of Sundberg et al. are discussed.

________________________, Committee Chair
Dr. Megan Heinicke

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Date

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TABLE OF CONTENTS

LIST OF TABLES

Tables Page

LIST OF FIGURES

The Rehabilitation of Verbal Operants Following Acquired Brain Injury

INTRODUCTION

Vocal verbal deficits, such as aphasia, are major concerns for individuals following acquired brain injury (ABI) and can further complicate and increase the length of costly rehabilitation (Humphreys, Wood, Phillips, & Macey, 2013). While behavior analysts have produced a considerable line of research on language assessment and training for individuals with developmental disabilities (e.g., Finn, Miguel, & Ahearn, 2012; May, Hawkins, & Dymond, 2013; Wallace, Iwata, & Hanley, 2006), behavior-analytic research on language training in neurorehabilitation settings is extremely limited (Heinicke & Carr, 2014). The majority of research on assessment and treatment of language deficits following ABI emphasize psycholinguistic theories or neurological approaches (Muma, Hamre, & McNeil, 1986). However, Skinner (1957) provided an analysis of verbal behavior and aphasia, stating individuals with aphasia may have lost some of the functional relationships that control certain responses (e.g., can tact an item but not emit the mand for the same item).

In his analysis, Skinner (1957) proposed the loss of functional relationships for ABI survivors might be due to injuries affecting specific classes of stimulus-response relations and not others. Researchers have since utilized identity and nonidentity matching tasks to identify affected classes of stimulus-response relations (Leicester, Sidman, Stoddard, & Mohr, 1971; Sidman, 1971; Sidman, Stoddard, Mohr, & Leicester, 1971). Identity tasks involve the same sample and comparison forms (e.g., spoken letter to spoken letter) while nonidentity tasks involve different sample and comparison forms (e.g., spoken letter to written letter). Sidman (1971) hypothesized nonidentity tasks to be more vulnerable to disruption for individuals with aphasia. In addition, Baker, LeBlanc, and Raetz (2008) presented a behavior-analytic conceptualization and taxonomy for aphasia based on Skinner's (1957) analysis of verbal behavior. Baker et al.'s taxonomy is a departure from the traditional psycholinguistic model of language (based on form and grammatical structure; LaPointe, 2005) and allows for empirical research on the function-based treatment of aphasia and other verbal deficits following ABI.

In addition, Skinner (1957) explained verbal deficits observed in ABI survivors through functional independence of verbal operants—in which a unique antecedent and consequence maintain each verbal operant—suggesting a learned response may not necessarily result in the emergence of other verbal operants without direct training under specific control. Researchers have demonstrated functional independence of verbal operants in several studies including children with (e.g., Hall & Sundberg, 1987; Kelley, Shillingsburg, Castro, Addison, & LaRue, 2007) and without developmental disabilities (e.g., Lamarre & Holland, 1985) as participants.

On the other hand, researchers have also been successful in demonstrating functional interdependence with both typically developing children (e.g., May, Downs, Marchant, & Dymond, 2016; Rosales, Rehfeldt, & Lovett, 2011) and individuals with developmental disabilities (e.g., Finn et al., 2012; May et al., 2013; Wallace et al., 2006). Functional interdependence involves the emergence of one verbal operant (e.g., tact) after another (e.g., mand) is directly trained. Efficient language training procedures are of great importance in neurorehabilitation settings due to varied access and rising cost of rehabilitation in the United States (Ashley, 2016). Wallace and colleagues (2006) found functional interdependence of operants was more likely to occur if the operants directly trained included high preference (HP) items for three adults with intellectual disabilities. The authors also suggested that the lack of transfer in previous studies might be due to an absence of the establishing operation (EO), because the studies were not evaluating HP items or contriving strong conditioned EOs.

Most studies evaluating behavior-analytic procedures to teach weak or missing verbal operants have been conducted with individuals with developmental disabilities or young children. However, Sundberg, San Juan, Dawdy, and Arugelles (1990) evaluated the interdependence of verbal operants with two, adult male ABI survivors to assess (a) which verbal operant (i.e., tact, mand, or intraverbal) would be acquired first following language training, and (b) whether direct training of one operant would transfer to the untrained verbal operants. Results indicated "lost" tacts and intraverbals were most rapidly acquired, and direct mand training proved to be the least efficient way to generate a mand repertoire. These results are contrary to earlier studies, which demonstrated mands were acquired faster than tacts for individuals with developmental disabilities (Hall & Sundberg, 1987; Sundberg, Milani, & Partington, 1977).

Sundberg et al.'s (1990) findings also support functional interdependence of verbal operants for individuals with ABI by demonstrating tact training produced the greatest amount of transfer to untrained verbal operants while mand training produced the least amount of transfer. These findings are contrary to the results of past studies with individuals with developmental disabilities, in which mand training has been found to produce the greatest amount of transfer (e.g., Finn et al., 2012; Petursdottir, Carr, & Michael, 2005; Sundberg et al., 1977). Overall, the authors concluded tact and intraverbal training might be the most efficient methods to re-teach mands for individuals with ABI.

To the authors' knowledge, the investigation by Sundberg et al. (1990) is the only published study evaluating the functional interdependence of verbal operants after ABI, and this study was published over 25 years ago. Replication of Sundberg et al. (1990) is warranted as the re-acquisition of verbal operants following ABI addresses socially significant skill deficits within a population in which behavior-analytic research has been limited (Heinicke & Carr, 2014). Further investigation may also demonstrate differences between two populations (i.e., naïve vs. previously competent speakers) and add to the literature of functional independence and interdependence of verbal operants. Adding to these lines of literature may lead behavior analysts to develop more efficient verbal behavior programming to facilitate interdependence in neurorehabilitation settings.

The purpose of the current study was to replicate and extend the Sundberg et al. (1990) investigation by addressing a few limitations and incorporating more recently evaluated language-training procedures utilized for individuals with developmental disabilities. First, tact training was modified to include a 3-item array to promote conditional discrimination as recommended by Green (2001). Second, mand training included HP activities rather than arbitrary household items used in Sundberg et al., which may have resulted in weak EO control. Previous studies have found emergence of mands after tact training for HP items (e.g., Gilliam, Weil, & Miltenberger, 2013;

Wallace et al., 2006), which may be why direct tact training for failed mand targets was necessary for one of two participants in Sundberg et al. Third, all verbal operant training conditions included a progressive prompt delay rather than the constant 5 s delay used by Sundberg et al. that allowed participants the opportunity to make errors early in training. Finally, the amount of trials in training sessions and mastery criteria were defined and held constant across conditions and participants.

METHOD

Participants

The university's Institutional Review Board approved all recruitment and experimental procedures described below. See Appendix A for the demographic survey administered with each participant and their caregiver. Mac was a 26-year-old man, seven years post injury, diagnosed with a traumatic insult injury resulting from a skateboarding accident. Mac was in a coma for three weeks after his injury, and he was prescribed Keppra during the course of the study but had been seizure free for one year. He reported receiving speech and occupational therapy (OT) in the past. Dee was a 29-year-old woman, two years post injury, diagnosed with a severe traumatic impact injury and aphasia resulting from a motorcycle accident. Dee scored a three on the Glasgow coma scale (i.e., the minimum score on the scale indicating deep coma or a brain-dead state) at the time of her injury and was in a coma for 24 weeks. Her medications at the time of the study included Keppra, Baclofen, and Nuedexta, and she reported receiving past physical therapy (PT) services. Charlie was a 32-year-old man, 13 years post injury, diagnosed with a non-traumatic brain injury and aphasia resulting from a brain hemorrhage secondary to a brain tumor and was in a coma for four weeks. His medications at the time of the study included Vimpant, Onfi, Zoloft, and Propanalol, and he reported receiving OT, PT, and speech therapy in the past.

All participants were recruited from a local support group and were all living at home with their caregivers. Only one participant, Dee, obtained a Bachelor's degree, while Mac and Charlie were currently working toward obtaining a degree. All participants were unemployed and were not receiving any type of rehabilitation services at the time of the study. All participants could hold short conversations (emitting 5-10 word sentences) and did not rely on the assistance of any communication devices. Mac, Dee, and Charlie were also able to emit echoic and/or textual responses, while demonstrating difficulties in emitting tacts, mands, and intraverbals (described below in *Pre-experimental Procedures*). Participants did not engage in high levels of aggression and/or refusal, although they all engaged in occasional, mild vocal protests (e.g., "This again?" "Aw come on, we did this already.").

Setting and Session Duration

Sessions were conducted in a partitioned area of the participant's home or in a small treatment room on a university campus. During all sessions, participants sat at a table across from the experimenter. A trained observer or video camcorder was present during all sessions for interobserver agreement (IOA) and procedural integrity purposes. After providing consent, participants were exposed to The Assessment of Basic Learning Abilities – Revised (ABLA-R; DeWiele, Martin, Martin, Yu, & Thomson, 2011), followed by the Verbal Behavior Assessment Battery (VBAB; Gross, Fuqua, & Merritt, 2013), a reinforcer survey, and a paired stimulus preference assessment. Once 12 items and activities were identified they were included in a target item identification and assignment phase to assess participants' tact, mand, and intraverbal responses for each item. These items were then included in baseline and used throughout training.

Approximately 2-3 experimental visits were conducted each week, and each visit lasted no longer than 2 hrs. A 5-10 min leisure break was provided after every training session, with the duration of training session varying based on type. Tact, mand, and intraverbal training sessions averaged 2 min and 9 s, 9 min and 2 s, and 2 min and 6 s in duration, respectively. The total time commitment for each participant ranged from 13 to 17 weeks (including follow-up sessions). Participants were compensated with a $50 gift card for participating in the study.

Materials

Nine items related to participants' preferred activities identified via pre-experimental assessments (described below) were divided into three sets for each participant and were present during some sessions (e.g., mand training) and not others (e.g., intraverbal training). See Tables 1-3 for lists of these items and activities for each participant. The treatment room or partitioned area also contained one table and chairs for the participant, experimenter, and one additional data collector. Additional materials necessary for data collection included a video camcorder, data sheets, clipboards, and a pen.

Experimental Design and Dependent Measures

The current study utilized a concurrent multiple-baseline design across behaviors (i.e., verbal operants; Cooper, Heron, & Heward, 2007) to control for historical and maturational confounds across the replication of treatment effects. The dependent measures included the percentage of correct responses during probe and training conditions and the number of training sessions required to meet the mastery criterion for each set. When one verbal operant was being trained for a particular set, transfer probes for the other two verbal operants for that set were conducted every third training session.

A prompted response was recorded if no response occurred within the current prompt delay. A correct response was scored if the subject's response was independent and corresponded with the item being tested, which included responses that were preceded by statements such as "Ahh, let's see, that's a…", or "Oh yeah that's a…" similar to Sundberg et al. (1990). An incorrect response was recorded if any other responses were emitted first or if responses were emitted in the wrong order (e.g., *album photo* for the response *photo album*).

Pre-experimental Procedures

Discrimination assessment. The ABLA-R was conducted to assess participants' discrimination abilities and guide experimenters in selecting the most appropriate modality (e.g., tangible, pictorial, verbal) in which to present stimuli in subsequent paired-stimulus preference assessments (Heinicke, Eastridge, Kupfer, Mozzoni, & Carr, 2013). The ABLA-R involves a simple imitation task, two-choice position discriminations, two-choice visual discriminations, two-choice visual match-to-sample discriminations, two-choice visual-visual a nonidentity matching task, and two-choice auditory-visual combined discriminations.

Language assessment. The Verbal Behavior Assessment Battery (VBAB; Gross, Fuqua, & Merritt, 2013) was conducted to confirm deficits in participants' tact, mand, and intraverbal repertoires reported by caregivers. The VBAB is based on Skinner's 1957 analysis of verbal behavior and incorporates 30 items from the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 2000), a previously validated language assessment, into five assessment measures evaluating listener behavior, echoic, tact, intraverbal, and vocal and selection-based mand repertoires. These 30 items are held constant across all assessment types and only the controlling variables differ across each type to assess deficits within each verbal operant.

In the tact assessment, an item was presented with the instruction “Name this”. In the listener responding assessment, an item was presented in an array with the instruction “Point to the (target item).” For the mand assessment, a set of two scenes comprised of 3-4 simple line drawings was shown to the participants. In the first scene, the target item was included and after 3 s, participants were shown the second scene with the target item replaced by a question mark and were asked, “What do you need to complete this picture?” If the participant did not respond or respond incorrectly, a selection-based mand assessment was presented in which the missing item was presented in an array and participants were asked to point to item needed to complete the picture. In the intraverbal assessment, participants were given the instruction “I am going to describe a word or item and I want you to tell me what I am describing.” Gross and colleagues (2013) developed item descriptions by using definitions of each target from the Longman Advanced American Dictionary. In the echoic assessment, participants were asked to repeat the name of an item immediately following the experimenter’s vocal model.

Preference assessment for activities. Participants and caregivers were asked to complete a reinforcer survey (see Appendix B) developed by the authors to develop a list of participants’ preferred activities. The top 12 nominated activities (e.g., watching TV, board games, crossword puzzles) were then assessed in a paired-stimulus preference assessment (Fisher et al., 1992) to identify a hierarchy of these activities. A verbal format was used for all participants to decrease the length of the assessment as they all scored at Level 6 on the ABLA (Heinicke et al., 2013). Although 12 activities were assessed, only the first nine highly or moderately preferred activities were used in training to promote interdependence of mands in tact and intraverbal training conditions (Wallace et al., 2006). The top three activities were assigned to the mand set to increase the likelihood that the EO for these items was high. The three LP activities were excluded, and the remaining six activities were semi-randomly assigned to tact or intraverbal sets.

Target item identification and assignment. The first author developed lists of items related to the preferred activities identified for each participant. For example, if one of a participant's HP activities was completing crossword puzzles, the experimenter's list may have included items such as a pencil, eraser, crossword, and clues. The experimenter then assessed participants' verbal repertoires for these listed items until she identified one item per activity for which the participant could not emit the tact, mand, or intraverbal response. Therefore, each mand, tact, and intraverbal set included three target items yielding a total of nine items used during training. See Tables 1-3 for lists of the items included in each set per participant.

During this phase, correct, incorrect, and no responses (i.e., failure to respond within 5 s) were followed by a neutral statement and presentation of the next trial. If the participant responded correctly on any trial, that item was removed from the experimenter's list and she tested the next item related to the activity. For the tact condition, the experimenter presented the instruction, "For this activity, I am going to point to an item, and I want you to tell me what it is." The experimenter then presented an array of three items, which were counterbalanced in the left, center, and right positions across trials, and pointed to the target item while asking, “What is it?” per trial. For the mand condition, the experimenter presented the instruction, “For this activity, I’d like you to complete activities. If you are missing any items you need to complete the activity, tell me what you need and I’ll give it to you.” The experimenter then presented the preferred activity (e.g., crossword puzzle and clues) related to the item being tested, while withholding the target item (e.g., pencil) per trial. For the intraverbal condition, the experimenter presented the instruction, “For this activity, I am going to describe an item and I’d like you to tell me what I am describing.” The experimenter then presented a verbal description of the target item per trial, which was generated in the same manner as Gross et al. (2013). A zero-correct criterion across two presentations for each item under tact, mand, and intraverbal conditions was required for an item to be included in subsequent phases.

Experimental Procedures

Baseline. Each participant was assigned three sets of targets, with each set consisting of three items (i.e., words) assigned to tact, mand, or intraverbal training conditions. The three items were presented randomly three times within a baseline session for a total of nine trials. Baseline sessions were conducted similar to the *Target item identification and assignment* phase. That is, the experimenter used the same instructions and carrier phrases for each condition, and a neutral statement and the next trial followed all responses. Baseline sessions continued until data were stable—defined as no new high or low data points across three consecutive sessions.

Training probes. A first-trial probe was conducted for each target in a set (i.e., a total of three trials) before each training session, in which correct responding to the first-trial probe was followed by social praise (and the delivery of the target item in mand trials). If a participant correctly responded to all three targets in a set during first-trial probes, the session was terminated and training did not occur. Any incorrect responses on first-trial probes were followed by a neutral statement and initiation of a training session.

Transfer probes were conducted every third training session under conditions that were not being directly trained (i.e., a total of six trials), and immediately after mastery of a set to assess for transfer to the untargeted operants. For example, if tact training included pencil, eraser, and clues, these three items were tested under mand and intraverbal conditions every third training session. All responses resulted in neutral feedback and presentation of the next trial.

Verbal Operant Training. Treatment began with tact training, followed by mand training, then intraverbal training. Mand and intraverbal conditions, respectively, did not begin until mastery of the previous set. Trials in all three training conditions were presented similar in the same manner as described in *Baseline*, with the addition of echoic prompts, a progressive prompt delay, and programmed consequences. The prompt delay progressed from 0 to 3 to 5 s. To increase the prompt delay, participants were required to correctly respond across six consecutive trials (or respond correctly to the prompt in the 0 s delay for six trials), similar to Shillingsburg, Gayman, and Walton (2016). The experimenter regressed to the previous prompt delay if participants responded incorrectly or did not respond for three consecutive trials, similar to Coon and

Miguel (2012). Additionally, all instructions included the addition of "If you don't know, I'll help you."

Incorrect responses resulted in an error correction procedure, which involved re-presenting the echoic prompt with 5 s to respond up to two times before the trial was terminated. Independent and correct prompted responses were followed by social praise and presentation of the next trial (and the missing item during mand training), in which independent responses were differentially reinforced with a greater magnitude of praise (e.g., "Wow, that's right, awesome job!" vs. "Yeah, that's right." for prompted responses). Mastery of a set was defined as participants responding correctly and independently in 89-100% of trials, or to all three targets during first-trial probes, across two consecutive sessions (whichever occurred first) with one session occurring on the next day.

Abolishing operations probe. An abolishing operation (AO) probe was conducted for each target (i.e., three trials) immediately after mastery of mand training sets to assess for appropriate EO control (Shillingsburg, Bowen, Valentino, & Pierce, 2014). The AO session was conducted in a similar method to that of training (i.e., same instruction and presentation of materials); however, the missing item was provided to the participant along with the training stimuli at the beginning of each trial.

Follow-up. Two to three weeks after participants met mastery criteria for a set, a follow-up assessment was conducted to assess the maintenance of the verbal operant directly trained as well as transfer to the untrained operants. Each target in a set was tested once under tact, mand, and intraverbal conditions, for a total of nine trials in a follow-up session. These trials were presented in the same manner as first-trial probes, but incorrect responses did not initiate a training session.

Interobserver Agreement

A secondary observer collected data in vivo or via video recordings for a minimum of 33% of sessions to assess interobserver agreement (IOA). The point-by-point method (Kazdin, 2011) was used to calculate IOA, in which the number of agreements on a trial-to-trial basis were recorded and divided by the number of trials in the session, converted to a percentage. The definition of an agreement depended on the type of experimental session being conducted. For paired-stimulus preference assessment sessions, an agreement was defined as both the experimenter and secondary observer recording the same selection for a trial. For the ABLA-R, the VBAB, and tact, mand, and intraverbal probe, baseline, and training sessions, an agreement was defined as the experimenter and secondary observer both recording a correct, incorrect, or non-response for a trial. Agreement for pre-experimental procedures, baseline, and training sessions averaged 100%, 99.7% (range 89% to 100%), and 100%, respectively.

Procedural Integrity

Procedural integrity was also measured either in vivo or via video recordings for a minimum of 33% of sessions to assess the accuracy of the experimenter’s implementation of the procedures. Each trial was scored for correct implementation of the procedures using a checklist of experimenter behavior (see descriptions below for each session type). The number of trials implemented correctly was divided by the number of trials in the session, converted to a percentage. An additional observer collected procedural integrity

IOA for a minimum of 50% of sessions in which procedural integrity was assessed by coding video recordings. Procedural integrity IOA averaged 100% for tact probes, baseline, and training sessions, 100% for mand probes, baseline and training sessions, and 100% for intraverbal probes, baseline, and training sessions.

Tact probes, baseline, and training. Procedural integrity data were collected using a 5-step checklist of experimenter behavior. The steps included (a) presenting three items in an array, (b) pointing to the correct target item, (c) allowing correct time for response (i.e., 0, 3 or 5 s for training, 5 s for probes), (d) providing correct echoic prompt, if required, and (e) providing the correct consequence (e.g., neutral feedback for transfer probes, social praise for correct responses in first-trial probes and training trials, trial termination for incorrect responses following prompts). Procedural integrity averaged 100% for tact probes, baseline, and training sessions.

Mand probes, baseline, and training. Procedural integrity data were collected using a 4-step checklist of experimenter behavior. The steps included (a) presenting the instruction to complete a task, (b) allowing correct time for response, (c) providing the correct echoic prompt, if required, and (d) providing the correct consequence (e.g., social praise and missing item for correct responses). Procedural integrity averaged 100% for mand probes, baseline, and training sessions.

Intraverbal probes, baseline, and training. Procedural integrity data were collected using a 4-step checklist of experimenter behavior. The steps included (a) presenting the correct verbal discriminative stimulus, (b) allowing correct time for response, (c) providing the correct echoic prompt, if required, and (d) providing the correct consequence. Procedural integrity for tact probes, baseline, and training averaged 100%, 100%, and 99.8% (range 90% to 100%), respectively.

RESULTS

All participants displayed deficits in tact, mand, and intraverbal repertoires based on the VBAB and demonstrated varied responding in the listener behavior, echoic, and textual assessments. Mac scored at 100% on the listener behavior, echoic, and selection-based mand assessments, while he scored at 60% on the vocal mand, 53% on the textual, 43% on the tact, 20% on the 3D mand, and 7% on the intraverbal assessments. Dee scored at 100% on the echoic, textual, and selection-based mand assessments, while she scored 83% on the listener behavior, 40% on the 3D mand, 23% on the vocal mand, and 13% on both tact and intraverbal assessments. Charlie scored at 100% on both the listener behavior and echoic assessments, while he scored 97% on the textual, 86% on the selection-based mand, 80% on the 3D mand, 77% on the tact, 63% on the intraverbal, and 30% on the vocal mand assessments.

Results of verbal operant training for Mac, Dee, and Charlie are depicted in Figures 1, 2, and 3, respectively. Tact, mand, and intraverbal conditions are represented in the top, middle, and bottom panels across experimental conditions. Participants' performance during first-trial probes and training for each set is depicted in the top portion of each panel, while performance during transfer probes for each set is depicted in the bottom portion of each panel. Performance is consistent across all participants and conditions during the initial phase due to the zero-correct criterion used to progress to baseline (described above in *Target Item Identification and Assignment).* Participants' performance during baseline remained low across conditions with the exception of Set 2 for Charlie. Charlie reported contacting two of the experimental stimuli (i.e., remote and bowl) outside of training sessions; therefore, we replaced the items for which he was correctly manding with new items using the zero-correct criterion before initiating training in his second panel.

Mac (Figure 1) met mastery criteria for tact training after seven training sessions by responding 100% correct across two consecutive training sessions. He responded with an average of 11% and 22% correct under mand and intraverbal conditions, respectively, for the transfer probes in Set 1. Mac's performance decreased under tact conditions during follow-up (i.e., 67% correct), while he responded 0% and 67% correct under mand and intraverbal conditions, respectively. Mac met mastery criteria for mand training after 14 training sessions by responding 100% correct across two consecutive first-trial probes. He responded an average of 47% and 0% correct under tact and intraverbal conditions, respectively, for the transfer probes in Set 2. Mac responded 33% correct during the abolishing operation probe, in which he continued to emit the response for two of the three targets. Mac withdrew from the study before intraverbal training could be completed due to the declining health of his caregiver; however, he completed seven training sessions, with his last three sessions including two first-trial probes at 100% correct responding. He responded an average of 34% and 17% correct under tact and mand probes, respectively, for the transfer probes that were completed for Set 3 before his withdrawal.

Dee (Figure 2) met mastery criteria for tact training after 31 training sessions by responding 89-100% correct across two consecutive training sessions. She responded with an average of 15% and 30% correct under mand and intraverbal conditions, respectively, for the transfer probes in Set 1. These responses did not maintain during follow-up, in which Dee responded 33% correct across all conditions for Set 1. Dee met mastery criteria for mand training after 25 training sessions by responding 100% correct across two consecutive first-trial probes. She responded with an average of 44% and 22% correct under tact and intraverbal conditions, respectively, for the transfer probes in Set 2. Dee's performance also declined during follow-up for these responses, in which Dee responded 0% correct across all conditions. Dee required 36 sessions of intraverbal training to meet mastery criteria, in which Dee responded 100% correct across two consecutive first-trial probes. She responded with an average of 33% and 39% correct under tact and mand conditions, respectively, for the transfer probes in Set 3. She responded 33% correct under intraverbal conditions and 0% correct under both tact and mand conditions during follow-up for Set 3.

Charlie (Figure 3) met mastery criteria for tact training after eight training sessions by responding 100% correct across two consecutive first-trial probes. He responded with an average of 44% and 0% correct under mand and intraverbal conditions, respectively, for the transfer probes in Set 1. Responding under tact and mand conditions maintained at 100% for these targets during follow-up; however, his performance declined (i.e., 67% correct) under intraverbal conditions. Charlie met mastery criteria for mand training after 11 training sessions by responding 100% correct across two consecutive first-trial probes. He responded with an average of 92% and 33% correct under tact and intraverbal conditions, respectively, for the transfer probes in Set 2. Responding under mand conditions for Set 2 maintained at 100% at follow-up, while there was a decrement in his performance under tact and intraverbal responses (i.e., 67% correct across both conditions). Intraverbal training took 10 sessions to meet mastery criteria, in which Charlie responded 100% correct across two consecutive first-trial probes. He responded with an average of 92% and 67% correct under tact and mand conditions, respectively, for the transfer probes in Set 3. Responding under intraverbal and tact conditions for Set 3 maintained at 100% during follow-up, while there was a decrement in his performance under mand conditions (i.e., 67% correct).

Table 4 summarizes the results for Mac, Dee, and Charlie. Overall, the differences in the average training sessions to meet mastery criteria per condition were negligible. That is, on average, participants required a similar number of training opportunities to relearn “lost” tacts, mands, and intraverbals. However, the total training time to meet mastery differed across conditions. Participants took the least amount of time to relearn tact (M = 44 min) and intraverbal (M = 46 min) targets, while participants required more than twice the amount of training time (M = 153 min) to relearn mand targets. In addition, we observed the most emergence of untrained verbal operants under tact conditions after either training type (i.e., mand or intraverbal), followed by moderate levels of emergence of mands, and the lowest levels of emergence of intraverbals.

Figure 4 depicts participants’ scores during tact, intraverbal, and mand assessments of the VBAB (left panels) and the number of sessions to mastery criteria (right panels). Mac scored low in the mand assessment within the VBAB (20% correct) and took the most training sessions to meet mastery criteria for mand training (14 sessions). Dee scored lowest in the tact and intraverbal assessments (both 13% correct) and took the most training sessions to meet mastery criteria for both tact and intraverbal training (31 and 36 sessions, respectively) compared to mand training (25 sessions). Charlie scored lowest in the mand assessment (30% correct) and took the most training sessions to meet mastery criteria for mand training (11 sessions). Overall, these data suggest there may be an inverse relationship between participants' scores on the VBAB and the number of sessions needed to reach mastery criteria across training conditions.

DISCUSSION

The purpose of this study was to add to the limited literature on the rehabilitation of verbal operants following ABI by systematically replicating Sundberg et al. (1990). Sundberg and colleagues noted their results differed from prior studies conducted with individuals with developmental disabilities—that is, the authors found mand training was the least efficient way to generate a mand repertoire and had the least amount of transfer to untrained operants. We evaluated if we could replicate Sundberg et al.'s findings after including more recent language training methods used for individuals with developmental disabilities. More specifically, we aimed to determine (a) which "missing" verbal operant (i.e., tacts, mands, or intraverbals) would be relearned first through direct training, and (b) whether ABI survivors would demonstrate functional independence or interdependence of verbal operants following training.

Participants in Sundberg et al. (1990) relearned tacts and intraverbals with the least number of training sessions, and only one of the two participants acquired "lost" mands. One participant (Charlie) in the current study acquired tacts and intraverbals in the least number of training sessions (although he only needed one additional mand training session compared to intraverbal training). Although Mac withdrew from the current study before completing intraverbal training, it is likely he would have reacquired the targets in Set 3 based on the increasing trend observed in the training phase. He performed at 100% correct in his last first-trial probe and might have met mastery criteria if he had returned for one additional session, in which he would then have also acquired tacts and intraverbals in the least number of training sessions. Meanwhile, Dee acquired mands in the least number of training sessions and needed the most training to acquire intraverbal targets. Despite the differences in acquisition rates across conditions, participants in the current study acquired all mand targets. This finding is in contrast to Sundberg et al., in which one participant required direct tact training to acquire mand targets.

Sundberg et al. (1990) also found tact training produced the greatest amount of transfer to the untrained verbal operants, while mand training produced the least amount of transfer. However, all participants in the current study demonstrated better mand-to-tact transfer, similar to recent research findings with individuals with developmental disabilities (e.g., Albert, Carbone, Murray, Hagerty, & Sweeny-Kerwin, 2012; Egan & Barnes-Holmes, 2009; Finn, et al., 2012). Despite the varying levels of emergence following tact vs. mand training, both studies support some functional interdependence of verbal operants with individuals following an ABI. However, transfer to intraverbal conditions were minimal, also supporting recent research findings with individuals with developmental disabilities.

The minimal transfer to the intraverbal conditions may be because intraverbals are likely more sophisticated than other elementary verbal operants (e.g., echoic, tact, mand). Intraverbals are controlled by more complex variables that vary for each individual, such as reinforcement histories with the type of intraverbal used (e.g., fill-in-the-blank, functions of items), the reinforcement history of the listener, divergent control that may result in various responses, and so forth. Other elementary verbal operants also occur more naturally in the natural environment, while simple (e.g., fill-in-the-blank, personal questions) and complex (e.g., categorization, open-ended questions) intraverbals are less likely to occur. Especially with the intraverbal used in the current study (answering descriptions of a given item), it may be that participants were not often presented with this type of intraverbal in their natural environments, which may be why we observed limited transfer under intraverbal conditions. Future research evaluating procedures to further strengthen functional interdependence, especially to intraverbal conditions following ABI is warranted.

There are a few explanations as to why participants in the current study performed differently during mand training compared with the participants in Sundberg et al. (1990). First, we exposed participants to items used in HP activities throughout all conditions, opposed to the arbitrary household items used in the prior investigation. The improved responding following this procedural modification supports the claim made by Wallace et al. (2006), in which functional interdependence may be more likely to occur when training stimuli include HP items. This may be because during tact training of a preferred item, the EO is present during the emission and reinforcement of the tact response, which assists in the establishment of a functional relationship between the EO and response topography.

This modification may also explain Charlie's increase in correct responding during baseline conditions for Set 2. Charlie contacted these items (i.e., remote, bowl) to complete HP activities (i.e., watching TV, making snacks) outside of experimental sessions, exposing him to naturalistic learning opportunities prior to mand training. In this case, we replaced these items with novel items identified during the target item identification phase and introduced mand training as soon as baseline data were stable.

Differences in prompting and error correction procedures may also explain the contrasting results between the current study and Sundberg et al. (1990). Sundberg et al. used a constant 5 s delay throughout all conditions, which allowed participants to make errors early in training. We used a progressive prompt delay with clear progression and regression criteria, which likely decreased the number of errors to mastery (Walker, 2008). Sundberg et al. also required participants to respond correctly to all three targets in a row or five transfer trials (e.g., tact-echoic-tact) for each target before a training session ended, which resulted in participants being exposed to up to 65 trials within one training session. Instead, we only re-presented the echoic prompt up to two times before presenting the next trial, decreasing the trial duration and allowing participants to come into contact with reinforcement sooner.

Sundberg and colleagues' (1990) error correction procedure may have also increased the aversive properties of the interrupted chain procedure used in the mand condition by repeatedly presenting the same trial. The authors reported participants often vocalized statements such as, "Dammit, I know this, dammit" (pg. 97). We observed similar responses for all participants in the current study, with participants engaging in statements such as, "Dammit, I'm so stupid" or "I know this one, dammit", and non-vocal behaviors such as kicking nearby items and crying. We echo Sundberg et al.'s interpretation that the interrupted chain procedure used to teach mands might closely resemble participants' daily lives, in which they often cannot mand for missing items needed to complete activities.

We observed similar negative statements during intraverbal training for Dee, which took her the greatest number of sessions to meet mastery criteria. Intraverbal training was the only condition that did not include visual stimuli, and these visual stimuli may have served as additional discriminative stimuli as a result of contiguous usage (Skinner, 1957) that helped evoke correct responses in Dee's other training conditions. For example, during mand training, the presence of a dirty mirror and paper towel (along with the vocal discriminative stimulus, "Let's help mom clean this mirror") may have aided in evoking the response 'glass cleaner'. Similarly, the presence of the stimuli delta in the field during tact training may have aided in evoking the correct response. Anecdotally, participants would tact the stimuli delta in the field as a process of elimination to respond correctly to the current instruction (e.g., "That's a photo album, that's a charger, this must be frosting."). We also saw a decrement in Dee's attending during intraverbal training, in which she would often repeat the instruction from the previous trial as a response. This decrement may also be due to the lack of visual stimuli during training. However, Dee was recovering from a minor surgery during intraverbal training between sessions 114 and 115 that led to a lack of sleep reported by both Dee and her caregiver, which limits clarity in interpreting Dee's results.

There are additional limitations of the current study worth noting. First, a reinforcer assessment was not conducted following verbal paired-stimulus preference assessments to evaluate the reinforcing effectiveness of the activities. Therefore, the activities assigned to mand conditions may not have been the most highly-preferred of the 12 activities assessed. However, the participants completed all activities in the mand conditions and requested to engage with the items during tact and intraverbal conditions (e.g., “Oh clues! Can I solve this one?” “You’re talking about a scorecard, let’s play Yahtzee!”), suggesting these activities were reinforcing. Second, transfer probes were only conducted during the target item identification and assignment phase and not throughout baseline, and it is possible that simple exposure to items may have resulted in transfer. However, all but one participant (Charlie) continued to respond 0% correct during the first transfer probe after training began despite being exposed to the stimuli throughout baseline. We wanted to minimize exposure to these targets; however, researchers might consider conducting transfer probes immediately prior to intervention to demonstrate that participants would continue to respond at 0% correct.

Third, an AO probe was only conducted at the end of mand training, during which all participants continued to mand for at least one item while it was present (range, 33-67% correct). While Sundberg et al. (1990) did not include any AO probes, more recent studies on teaching mands have programmed both EO and AO conditions during training to promote appropriate EO control and ensure functional use of acquired mands (e.g., Ingvarsson & Hollobaugh, 2010; Lechago, Carr, Grow, Love, & Almason, 2010; Shillingsburg et al., 2014). Although these studies were conducted with children with developmental disabilities, it may be that embedding AO conditions throughout training with individuals with ABI is necessary to promote appropriate EO control as well. Continued responding for items during AO probes despite their presence might also be explained through rule-governed behavior. That is, the "…tell me what you need" portion of the full instruction (i.e., "If you are missing any items you need to complete the activity, tell me what you need and I'll give it to you") during consecutive mand training sessions may have produced rule-governed behavior, in which participants continued to tell the experimenter what was needed to complete the activity despite its presence, similar to the contingencies contacted throughout training.

Fourth, we defined mastery of a training set as two consecutive sessions at 89-100% during training or first trial probes, with one session occurring on another day. Although we attempted to make mastery criteria more stringent by requiring the second session to occur on another day, our criteria may not have been rigorous enough to produce maintenance of effects. That is, only one participant (Charlie) was able to maintain responses at 100% during follow-up. Fuller and Fienup (2018) compared the effects of three differing mastery criterion levels (i.e., 50%, 80%, and 90%) on the maintenance of spelling and reading sight words with three children with autism spectrum disorder and found that mastery at a higher performance level was predictive of greater maintenance performance. Given the ultimate goal of re-teaching of ABI survivors language is to maintain "lost" verbal operants across differing contexts over time, a 100% correct criterion across several days may be necessary, particularly given that memory deficits are common in this population. Additionally, this 100% criterion may need to occur during training (rather than first-trial probes) during which participants contact more learning opportunities (e.g., nine trials vs. three trials in the first-trial probes), thus contacting more reinforcement.

In addition to addressing the limitations mentioned above, investigators interested in extending the current study might consider the following procedural modifications to further identify effective and efficient language training procedures for individuals with ABI. First, researchers might evaluate other mand training conditions that do not involve the use of an interrupted chain procedure. This procedure likely involves aversive properties that closely resemble survivors' daily lives, as evidenced by participants' emotional responding during this phase in both Sundberg et al. (1990) and the current study. Additionally, the interrupted chain procedure used in our mand training was likely why the total training time in mand conditions (*M* = 153 m) was over twice that of tact and intraverbal training (*M* = 44 and *M* = 46 min, respectively). This is due to the additional components of mand training (i.e., setting up the chain, delivering the missing item, and allowing participants to complete the chain).

Identifying less aversive and more efficient mand training is especially important given the cost of rehabilitation (Humphreys, et al., 2013). For example, experimenters could provide access to an item and subsequently block access to the item (e.g., Buckley & Newchok, 2005) or implement tact to mand transfer procedures (e.g., Sweeny-Kerwin, Carbone, O'Brien, Zecchin, & Janecky, 2007; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012). It may be complicated to design a mand condition using these procedures as the responses intended to be trained as mands may come under control of tact variables resulting in faulty stimulus control as reported in a review by Gamba, Goyos, and Petursdottir (2015). However, these alternative procedures to reduce emotional responding may still be beneficial as problem behaviors (e.g., noncompliance) slow progress during rehabilitation, which limit a client's ability to achieve rehabilitation goals (Heinicke et al., 2013).

Second, researchers might also consider further evaluating the VBAB (Gross et al., 2013) for individuals with ABI. In the current study, we found an inverse relationship between participants' scores on the VBAB and the number of sessions needed to reach mastery criteria across training conditions. This relationship demonstrates a potential predictive feature of the VBAB despite it being designed as an assessment tool for older individuals with dementia. Future research could focus on both updating the assessment targets to replace less relevant stimuli (e.g., removing items such as *protractor* and *trellis* that might not be familiar items to young adults) and validating this assessment with ABI survivors using similar methods to Gross et al.

Finally, researchers might consider evaluating the efficacy of teaching problem-solving strategies to ABI survivors who are re-learning language. Mac and Charlie were 7 and 13 years post-injury, respectively, at the time of the study, and these participants may have acquired problem-solving strategies during rehabilitation that boosted their re-acquisition rates. In comparison, Dee was only two years post-injury and required the most training sessions. Anecdotally, all participants would mouth-out or vocalize the beginning letter or syllable of the target item (e.g., "ch- ch- charger"), as well as self-correct using the same strategy (e.g., "ch- ch- no that's not right, it's photo album!"), which seemed to be helpful strategies. Charlie also reported that he "studied before each session so I could beat you [the experimenter] to the answer", as he often vocalized frustration with being provided the answer too soon (i.e., during the shorter prompt delay intervals) with a "frustration meter" ranging from 1-10.

On the other hand, Dee, who received very limited rehabilitation services following her injury (and was the only participant who did not receive speech therapy), developed and used her own strategy during some training sessions. She created a specific acronym for the targets in intraverbal training—that is, WMC for *wipes*, *markers*, *charger*—which she substituted for more common labels (e.g., woman, man, child). We consider this a maladaptive strategy as it would not be helpful in her natural environment, where these stimuli will not appear together in repeated trials as presented in training. Problem-solving strategies, such as visual imagery (e.g., Kisamore, Carr, & LeBlanc, 2011), and procedural modifications, such as multiple exemplar training (e.g., Allan, Vladescu, Kisamore, Reeve, & Sidener, 2014), could be evaluated to determine whether they assist in the re-acquisition and maintenance of verbal operants for ABI survivors.

Although the line of research on re-teaching verbal operants to ABI survivors is very small, we would like to provide a couple of preliminary clinical recommendations for behavior analysts working in neurorehabilitation settings. First, practitioners might consider using HP stimuli along with a progressive prompt delay during initial language training so clients have a greater likelihood of contacting reinforcement early in rehabilitation. Charlie, who participated in several language studies since his injury, stated that he enjoyed participating in the current study and had more fun with the training stimuli than the 2D stimuli of arbitrary items (e.g., household items, community locations) he contacted in previous studies. Given all participants relearned mands and we saw moderate emergence of tacts and mands in the current study, there may be clinical benefits to using HP stimuli in which tacts and mands may not need to be directly taught.

Second, practitioners might consider using the VBAB to identify a verbal repertoire that may not be as affected following ABI to program for the support of weaker ones. For example, if a survivor is able to mand for items, but cannot tact these items, practitioners may find it beneficial to put survivors in a scenario in which an item needs to be requested, which may lead to the emergence of the tact for the same item without additional training due to the functional relationship between the EO for the item and the response topography. Tacts may then be used to help teach intraverbal responses through problem solving strategies through tacting while engaging in visual imagining. These preliminary clinical recommendations, as well as the procedural variations and avenues for future research discussed above, may drastically decrease the amount of time spent conducting language training. More efficient language training would allow for a shift in resources to other behavioral deficits and/or excesses, as language deficits are just one potential consequence following ABI that might warrant behavioral intervention.

Participant Information Interview – Appendix A

Date: ____________

Participant Information Interview

Participant #:__________
Gender: □ Female □ Male
Birth date: __________
Age: ___________
ABLA-R Scores:

Reported Diagnoses:

Other Reported Diagnoses:

Coma scale report (either Glasgow (3-15) or Rancho Los Amigo - Revised (I-X):

Length of Coma (if applicable):

Description of Communication Modality (e.g., vocal, PECS) and Skills (e.g., 1-2 word utterances, 2-4 word sentences, 4-5+ sentences):

Type of brain injury (traumatic vs. non-traumatic - i.e., internal insults such as stroke, infection, tumor, neurotoxic poisoning, anoxia)

If traumatic, was the injury considered a traumatic impact injury (e.g., contact injury or head struck by/against object such as assults, falls, gunshots, and blast injuries) or a traumatic inertial injury (e.g., non-contact injury where the brain has moved within the skull [acceleration/deceleration] such as falls without contact, MVAs, sports-related injuries with no head contact)

Description of injury (e.g., subdural hematoma)

Cause of injury (e.g., fall, MVA)

Type of injury

Time since injury

Any cognitive/neurological testing scores that have been completed, if possible

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Past and current treatment information (e.g., any behavior plans in place, any additional services such as SLP, OT, PT, etc.)?

Current medications:

Current residential placement (at home, assisted living, residential program)

Preferred Items Assessment for Adults with Acquired Brain Injury - Appendix B
Care Provider Version

Interviewer: ______________________________ Interview Date: ______________________

Client Name: _____________________________ Informant Name: _____________________

Relation to Client: __________________________

The purpose of this assessment is to get as much specific information as possible form both the client and care provider as to what items or activities would be useful reinforcers for the client.

Events and Activities

In this section of the assessment, the provided list is designed to determine events and activities the client has enjoyed during the past month. Across the client and care provider versions of the assessment, each item will be rated three times (i.e., on frequency, availability, and enjoyability).

Ask the care provider to rate:

1) How often the listed events or activities have happened in the client's life in the past month and place a check mark in the appropriate box according to how often the item has occurred.

☐ Not at all - This has NOT HAPPENED for the client in the past month
☐ A few times - This has HAPPENED A FEW TIMES (1 to 6 times) in the past month
☐ Often - This has HAPPENED OFTEN (7 or more times) in the last month

2) How available these events or activities are to the client and place a check mark in the appropriate box according to how available the item is available.

☐ Not at all - This has NOT BEEN AVAILABLE for the client during the past month
☐ A few times - This item has been AVAILABLE A FEW TIMES (1 to 6 times) during the past month
☐ Often - This item has been AVAILABLE OFTEN (7 or more times) during the past month

	FREQUENCY			AVAILABILITY			
Items	**Not at all**	**A few times**	**Often**	**Not at all**	**A few times**	**Not at all**	**Alone or with Others?**
1. Being outside (sitting outside, being in the country)							
2. Planning trips or vacations, looking at travel brochures, traveling							

3. Online shopping, purchasing things (for self or others)							
4. Listening to music (radio, stereo)							
5. Reading or listening to stories, novels, plays, or poems							
6. Watching television							
7. Completing a difficult task (e.g., math problems)							
8. Doing jigsaw puzzles, crosswords, and word games							
9. Listening to nonmusic radio programs (talk shows)							
10. Making or eating snacks							
11. Helping others, helping around the house, dusting, cleaning, setting the table, cooking							
12. Combing or brushing hair							
13. Watching animals or birds (at the zoo or in the yard)							
14. Listening to the sounds of nature (birdsong, wind, surf)							
15. Sending letters, cards, notes							
16. Reading, watching, or listening to the news							
17. Having coffee, tea, a soda, etc. with others							
18. Speaking with old friends (on the telephone)							
19. Playing cards or games							
20. Doing handwork (crocheting, woodworking, crafts, knitting, painting, drawing, ceramics, clay work)							
21. Exercising (walking, aerobics, swimming, dancing)							
22. Indoor gardening or related activities (tending plants)							
23. Outdoor gardening or related activities (mowing the lawn, raking, watering plants, lawn work)							
24. Looking at photo albums and photos							
25. Stamp collecting or other collections							
26. Sorting out drawers or closets							
27. Singing karaoke							
28. Grooming self (wearing makeup, having hair done)							
29. Watching movies							
30. Participating or watching sports (golf, baseball)							
31. Other: ______________________________ __________							

Additional Stimuli

In this section of the assessment, questions are provided to determine additional categories of stimuli that might be useful reinforcers for the client as well as probe questions to get more specific information on the client's preferences.

1. Some individuals really enjoy certain foods or snacks such as ice cream, pizza, juice, graham crackers, McDonald's hamburgers, etc. What are the some things _______________ likes to eat?

RESPONSE TO PROBE QUESTIONS:

2. Some individuals really enjoy it when others give them attention such a hug, a pat on the back, clapping, say "Good job", etc. What forms of attention does ________________ seem to enjoy the most?

Preferred Items Assessment for Adults with Acquired Brain Injury - Appendix B
Care Provider Version

RESPONSE TO PROBE QUESTIONS:

This assessment is based on the Reinforcer Assessment for Individuals with Severe Disabilities (Fisher, Piazza, Bowman, & Amari, 1996) and the Pleasant Events Schedule - AD (Teri & Logsdon, 1991).

Preferred Items Assessment for Adults with Acquired Brain Injury – Appendix B
Client Version

Interviewer: ____________________________________ Interview Date: _____________________

Client Name: ___________________________________

The purpose of this assessment is to get as much specific information as possible form both the client and care provider as to what items or activities would be useful reinforcers for the client.

Events and Activities

In this section of the assessment, the provided list is designed to determine events and activities the client has enjoyed during the past month. Across the client and care provider versions of the assessment, each item will be rated three times (i.e., on frequency, availability, and enjoyability). Ask the client to rate if he or she has enjoyed engaging in the target event or activity in the past month (i.e., "Now Enjoys") and/or if the client has enjoyed the activity in the past five years (i.e., "Enjoyed in the Past"). The client may endorse both options.

Items	**Now Enjoys**	**Enjoyed in the Past**	**Alone or with Others?**	**Additional Information**
1. Being outside (sitting outside, being in the country)	+ … -	+ … -		
2. Planning trips or vacations, looking at travel brochures, traveling	+ … -	+ … -		
3. Online shopping, purchasing things (for self or others)	+ … -	+ … -		
4. Listening to music (radio, stereo)	+ … -	+ … -		
5. Reading or listening to stories, novels, plays, or poems	+ … -	+ … -		
6. Watching television	+ … -	+ … -		
7. Completing a difficult task (e.g., math problems)	+ … -	+ … -		
8. Doing jigsaw puzzles, crosswords, and word games	+ … -	+ … -		
9. Listening to nonmusic radio programs (talk shows)	+ … -	+ … -		
10. Making or eating snacks	+ … -	+ … -		

11. Helping others, helping around the house, dusting, cleaning, setting the table, cooking	+ … -	+ … -		
12. Combing or brushing hair	+ … -	+ … -		
13. Watching animals or birds (at the zoo or in the yard)	+ … -	+ … -		
14. Listening to the sounds of nature (birdsong, wind, surf)	+ … -	+ … -		
15. Sending letters, cards, notes	+ … -	+ … -		
16. Reading, watching, or listening to the news	+ … -	+ … -		
17. Having coffee, tea, a soda, etc. with others	+ … -	+ … -		
18. Speaking with old friends (on the telephone)	+ … -	+ … -		
19. Playing cards or games	+ … -	+ … -		
20. Doing handwork (crocheting, woodworking, crafts, knitting, painting, drawing, ceramics, clay work)	+ … -	+ … -		
21. Exercising (walking, aerobics, swimming, dancing)	+ … -	+ … -		
22. Indoor gardening or related activities (tending plants)	+ … -	+ … -		
23. Outdoor gardening or related activities (mowing the lawn, raking, watering plants, lawn work)	+ … -	+ … -		
24. Looking at photo albums and photos	+ … -	+ … -		
25. Stamp collecting or other collections	+ … -	+ … -		
26. Sorting out drawers or closets	+ … -	+ … -		
27. Singing karaoke	+ … -	+ … -		
28. Grooming self (wearing makeup, having hair done)	+ … -	+ … -		
29. Watching movies	+ … -	+ … -		
30. Participating or watching sports (golf, baseball)	+ … -	+ … -		
31. Other: ________________________________ __________	+ … -	+ … -		

Additional Stimuli

In this section of the assessment, questions are provided to determine additional categories of stimuli that might be useful reinforcers for the client as well as probe questions to get more specific information on the client's preferences.

3. Some individuals really enjoy certain foods or snacks such as ice cream, pizza, juice, graham crackers, McDonald's hamburgers, etc. What are the some things you like to eat?

RESPONSE TO PROBE QUESTIONS:

4. Some individuals really enjoy it when others give them attention such a hug, a pat on the back, clapping, say "Good job", etc. What forms of attention do you enjoy the most?

RESPONSE TO PROBE QUESTIONS:

Table 1

Tact Training Stimulus Sets and Transfer Probe Arrangements

Participant	Tact Training Stimuli	Mand Probes	Intraverbal Probes
Mac	Charger	For this activity, I'd like you to listen to music with this dead phone.	This is a piece of equipment used to put electricity into a battery.
	Photo Album	For this activity, I'd like you to show me some old pictures.	This is a book you put old memories in that you can look through.
	Playing Cards	For this activity, let's play the game that has slap thief.	This is the item used to play Slamwich.
Dee	Photo Album	For this activity, I'd like you to show me some old pictures.	This is a book you put old memories in that you can look through.
	Karaoke App	For this activity, I'd like you to sing along to a song with the correct words.	This is an application that plays music and has lyrics to allow you to sing along.
	Clues	For this activity, I'd like you to solve this crossword puzzle.	This is an object or piece of information that helps someone solve a crime, mystery, or puzzle.
	Timer	For this activity, make sure we only have 1 minute to think of our words for Scattergories.	This is an instrument that tells you how much longer you have to complete an activity.

Charlie	Return Address	For this activity, I'd like you to send me this letter.	This is the details of the place where someone can send back letters, packages, etc.
	Lever	For this activity, let's play with this slot machine.	This is a stick or handle on a machine that you move to operate it.

Table 2

Mand Training Stimulus Sets and Transfer Probe Arrangements

Participant	Mand Training Stimuli	Tact Probes	Intraverbal Probes
Mac	For this activity, I'd like you to connect your camera to your laptop.	USB Cable	This is a part of equipment used to connect to other equipment, such as computers, cameras, etc.
	For this activity, I'd like you to film us and make sure you save the footage.	Memory Card	This is a piece of electronic equipment for storing data, used in computers, digital cameras, mobile phones, etc.
	For this activity, let's play Kubb.	Baton	This is used to knock over Kubb pieces.
Dee	For this activity, let's look at pictures of animals together.	Magazine	This is a large thin book with a paper cover that contains news stories, articles, photographs, etc. and is sold weekly or monthly.
	For this activity, let's decorate this treat.	Frosting	This is a mixture made from very fine light sugar and liquid used to cover cakes and other desserts.
	For this activity, let's help mom and clean this mirror.	Glass Cleaner	This is a substance used to clean that makes items clear and shiny.

	For this activity, let's mix up these bingo balls.	Bingo Cage	This is an item made of metal wire that can be turned to mix up the items inside.
Charlie	For this activity, keep track of your points during Yahtzee.	Scorecard	This is a printed card used by someone watching a sports match, race, or game to record what happens.
	For this activity, tell me what you'll do the first 4 hours of your Vegas trip.	Itinerary	This is a planned route, journey, or schedule that lays out times of activities.

Table 3

Intraverbal Training Stimulus Sets and Transfer Probe Arrangements

Participant	Intraverbal Training Stimuli	Tact Probes	Mand Probes
Mac	This is a ring that you have to throw a ball though to score points in basketball.	Hoop	For this activity, let's go shoot around this basketball.
	This is information you need to access personal accounts online.	Log-In	For this activity, let's watch Netflix.
	This is a printed card used by someone watching a sports match or race to record what happens.	Scorecard	For this activity, I'd like you to keep track of your points during Yahtzee.
Dee	This is a piece of equipment used to put electricity into a battery or device.	Charger	For this activity, I'd like you to listen to music on this dead phone.
	This is a pre-moistened cloth used to rub a surface in order to remove dirt, liquid, etc.	Wipes	For this activity, I'd like you to disinfect this table
	This is a pen with a point made of felt with varying colors, used for marking or drawing things.	Markers	For this activity, I'd like you to color this.

	This is a piece of equipment used to put electricity into a battery or device.	Charger	For this activity, I'd like you to listen to music on this dead phone.
Charlie	This is a writing instrument made of wood with a thin piece of a black or colored substance in the middle.	Pencil	For this activity, write in the words in a way you can erase them.
	This is a drawing of a particular area, for example a city or country, which shows its main features, such as its roads, rivers, mountains etc.	Map	For this activity, show me the location of where you'd like to take your next trip.

Table 4

Summary of Results

Participant	Number of Sessions to Mastery (Total training time in min)			Average % Correct Across Transfer Probes					
				Tact Training		Mand Training		IV Training	
	Tact	Mand	IV	Mand	IV	Tact	IV	Tact	Mand
Mac	7 (15)	14 (149)	7[a] (12)	11%	22%	47%	0%	34%	17%
Dee	31 (96)	25 (193)	36 (107)	15%	30%	44%	22%	33%	39%
Charlie	8 (22)	11 (118)	10 (18)	44%	0%	92%	33%	92%	67%
M	15 (44)	17 (153)	18[a] (46)	21%	21%	56%	18%	46%	41%

Note. IV = Intraverbal training.
[a] Intraverbal training was not completed for Mac

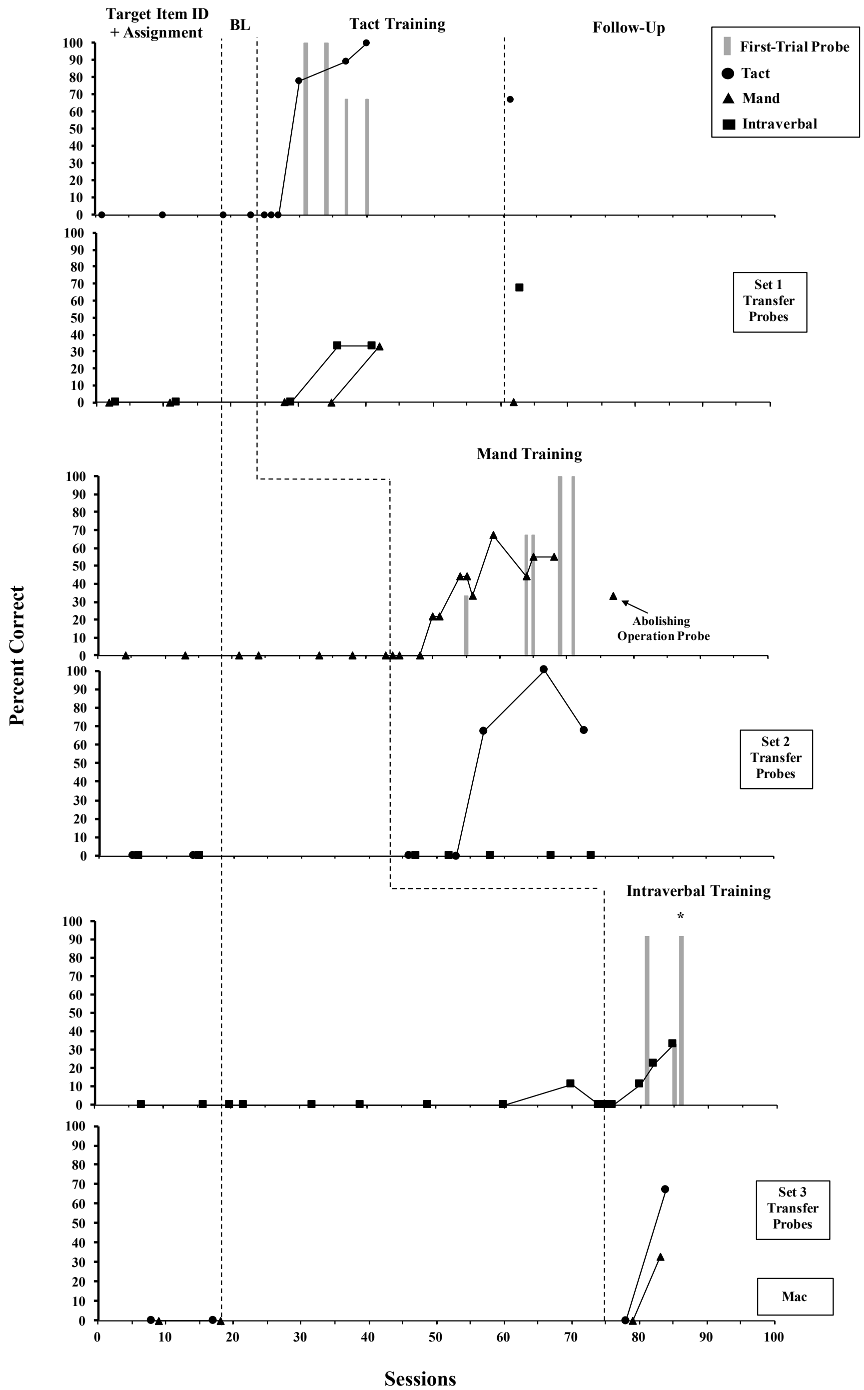


Figure 1. Percent correct responding during first-trial probes and training (top portion of each panel) and transfer probes (bottom portion of each panel) across object identification, baseline (BL), training, and follow-up phases for Mac. Tact, mand, and intraverbal conditions are represented in the top, middle, and bottom panels, respectively.

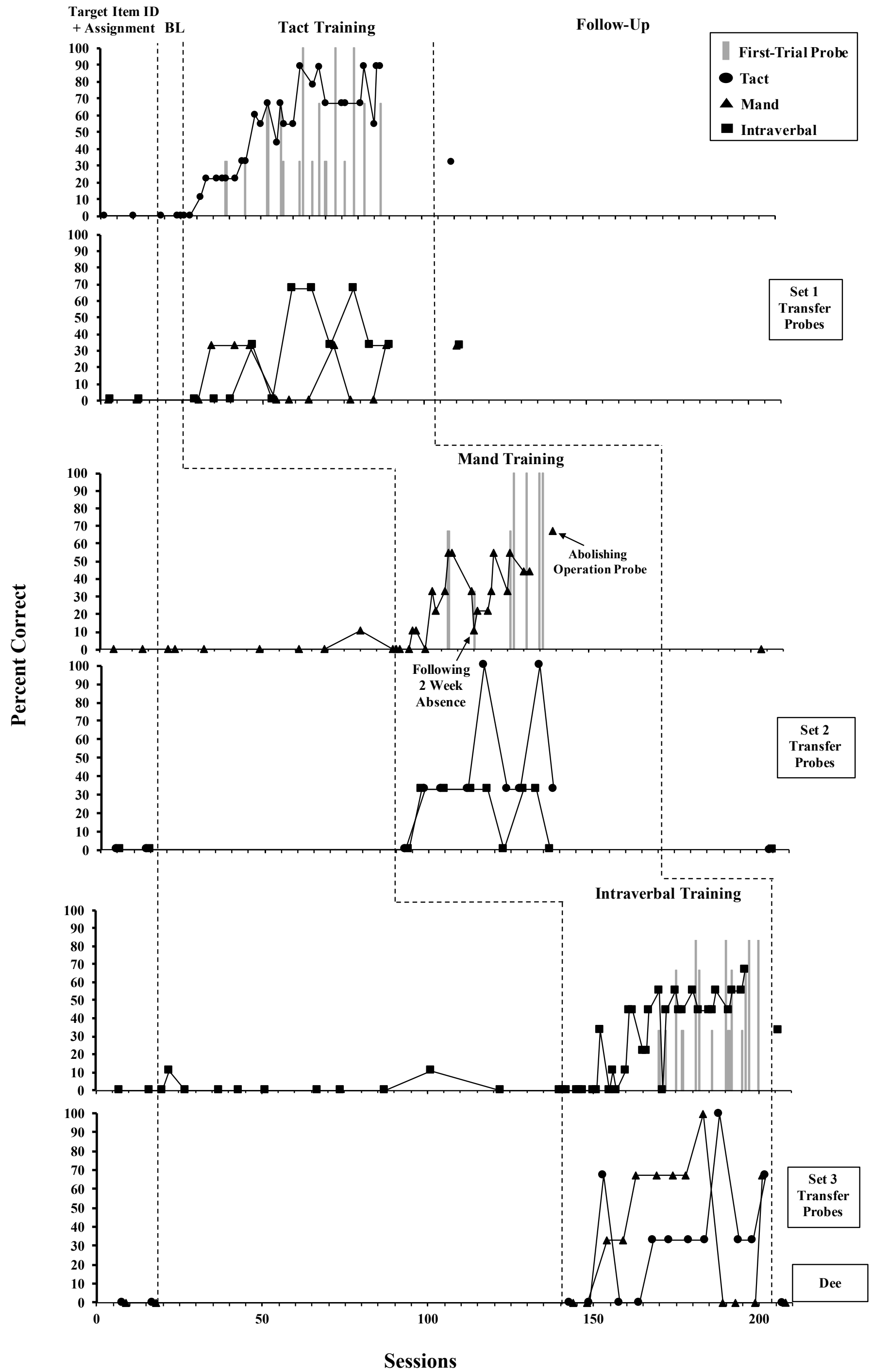
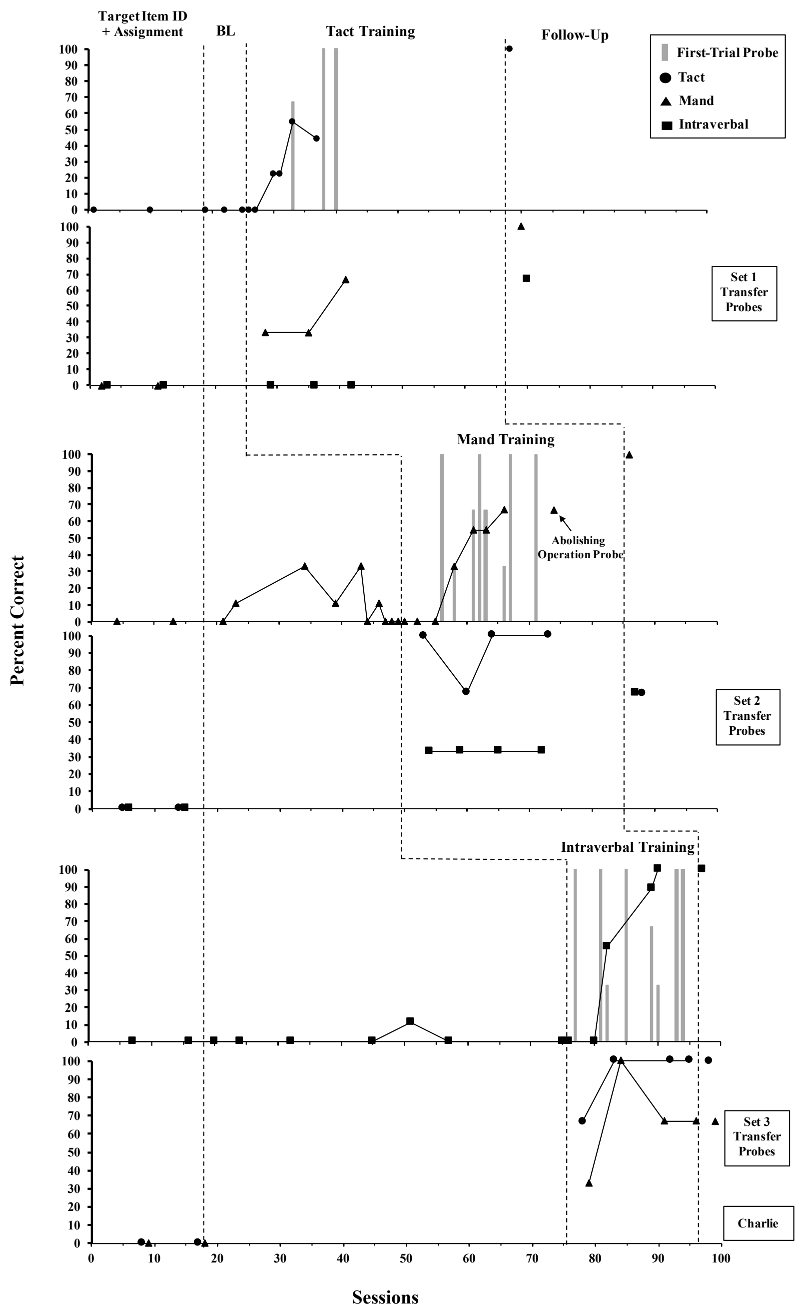


Figure 2. Percent correct responding during first-trial probes and training (top portion of each panel) and transfer probes (bottom portion of each panel) across object identification, baseline (BL), training, and follow-up phases for Dee. Tact, mand, and intraverbal conditions are represented in the top, middle, and bottom panels, respectively.



F*igure 3.* Percent correct responding during first-trial probes and training (top portion of each panel) and transfer probes (bottom portion of each panel) across object identification, baseline (BL), training, and follow-up phases for Charlie. Tact, mand, and intraverbal conditions are represented in the top, middle, and bottom panels, respectively.

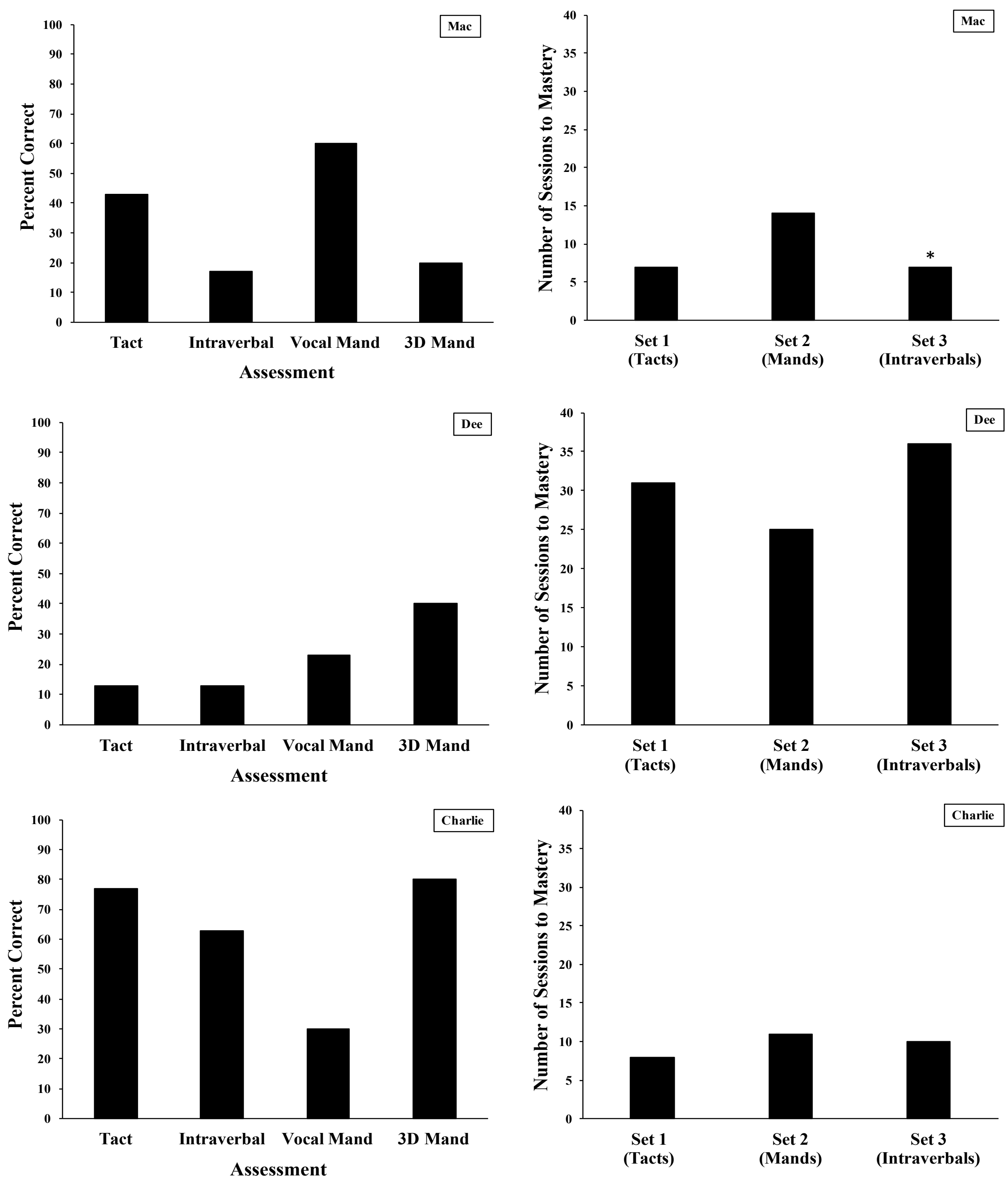


Figure 4. Percent correct responding during tact, intraverbal, and mand assessments of the Verbal Behavior Assessment Battery (VBAB; left panels) and number of sessions to mastery criteria (right panels) for all participants. The asterisk in Mac's right panel indicates he did not complete intraverbal training.

References

Albert, K. M., Carbone, V. J., Murray, D. D., Hagerty, M., & Sweeney-Kerwin, E. J. (2012). Increasing the mand repertoire of children with autism through the use of an interrupted chain procedure. *Behavior Analysis in Practice, 5,* 65-76. doi:10.1007/BF03391825

Allan, A. C., Vladescu, J. C., Kisamore, A. N., Reeve, S. A., & Sidener, T. M. (2014). Evaluating the emergence of reverse intraverbals in children with autism. *The Analysis of Verbal Behavior, 31*, 59-75. doi:10.1007/s40616-014-0025-8

Ashley, M. J. (2016). Brain injury overview. In S. A. Kolakowsky-Hayner, H. Reyst, & M. C. Abashian (Eds.), *The essential brain injury guide* (4th ed.) (pp. 1-27). Vienna, VA: Brain Injury Association of America.

Baker, J. C., LeBlanc, L. A., & Raetz, P. B. (2008). A behavioral conceptualization of aphasia. *The Analysis of Verbal Behavior, 24*, 147-158. doi:10.1007/BF03393063

Buckley S., & Newchok, D. K. (2005). Differential impact of response effort within a response chain on use of mands in a student with autism. *Research in Developmental Disabilities, 26*, 77–85. doi:10.1016/j.ridd.2004.07.004

Coon, J., & Miguel, C. F. (2012). The role of increased exposure to transfer-of-stimulus-control procedures on the acquisition of intraverbal behavior. *Journal of Applied Behavior Analysis, 45*, 657-666. doi:10.1901/jaba.2012.45-657

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.) Upper Saddle River, NJ: Pearson. doi:10.1080/09362830903235375

DeWiele, L., Martin, G. L., Martin, T. L., Yu, C. T., & Thomson, K. (2011). *The Kerr-Meyerson Assessment of Basic Learning Abilities Revised: A self-instructional manual* (2nd ed.). St. Amant Research Centre, Winnipeg, MB, Canada.

Egan, C. E., & Barnes-Holmes, D. (2009). Emergence of tacts following mand training in young children with autism. *Journal of Applied Behavior Analysis, 42,* 691–696. doi:10.1901/jaba.2009.42-691

Finn, H. E., Miguel, C. F., & Ahearn, W. H. (2012). The emergence of untrained mands and tacts in children with autism. *Journal of Applied Behavior Analysis, 45,* 265–280. doi:10.1901/jaba.2012.45-265

Fisher, W. W. Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment. *American Journal on Mental Retardation*, *101*, 15-25. doi:10.1901/jaba.1992.25-491

Fisher, W., Piazza, C.C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491-498. doi:10.1901/jaba.1992.25-491

Fuller, J. L., & Fienup, D. (2018). A Preliminary Analysis of Mastery Criterion Level: Effects on Response Maintenance. *Behavior Analysis in Practice. 11*, 1-8. doi:10.1007/s40617-017-0201-0.

Gamba, J., Goyos, C., & Petursdottir, A. I. (2015). The functional independence of mands and tacts: Has it been demonstrated empirically? *The Analysis of Verbal Behavior, 31*, 10-38. doi:10.1007/s40616-014-0026-7

Gilliam, A., Weil, T. M., & Miltenberger, R. G. (2013). Effects of preference on the emergence of untrained verbal operants. *Journal of Applied Behavior Analysis, 46,* 523-527. doi:10.1002/jaba.34

Green, G. (2001). Behavior analytic instruction for learners with autism: Advances in stimulus control technology. *Focus on Autism and Other Developmental Disabilities, 16,* 72-85. doi:10.1177/108835760101600203

Gross, A. C., Fuqua, R. W., & Merritt, T. A. (2013). Evaluation of verbal behavior in older adults. *The Analysis of Verbal Behavior, 29*, 85-99. doi:10.1007/BF03393126

Hall, G., & Sundberg, M. L. (1987). Teaching mands by manipulating conditioned establishing operations. *The Analysis of Verbal Behavior*, 5, 41–53. doi:10.1007/BF03392819

Heinicke, M. R., & Carr, J. E. (2014). Applied behavior analysis in acquired brain injury rehabilitation: A meta-analysis of single-case design intervention research. *Behavioral Interventions, 29*, 77-105. doi:10.1002/bin.1380

Heinicke, M. R., Eastridge, D., Kupfer, J., Mozzoni, M. P., & Carr, J. E. (2013). Assessing preferences of individuals with acquired brain injury using alternative stimulus modalities. *Brain Injury, 27*, 48-59.doi:10.3109/02699052.2012.722250

Humphreys, I., Wood, R. L., Phillips, C. J., & Macey, S. (2013). The costs of traumatic brain injury: A literature review. *ClinicoEconomics and Outcomes Research*, *5*, 281-287. doi: 10.2147/CEOR.S44625

Ingvarsson, E. T., & Hollobaugh, T. (2010). Acquisition of intraverbal behavior: Teaching children with autism to mand for answers to questions. *Journal of Applied Behavior Analysis, 43,* 1-17. doi:10.1901/jaba. 2010.43-1.

Kaplan, E., Goodglass, G., & Weintraub, S. (2000). *Boston Naming Test.* (2nd ed.). Philadelphia.

Kazdin, A.E. (2011). *Single-Case Research Designs: Methods for Clinical and Applied Settings* (2nd ed.) New York: Oxford University Press.

Kelley, M. E., Shillingsburg, M. A., Castro, M. J., Addison, L. R., & LaRue, R. H. (2007). Further evaluation of emerging speech in children with developmental disabilities: Training verbal behavior. *Journal of Applied Behavior Analysis, 40,* 431-445. doi:10.1901/jaba.2007.40-431

Kisamore, A. N., Carr, J. E., & LeBlanc, L. A. (2011). Training preschool children to use visual imagining as a problem-solving strategy for complex categorization tasks. *Journal of Applied Behavior Analysis, 44,* 255–278. doi:10.1901/jaba.2011.44-255

Lamarre, J., & Holland, J. G. (1985). The functional independence of mands and tacts. *Journal of the Experimental Analysis of Behavior, 43,* 5-19. doi:10.1901/jeab.1985.43-5

LaPointe, L. L. (2005). *Aphasia and Related Neurogenic Language Disorders*. New York: Thieme.

Lechago, S. A., Carr, J. E., Grow, L. L., Love, J. R., & Almason, S. M. (2010). Mands for information generalize across establishing operations. *Journal of Applied Behavior Analysis, 43,* 381-395. doi:10. 1901/jaba.2010.43-381

Leicester, J., Sidman, M., Stoddard, L.T., & Mohr, J.P. (1971). The nature of aphasic responses. *Neuropsychologia, 9*, 141-155. doi:10.1016/0028-3932(71)90039-X

May, R. J., Downs, R., Marchant, A., & Dymond, S. (2016). Emergent verbal behavior in preschool children learning a second language. *Journal of Applied Behavior Analysis*, *49*, 711-716. doi:10.1002/jaba.301

May, R. J., Hawkins, E., & Dymond, S. (2013). Brief report: Effects of tact training on emergent intraverbal vocal response in adolescents with autism. *Journal of Autism and Developmental Disorders, 43*, 996-1004. doi:10.1007/s10803-012-1632-7

Muma, J. R., Hamre, C. E., & McNeil, M. R. (1986). Theoretical models applicable to intervention in adult aphasia. In R. Chapey (Ed.). Language intervention strategies in adult aphasia (2nd ed.) (pp. 277- 283). Baltimore, MD: Williams & Wilkins.

Petursdottir, A. I., Carr, J. E., & Michael, J. (2005). Emergence of mands and tacts of novel objects among preschool children. *The Analysis of Verbal Behavior, 21,* 59 74. doi:10.1007/BF03393010

Rosales, R., Rehfeldt, R. A., & Lovett, S. (2011). Effects of multiple exemplar training on the emergence of derived relations in preschool children learning a second language. *The Analysis of Verbal Behavior, 27*, 61-74. doi:10.1007/BF03393092

Shillingsburg, M. A., Bowen, C. N., Valentino, A. L., & Pierce, L. E. (2014). Mands for information using "who" and "which" in the presence of establishing and abolishing operations. *Journal of Applied Behavior Analysis, 47,* 136–150. doi:10.1002/jaba.101.

Shillingsburg, M. A., Gayman, C. M., & Walton, W. (2016). Using textual prompts to teach mands for information using "Who?" *The Analysis of Verbal Behavior, 32*, 1-14. doi:10.1007/s40616-016-0053-7

Sidman, M. (1971). The behavioral analysis of aphasia. *Journal of Psychiatric Research, 8*, 413-422. doi:10.1016/0022-3956(71)90034-3

Sidman, M., Stoddard, L. T., Mohr, J. P., & Leicester, J. (1971). Behavioral studies of aphasia: Methods of investigation and analysis. *Neurophychologia, 9,* 119-140. doi:10.1016/0028-3932(71)90038-8

Skinner B.F. (1957). *Verbal behavior.* New York: Appleton-Century-Crofts.

Sundberg, M. L., Milani, I., & Partington, J. W. (1977). The use of sign language with hearing non-vocal mentally impaired persons. Paper presented at the 85th Annual Meeting of the American Psychological Association, San Francisco.

Sundberg, M. L., San Juan, B., Dawdy, M., & Argüelles, M. (1990). The acquisition of tacts, mands, and intraverbals by individuals with traumatic brain injury. *The Analysis of Verbal Behavior, 8*, 83-99. doi:10.1007/BF03392850

Sweeney-Kerwin, E. J., Carbone, V. J., O'Brien, L., Zecchin, G., & Janecky M. N. (2007). Transferring control of the mand to the motivating operation in children with autism. *The Analysis of Verbal Behavior, 23,* 89-102. doi:10.1007/BF03393049

Teri, L. & Logsdon, R.G. (1991). Identifying pleasant activities for Alzheimer's Disease patients: The pleasant events schedule-AD. *The Gerontologist, 31,* 124–127.

van der Meer L., Sutherland D., O'Reilly M. F., Lancioni G. E., & Sigafoos J. (2012) A further comparison of manual signing, picture exchange, and speech-generating devices as communication modes for children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *6*, 1247-1257. doi:10.1016/j.rasd.2012.04.005

Wallace, M. D., Iwata, B. A., & Hanley, G. P. (2006). Establishment of mands following tact training as a function of reinforcer strength. *Journal of Applied Behavior Analysis, 39*, 17-24. doi:1901/jaba.2006.119-04