

THE USE OF EQUIVALENCE-BASED INSTRUCTION TO TEACH GRADUATE
STUDENTS SIMPLIFIED DEFINITIONS OF BEHAVIOR ANALYTIC TERMINOLOGY

By

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ABSTRACT

THE USE OF EQUIVALENCE-BASED INSTRUCTION TO TEACH GRADUATE STUDENTS SIMPLIFIED DEFINITIONS OF BEHAVIOR ANALYTIC TERMINOLOGY

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Individuals who are pursuing their Board-Certified Behavior Analyst (BCBA) certification are required to have an effective understanding of applied behavior analysis (ABA) terminology. Hemwell (2020) used Equivalence Based Instruction (EBI) and Match-to-Sample (MTS) training to teach technical definitions of ABA terminology to first-year ABA students. Participants displayed limited emergent intraverbal responding and maintenance. Hemwell (2020) speculated this was due to the length and complexity of the definitions. The current study extended on Hemwell (2020) to determine if using simplified definitions of ABA terminology was effective in promoting the acquisition, and maintenance of ABA terminology. Using a multiple probe across behaviors design replicated across participants, participants were exposed to 30 simplified ABA terms, along with definitions and examples via a MTS teaching method. Participants were assessed on their performance of untaught relations in a selection-based pre-post assessment, as well as through written intraverbal probes. Despite text simplification, emergent intraverbal responding was variable and did not maintain for all terms. However, emergent selection-based responding across all relations from pre to post test was evident. Following text simplification, participants displayed emergent selection based responding with more complex definitions from the Cooper et al. (2020) textbook. Overall, future instructors may consider the use of EBI and text simplification in their courses to teach ABA terminology, examples, and principles.

Keywords: Equivalence-based instruction, Match-to-Sample, conditional discrimination, selection-based responding, topography-based responding, text simplification

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Introduction

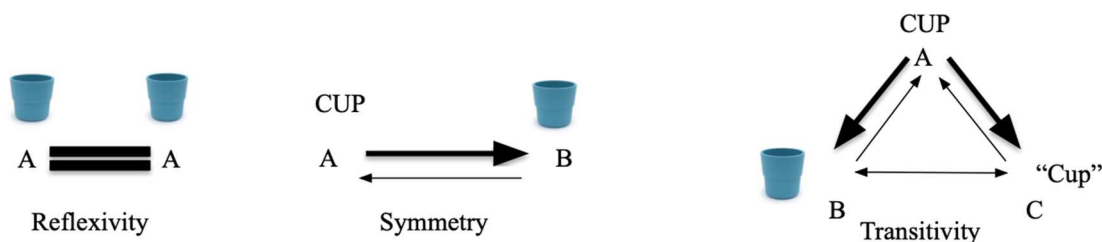
There are currently over 30,000 Board Certified Behavior Analysts (BCBAs) worldwide, whose role is to use the principles of applied behavior analysis (ABA) to provide effective treatment to children with autism and other disabilities, and support to their families (Behavior Analyst Certification Board, 2022; Carr & Nosik, 2016). Practicing behavior analysts must be board certified, which is obtained by completing required coursework, obtaining a minimum number of fieldwork hours, and passing the Behavior Analyst Certification Board (BACB) Exam. To be successful on the BACB exam, individuals must have the ability to comprehend and explain principles of ABA terminology, scenarios, and applied examples (Critchfield et al. 2017).

Equivalence-Based Instruction

Equivalence-Based Instruction (EBI) is a potentially quick and effective method to teach vocabulary terminology to those studying to be behavior analysts. EBI uses principles of stimulus equivalence to teach that two or more stimuli are the same, related, and/or functionally similar (Critchfield et al., 2018). EBI involves the principle of emergent relations in which some relations are taught and then the learner develops a new relational understanding without direct teaching (O'Neill & Rehfeldt, 2014). One method of using EBI is by dividing stimuli into different classes or categories and teaching certain relations between stimuli with the expectation other relations emerge (Fienup et al., 2011). For example, when teaching vocabulary terms, the categories may include 1) the vocabulary terms, 2) their definitions, and 3) examples of each word. Using conditional discrimination skills, individuals are likely to form relations between the stimuli.

Emergent relations typically develop from selection-based to topography-based (O'Neill & Rehfeldt, 2014); once individuals are taught to match stimuli with similar relations, they will then develop emergent topography-based (intraverbal responding) understanding of the relations. Examples of this relational framework are reflexivity, symmetry, and transitivity. An example of reflexivity would be if presented with a picture of a cup, and provided three comparison stimuli (e.g., individual pictures of cup, table, spoon), the learner would select the picture of the cup. Another emergent relation would be the selection of the word CUP upon seeing the presented stimuli (e.g., picture of a cup), establishing a relation between the two stimuli, this is referred to as symmetry (Cooper et al., 2020). Last, transitivity builds further in developing relations. For example, when presented with the written word CUP a learner would select from an array, a picture of a cup, and vocally identify the presented stimuli (e.g., “cup”). See Figure 1 for a visual example of the three relations.

Figure 1. Examples of Emergent Relations



Note. Reflexivity is a standard example of basic matching, so these two pictures of a cup are identical and match. Symmetry is where you would establish a relationship between the picture of a cup and say the written word cup. Transitivity builds even further on this. For example, the written word Cup is related to the picture of a cup and the vocal statement “cup”.

Matching-to-Sample (MTS) is a typical approach within EBI used to teach these relations (Brodsky & Fienup, 2018). MTS involves the presentation of a sample stimulus (e.g., a term), and the selection of a related comparison stimulus in an array of two or more stimuli (e.g., a

definition that corresponds with the targeted term, and at least one other word that does not). For example, when presented with the sample stimulus “cup,” and the comparison stimuli are “cylinder drinking container,” “flat saucer for food,” or “circular hole w/ bottom for food,” the learner would select the comparison stimulus “cylinder drinking container.” Because MTS procedures require the individual to select a comparison stimulus based on the presented stimulus, this type of responding is referred to as selection-based responding (Polson & Parsons, 2000).

Previous research studies have shown the effectiveness of using EBI to teach ABA topics to graduate students, such as functions of behavior and single subject designs. Albright et al. (2016) used computer-based MTS training to evaluate the emergence of selection-based and topography-based responding with ABA graduate students using a pretest-train-posttest design. Topography based responding involves the teaching of specific topography (e.g., intraverbal) based on a specific controlling variable (e.g., “Ready, set, _”; Polson & Parsons, 2000). Specifically, ten graduate students were taught four equivalence classes representing the four functions of behavior (e.g., attention, escape, access to tangibles, and automatic reinforcement). Albright & colleagues (2016) established stimuli within each class including a textual label (A), descriptions (B), graphical representations (C), and clinical vignettes (D). Using topography-based responding, the oral pretest assessed BA, CA, and DA relations; a selection-based multiple-choice pretest then assessed all relations, and a computer pretest assessed only the relations to be trained. Participants then completed MTS training on AB, AC, and AD relations, and completed tests of symmetry and transitivity. Following this training, participants completed posttests identical to the pretests. All participants in this study showed improvements from their pre- to posttest scores and demonstrated maintenance of knowledge two weeks after completing

the posttest. This study demonstrated the effectiveness of selection-based training on emergent topography-based responding; however, only four relevant ABA topics were taught all within a single day.

Walker & Rehfeldt (2012) used EBI to teach distance learning graduate students single subject designs using a pretest-train-posttest-maintenance design. This study consisted of topography-based tact and intraverbal pretests assessing whether participants could name the correct design when presented with the definition (BA), graph (CA), and clinical vignette (DA). Following the pretest, participants completed selection-based intraverbal instruction where they were taught AB, AC, and BD relations using multiple choice questions. Last, participants completed the posttest, identical to the pretest, and a test at 16-weeks to measure maintenance. Performance varied by participant; however, all participants demonstrated the emergence of CA tact relations following AC intraverbal instruction. All participants improved in scores from the pre- to posttest. However, it is important to note one limitation of this study is that participants were only exposed to one example and therefore did not demonstrate generalization to novel clinical vignettes.

Finally, Hemwell (2020) used EBI to prepare individuals pursuing their BCBA® certification for the BACB® exam and careers in the field of ABA by improving their understanding of key behavior analytic concepts. Hemwell (2020) assessed the effectiveness of EBI on the acquisition of knowledge of behavior terminology and examples using intraverbal probes and MTS procedures through a pretest-train-posttest design. Stimulus sets taught to participants were based on terms in three chapters of the Cooper et al. (2020) textbook, *Applied Behavior Analysis, 5th edition*. Each stimulus set consisted of 10 terms from each of the following chapters: 18 (“Verbal Behavior”), 19 (“Equivalence-Based Instruction”), and 30

(“Generalization and Maintenance of Behavior Change”), for a total of 30 terms. “A” stimuli were the MTS stimuli, or the terms. “B” stimuli were the definitions of the terms taken verbatim from the Cooper et al. (2020) textbook. “C” stimuli were examples of each term developed by the experimenter. Participants completed a selection-based responding 180 question pre-test that assessed knowledge of all relations of stimuli. Next, participants completed topography-based responding through intraverbal probes, consisting of 60 open-ended questions with 20 questions per stimulus set. Intraverbal probes were completed prior to teaching stimulus sets (e.g., 3 per participant) as a baseline measure. Participants were then assigned to complete EBI training for the first stimulus set. Following mastery of a stimulus set, participants completed intraverbal probes again. If a participant did not pass an intraverbal probe by meeting the 80% correctness mastery criteria, they completed remedial training (e.g., additional EBI training until they were able to pass the intraverbal probe). This sequence of training and assessment was repeated for all three stimulus sets. Once training on all sets was complete, the participants completed a posttest, identical to the pretest. Results of Hemwell’s study show that EBI produced emergent selection-based responding, but EBI training did not result in participants reaching mastery criteria for intraverbal responding. Hemwell hypothesized that the reason for these results was due to the length and difficulty of the definitions that were taught in her study and stated further research should be conducted to investigate this limitation.

Text Simplification

The overarching goal of text simplification is to rewrite complex text into simpler language that is easier to understand for most individuals (Xu et al., 2015). Studies have shown that text simplification is an effective method to increase reading comprehension and understanding of material. Several studies have been conducted to evaluate the methods used for

automatic text simplification and how text difficulty impacts comprehension (Siddharthan, 2014). For example, Xu et al. (2015) evaluated effective methods for measuring and developing simplified text, specifically looking at Wikipedia. Results of the study showed a variety of components to take into consideration when simplifying text. Specifically, individuals must consider the target audience and who the text is for when simplifying text. In addition, using elements such as paraphrasing and splitting to simplify text are effective methods. Still, Siddharthan (2014) discussed the need for further research on how examples of simplified language generalize to the real world, concluding that more systematic evaluations are needed that measure text comprehension by end users.

As previous studies have shown that simplifying definitions may help with comprehension of material, the current study aimed to replicate and extend Hemwell (2020) to determine if using simplified definitions of ABA terminology was effective in promoting the acquisition, understanding, and maintenance of ABA terminology. Specifically, the present study assessed whether simplifying ABA definitions and terminology impacted results and maintenance of emergent responding within intraverbal probes and multiple-choice responding. The specific research questions were:

- 1) Does EBI training with simplified definitions lead to acquisition of selection-based responding for AB and AC relations?
- 2) To what extent does EBI training with simplified definitions impact emergent written topography-based responses (i.e., intraverbal probes) for BA and CA relations? Does this performance maintain over time?

- 3) To what extent does EBI training with simplified definitions impact emergent selection-based responses with behavior terminology (AB, AC relations), definitions (BA, BC), and examples (CA, CB)?
- 4) Does performance with simplified behavior terminology, definitions, and examples generalize to the definitions provided by Cooper et al. (2020) (AD relations)?

Methods

Participants & Setting

Seven students in their first semester of a hybrid Master of Arts in ABA program located in the Midwest participated in the current study. Participants' ages ranged from 22 years-old to 25 years-old and all spoke English as their first language. Participants' prior experience with and training in ABA varied. Andy was a 24-year-old White male with a Bachelor of Arts (BA) in psychology and no ABA experience prior to the study. Alice was a 23-year-old White female with a BA in psychology and 1- 2 years of ABA experience working as a behavior technician prior to the study. Eliza was a 25-year-old White female with a Bachelor of Science (BS) in behavioral neuroscience and 1 - 2 years of ABA experience working as a Registered Behavior Technician (RBT). Kelly was a 24-year-old White female with a BS in kinesiology and no ABA experience prior to the study. Rachael was a 22-year-old White female with a BA in psychology; she had 1 - 2 years of ABA experience as a behavior technician and had taken ABA courses prior to the study. Julia was a 22-year-old female with a BS in kinesiology and 1 - 2 years of ABA experience as a behavior technician; she was actively studying for RBT certification prior to the study. Sarah was a 22-year-old White female with a BA in psychology, and 1 - 2 years of ABA experience as a behavior technician. All of the intraverbal probe sessions, pretest, and posttest took place online via Desire2Learn® (D2L®), and all teaching sessions occurred online via Google Slides™.

Materials & Experimental Stimuli

Participants were required to have access to a computer with internet and a webcam; however, if a participant did not have a reliable computer with internet and a webcam, they were loaned a laptop for the duration of the study. Throughout the experiment participants used D2L®

and Google Slides™ to complete the pretests, teaching sessions, posttests, and intraverbal probes (described in more detail below). The link to the appropriate teaching sessions was sent to participants via university email once the appropriate intraverbal probe was completed. The intraverbal probe tests, located on D2L®, consisted of fill-in-the-blank questions. The teaching sessions, pretests, and posttests consisted of an MTS teaching format. When completing the intraverbal probes, pretest, and posttest, participants were required to use Respondus Lockdown Browser® and Respondus Monitor® features within D2L®. The Respondus Lockdown Browser® is a browser that prevents individuals from accessing outside resources from the internet browser during testing. Additionally, Respondus Monitor® uses the individuals' webcams and requires them to show videos of their surroundings (Respondus LockDown Browser & Monitor, 2020).

The experimental stimuli consisted of the same three stimulus sets of behavior analytic vocabulary terms used by Hemwell (2020). Each stimulus set contained 10 terms each from the following chapters in the textbook *Applied Behavior Analysis* (Cooper et al., 2020): 18 (“Verbal Behavior”), 19 (“Equivalence-Based Instruction”), and 30 (“Generalization and Maintenance of Behavior Change”), for a total of 30 terms. The same examples for each term, developed by Hemwell (2020), were also used.

Extending Hemwell (2020), a simplified definition of each ABA term (operationally defined as a statement of 30 words or less that describes the term without the use of jargon) was developed. To simplify each definition, the experimenter first consulted various introductory to behavior analysis and verbal behavior textbooks to identify an alternative definition for each term. She then compiled the terms and definitions into a survey for behavior analysis faculty, BCBAs, and trainees and asked respondents how they would simplify the definition for someone

not familiar with ABA. Responses to the surveys were used to create new definitions for each term, with the goal of making the term easier to understand while also maintaining the specific components that were considered necessary to keep the definition accurate. Upon reviewing the new definitions, it was determined the definitions were still too complex, containing various ABA principles and jargon. After further discussion, the experimenter removed all ABA jargon and further shortened each definition. The resulting simplified definitions were all 5 to 29 words in length and did not contain jargon. All final definitions were reviewed by two BCBAs and considered acceptable for introductory ABA learners.

A list of the terms, definitions, and examples used for each stimulus set can be found in Tables 1-5. “A” stimuli were the MTS stimuli, or the terms. “B” stimuli were simplified definitions of the identified terms from the textbook. “C” stimuli were examples of each term developed by the experimenters. “D” stimuli were Cooper et al. (2020) definitions measured in the pre and posttests.

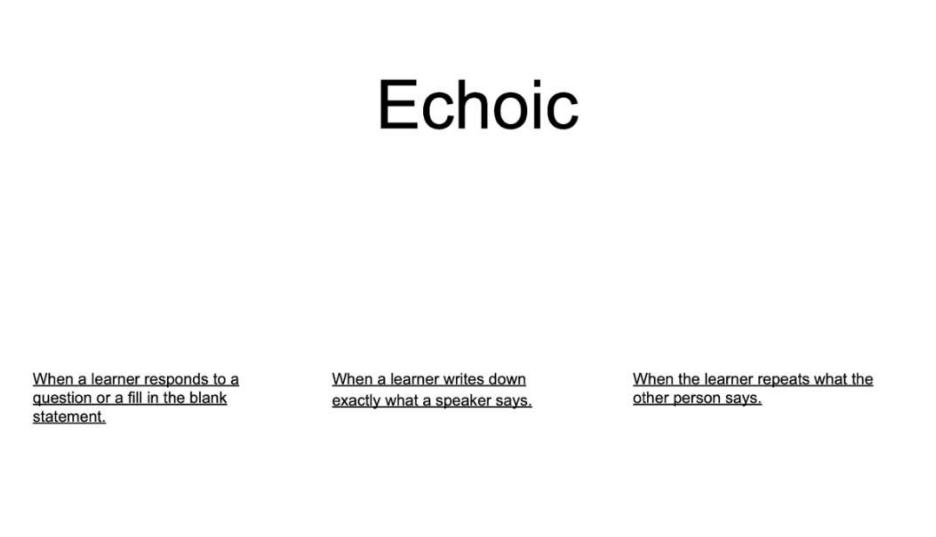
Response Measurement & Dependent Variables

Pretest, intraverbal probe, posttest, and teaching data were collected and scored as a percentage of correct responses. Correct responding during the intraverbal probes was defined as the participant typing in the term that corresponded to the definition or example provided. Correct responses had to include at least 75% of the words contained within the term. For example, if the definition of “higher order operant class” was provided and the participant typed “higher order class”, this was scored as correct. However, if the definition of “response generalization” was provided and the participant typed “generalization,” this was scored as incorrect. Responses were also scored as correct if they included a synonym of one of the words in the concept that did not change the meaning of the word. For example, when presented with

the definition of naturally existing contingency, the response “naturally occurring contingency” was scored as correct. Responses were also scored as correct regardless of whether the participant typed the plural or singular word, and regardless of tense or part of speech. For example, when presented with an example of a tact, “tact,” “tacts,” or “tacting” were all scored as correct. Minor spelling errors were also scored as correct. For example, if a participant typed, “transititivity” instead of “transitivity,” this answer was scored as correct.

Correct responding during the pretests and posttests was defined as selecting the term, definition, or the example (depending on the relation being trained or tested) that corresponded to the sample stimulus presented at the top of the screen. Correct responding during the EBI teaching sessions was defined as selecting the comparison stimulus that corresponded to the sample stimulus presented at the top of the screen by using a mouse pointer to click on the correct definition or example. For example, during MTS AB relation training, if the word “echoic” was presented as the sample stimulus, the correct response would be selecting the stimulus that displayed the definition of the word “echoic.” See Figure 2 for an example of an MTS AB relation.

Figure 2. Example of Equivalence Based Instruction Teaching Session (Google Slide)



Note. An example of what the participant views during an EBI teaching session; Match-to-sample (MTS) for AB relation (term-definition).

Interobserver Agreement

Interobserver agreement (IOA) was assessed for scoring on the EBI teaching sessions and the intraverbal probes. To assess for IOA, a second-year master's student used a scoring key to score 30% of each participants' EBI teaching sessions and intraverbal probes. Specifically, to assess IOA for EBI teaching sessions, the second observer watched a recording of the EBI teaching session and marked the response selected by the participant for each question. The responses recorded by the second observer were compared to those recorded by the experimenter. An agreement was counted as when the experimenter and second observer indicated the same response; a disagreement was counted when the experimenter and second observer indicated different responses were selected. IOA was calculated by dividing agreements by agreements plus disagreements multiplied by 100 to yield a percentage. To assess IOA for intraverbal probes the second observer accessed an intraverbal probe via D2L, and scored the response entered by the participant as correct or incorrect. The responses recorded by the second

observer were compared to those recorded by the experimenter. An agreement was counted as when the experimenter and second observer indicated the same response; a disagreement was counted when the experimenter and second observer indicated different responses were selected. Total count IOA was calculated as the number of correct responses calculated by the experimenter divided by the number of correct responses calculated by the second observer multiplied by 100 to yield a percentage (Cooper et al., 2020). IOA for all participants' EBI performance on stimulus sets 1 was 100%, while for stimulus set 2 it was 99%. IOA for MTS performance on stimulus set 3 was 95% (range, 95% to 100%) across all participants. IOA for all participants except Julia's intraverbal probe performance on all stimulus sets was 100%. IOA for Julia's intraverbal probe performance was 99%. Finally, because D2L® automatically scored the pretest and posttest, IOA was not calculated.

Experimental Design

A multiple probe design with probe conditions (Ledford & Gast, 2018) across stimulus sets was replicated across participants and embedded in a pretest-train-posttest design to evaluate the effectiveness of the EBI on the acquisition of simplified definitions and examples of behavior analytic vocabulary. This design was appropriate for the current study because the skills taught were unlikely to emerge during baseline in the absence of direct instruction. All participants first completed a pretest and then started in baseline for all three stimulus sets until they demonstrated stable responding. Then participants completed EBI teaching sessions (described below) for an assigned stimulus set until they reached mastery criterion. Next, participants completed an intraverbal probe. If they demonstrated mastery, they moved on to EBI teaching for the next assigned stimulus set. If they did not demonstrate mastery criteria, they completed remedial

training (described below). Participants followed this format until they completed EBI and intraverbal probes for each stimulus set, then finally took a posttest.

Hemwell (2020) had all participants complete each stimulus set in the order in which the content was introduced in Cooper et al. (2020). However, to control for level of difficulty within the stimulus sets, the present study assigned stimulus sets randomly across participants.

Procedures

Pretest

Prior to any training, a pretest was administered to assess baseline knowledge of each relation and to be used as a comparison to test emergent symmetrical and transitive relations on the posttest. Each participant completed a 210-question multiple choice pretest that assessed all relations of stimuli (AD, AB, AC, CA, BA, BC, CB) with no time limit. Participants were given instructions to select the option that corresponded to the term, definition, or example presented and they were told to guess if unsure of the answer. The examples used in the pretest were novel, meaning they were different from the ones used in the EBI teaching sessions and intraverbal probes. D2L® was programmed to randomize the order of questions for each participant. No feedback was provided for correct or incorrect answers during the pretest. The test format consisted of the target word, definition, or example as the question and four answer choices listed below the question. Each stimulus sets' terms, definitions, and examples were kept separate from each other; when an individual was given a stimulus from stimulus set 1 they were only given answer options that related to stimulus set 1.

Intraverbal Probes

Each participant completed three initial intraverbal probes following the pretest and prior to EBI teaching sessions. Participants also completed intraverbal probes following mastery of

each stimulus set in the EBI teaching sessions and remedial training sessions. This was done to ensure experimental control by showing that change in scores only occurred when the intervention was applied (Ledford & Gast, 2018). Each intraverbal probe consisted of 60 fill-in-the-blank and/or open-ended questions—20 questions per each of the three stimulus sets. There were two different intraverbal probes, “Intraverbal probe A” and “Intraverbal probe B,” which each had the exact same format and definitions but included one of the two examples used in the EBI teaching sessions (see Tables 4, 5, and 6). The order of intraverbal probes (A or B) completed by participants was randomized. Each intraverbal probe was taken on a different day and on a different day from the pretest. Data were only collected on BA and CA relations during intraverbal probes due to the nature of the intraverbal test format.

All intraverbal probe conditions were identical. Intraverbal probe questions included either the definition or example presented at the top of the screen and one box below for the participant to write in the corresponding term. The participants were instructed to type the term that corresponded to the example or definition presented. If they did not know the answer, they were instructed to type “I don’t know”, “Idk”, or some other indicator that showed they attempted to answer the question. Participants had unlimited time to complete each intraverbal probe but were required to use the lockdown browser when completing the intraverbal probe. After completing the last question on the probe, the participants clicked “Submit” and results were saved for the experimenter to score. Mastery criteria on the intraverbal probes were set to 80% correct responding or higher on both BA and CA relations for the corresponding stimulus set. No feedback was provided to participants concerning their performance on the intraverbal probes or which questions they answered correctly or incorrectly

If the participant did not pass the probe, the experimenter sent an email instructing them to complete remedial training (described below). The email also included brief feedback stating that responses are expected to include the full term. Following remedial training, participants completed the alternate intraverbal probe. If participants did not pass the second probe for the same stimulus set, they were provided with additional feedback (e.g., slow down during remedial training, and to read through each question and answer). Following remedial training, the participant completed a third probe.

Equivalence Based Instruction (EBI) Teaching Sessions

During EBI teaching sessions, participants were taught AB and AC relations via MTS procedures. Teaching sessions consisted of 40 questions total per stimulus set. The first 10 teaching trials were term-definition (AB) relations. The last 10 teaching trials were term-example (AC) relations, and the training included two different examples across the two AC relation sections.

EBI teaching sessions were delivered via Google Slides™. Prior to the session, participants were given the instructions via email to screen-record their participation either in presentation mode or over Zoom for researchers to score and determine when they reached mastery criterion. The training also included an introductory slide describing the general procedure of the EBI teaching sessions, including information about the reinforcement slides and error correction procedure. The EBI target stimuli (A = term) were presented simultaneously with three comparison stimuli below. The instructions for the EBI teaching sessions were to select the definition or example that corresponded to the term presented at the top of the screen. Correct selections were hyperlinked to a slide with a visual that read “CORRECT!” in green font. Incorrect responses were hyperlinked to a visual that read “INCORRECT” in red font and

resulted in the delivery of the error correction procedure where participants were presented with the same question again with the correct answer prompted by an arrow above the term.

Participants would then select the prompted answer that was hyperlinked to a screen that read: “Correct.” in grey font. Next, the same term was presented one more time without the arrow to transfer stimulus control from the prompt to the term. Correct selections were then hyperlinked to a slide that said “Correct,” in green font. Any errors during the error correction procedure started the procedure over from the initial “INCORRECT” in red font feedback slide. In order to continue after feedback, participants selected a button that read “Next,” which was hyperlinked to either the next term or the next slide in the error correction procedure depending on whether the participant selected the correct stimulus.

Participants were then instructed to either upload the video of their screen recording to D2L®, or to provide a mediaspace link of the recording via email. The experimenter then watched the recorded video and scored participants’ performance, marking whether each selection was correct or incorrect. Mastery criterion was set to 90% correct responding or higher across three consecutive teaching sessions for each stimulus set. The experimenter emailed participants once they reached mastery criterion and instructed them on which intraverbal probe to take located in D2L®. An identical procedure was followed for all stimulus sets. The assignment of stimulus sets was randomized for each participant. With the goal to measure the complexity of terminology within each stimulus set based on EBI teaching session performance.

Remedial Training (All Participants)

If participants scored below an 80% on either BA or CA relations on the intraverbal probe for the current stimulus set, they were instructed to complete remedial training. The first round of remedial training for all stimulus sets consisted of three additional EBI teaching

sessions, followed by an email with feedback to be sure to write down the full term for every response during the intraverbal probe. Due to time constraints, participants were allowed to complete up to two remedial training sessions a day. Intraverbal probes could not be taken on the same day a participant completed training(s); however, after completion of an intraverbal probe, participants were allowed to complete the next assigned training on the same day. If participants did not reach mastery criteria on the probes following remedial training, they were assigned to complete two additional remedial training sessions; these could both occur on the same day. Prior to the completing the two additional remedial training sessions, the experimenter stated for the participants to slow down when completing the training. Following this, if mastery criteria was still not met, no additional remedial training was provided, and participants moved on to the EBI teaching sessions for the next randomized stimulus set.

Posttest

Each participant completed a 210-question multiple choice posttest that tested all relations of stimuli (AD, AB, AC, CA, BA, BC, CB) following completion of teaching sessions and intraverbal probes of all three stimulus sets. The test format was identical to the pretest administered at the beginning of the study and no feedback was provided for correct or incorrect answers during the posttest.

Procedural Fidelity

Data were collected on procedural fidelity (PF) of the EBI teaching sessions. The experimenter used the same GoogleSlides© created by Hemwell (2020), who based the presentations on a checklist created by Cummings & Saunders (2019). The experimenter assessed the method in which each EBI teaching session was presented to assess for PF. Each EBI teaching session consisted of 40 trials within each set and each trial consisted of seven

necessary fidelity components that described to which slide each stimulus was to be hyperlinked. To assess for PF, each slide was scored as correct if the experimenter incorporated all necessary components or incorrect if the experimenter missed any of the necessary components when creating the slide. Fidelity was calculated as the number of steps scored as correct by the total number of checklist steps multiplied by 100 to yield a percentage (Cooper et al., 2020). All three stimulus sets of EBI teaching sessions were created with 90% fidelity.

Social Validity

Following completion of the study, participants were emailed a survey to assess the social validity of this intervention. Participants were sent a Qualtrics link via university email that included questions regarding their knowledge and comfort of the behavior analytic terms before and after participation in the training, time commitment, significance of the information they learned, and overall satisfaction with the teaching method. Participants were instructed to rate each question on a five-point Likert scale with the following options: strongly agree, agree, neutral, disagree, and strongly disagree. The results of the social validity survey can be found in Table A7. All participants reported that the information they learned was relevant to their schoolwork and fieldwork. The majority of participants reportedly felt more confident in their understanding of the targeted terms following their participation in the study. The majority of participants agreed that EBI teaching sessions and intraverbal probes were easy to navigate.

Results

Intraverbal Probes (BA and CA Relations)

Andy

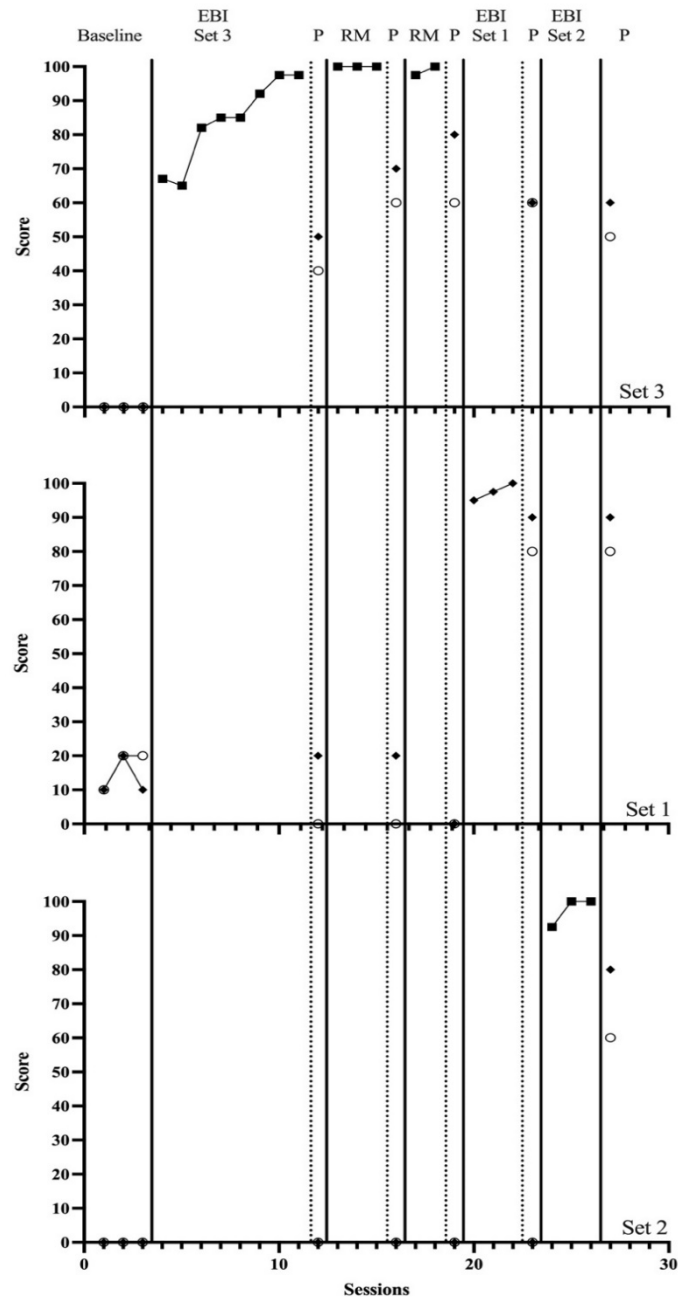
Data for Andy's intraverbal probes and EBI teaching sessions can be found in Figure 3. Andy's scores on BA and CA relations ranged from 0% to 20% across stimulus sets on the first three intraverbal probes in the baseline condition. Andy started the study with stimulus set 3. Andy met mastery criteria within eight EBI teaching sessions for stimulus set 3. He then scored a 50% on BA relations and 40% on CA relations on the intraverbal probe for stimulus set 3; scores on both relations for stimulus sets 1 and 2 remained at baseline levels (range, 0% to 20%). Andy completed three remedial training sessions for stimulus set 3 and improved his BA score to a 70% and CA score to a 60%. Because this still did not meet mastery criteria for stimulus set 3, Andy completed two additional remedial training sessions. Andy improved his BA score to an 80% and CA score to an 60% and moved onto the next randomly assigned stimulus set (set 1).

Andy completed EBI teaching sessions and reached mastery criterion for stimulus set 1 after three sessions. He then scored 90% on BA relations and 80% on CA relations on the intraverbal probe for stimulus set 1. His scores for the previously taught stimulus set, stimulus set 3, remained above baseline levels at 60% for both relations and his scores for the untaught stimulus set (set 2) remained at baseline levels (0%). Since Andy met mastery criteria for stimulus set 1, he moved onto the final randomly assigned stimulus set (set 2).

Andy met mastery criterion for stimulus set 2 within three EBI teaching sessions. His scores on BA and CA relations for stimulus set 2 were 80% and 60%, respectively. Scores for stimulus set 3 dropped slightly (60% BA, 50% CA) and scores for stimulus set 1 remained at

mastery criteria level (90% BA, 80% CA). Andy would have required remedial training sessions for stimulus set 2, however, the study ended before he could complete those sessions.

Figure 3. Graphical Display of Andy's Probe, EBI, and Remedial Training Data



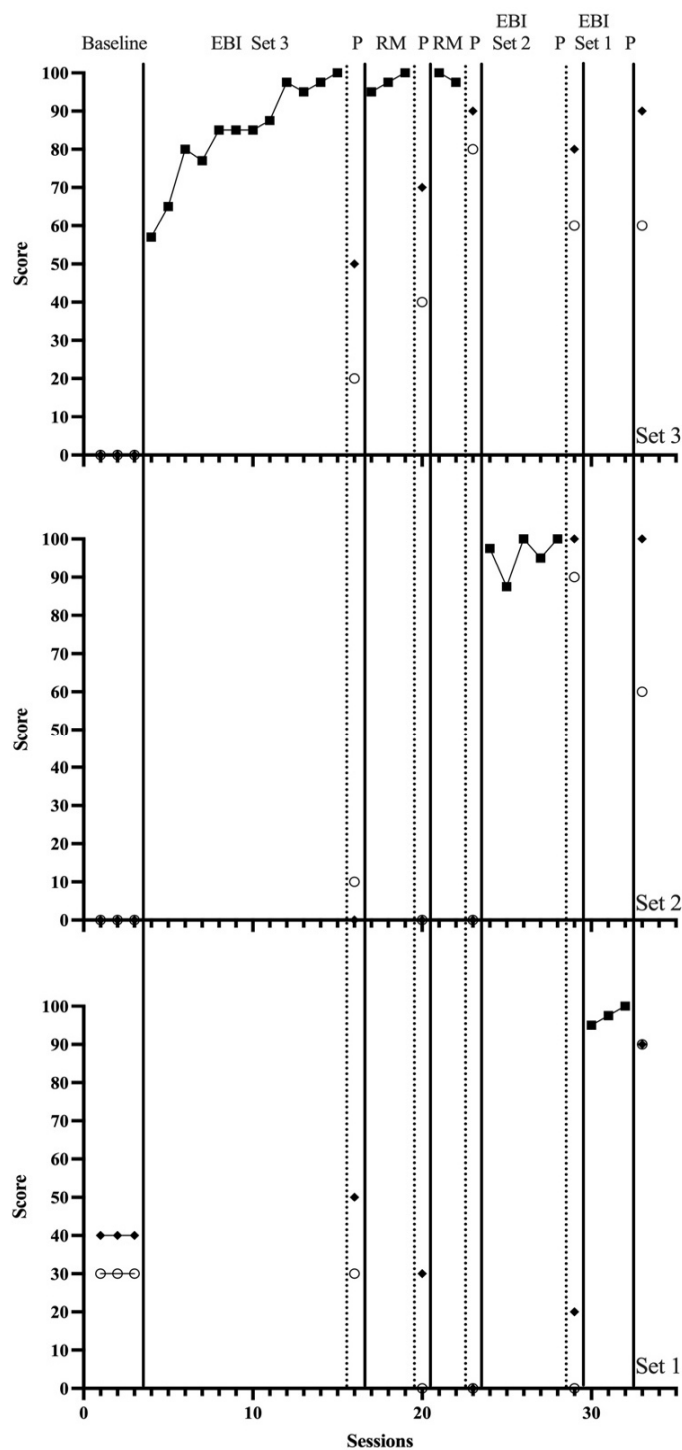
Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

Alice

Data for Alice's intraverbal probes and EBI teaching sessions can be found in Figure 4. Scores on BA and CA relations ranged from 0% to 40% across stimulus sets on the first three intraverbal probes in the baseline condition. Alice started the study with stimulus set 3. It took Alice twelve EBI teaching sessions to reach mastery criterion for stimulus set 3. She then scored a 50% on BA relations and 20% on CA relations on the intraverbal probe for stimulus set 3. Scores on relations for both stimulus sets 1 and 2 remained at or above baseline levels (range, 0% to 50%). Alice completed three remedial training sessions for stimulus set 3 and improved her BA score to a 70% and CA score to a 40%. This still did not meet mastery criteria for stimulus set 3, therefore, Alice completed two additional remedial training sessions. Alice improved her BA score to 90% and CA score to 80% (scores on relations for stimulus sets 1 and 2 continued at baseline levels) and moved onto the next randomly assigned stimulus set (set 2).

Alice reached mastery criterion for stimulus set 2 after five EBI teaching sessions. She scored 100% on BA relations and 90% on CA relations on the intraverbal probe for stimulus set 2. Her scores for the previously taught stimulus set 3 remained above baseline levels (80% BA, 60% CA) and her scores for stimulus set 1 remained below baseline levels (BA 20%, CA 0%). Alice then completed EBI teaching sessions for stimulus set 1 and met mastery criterion within 3 sessions. Her scores on BA and CA relations for stimulus set 1 were 90% and 90%, respectively. She scored 90% on BA relations and 60% on CA relations for stimulus set 3 and scored 90% on BA relations and 90% on CA relations for stimulus set 1.

Figure 4. Graphical Display of Alice's Probe, EBI, and Remedial Training Data



Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

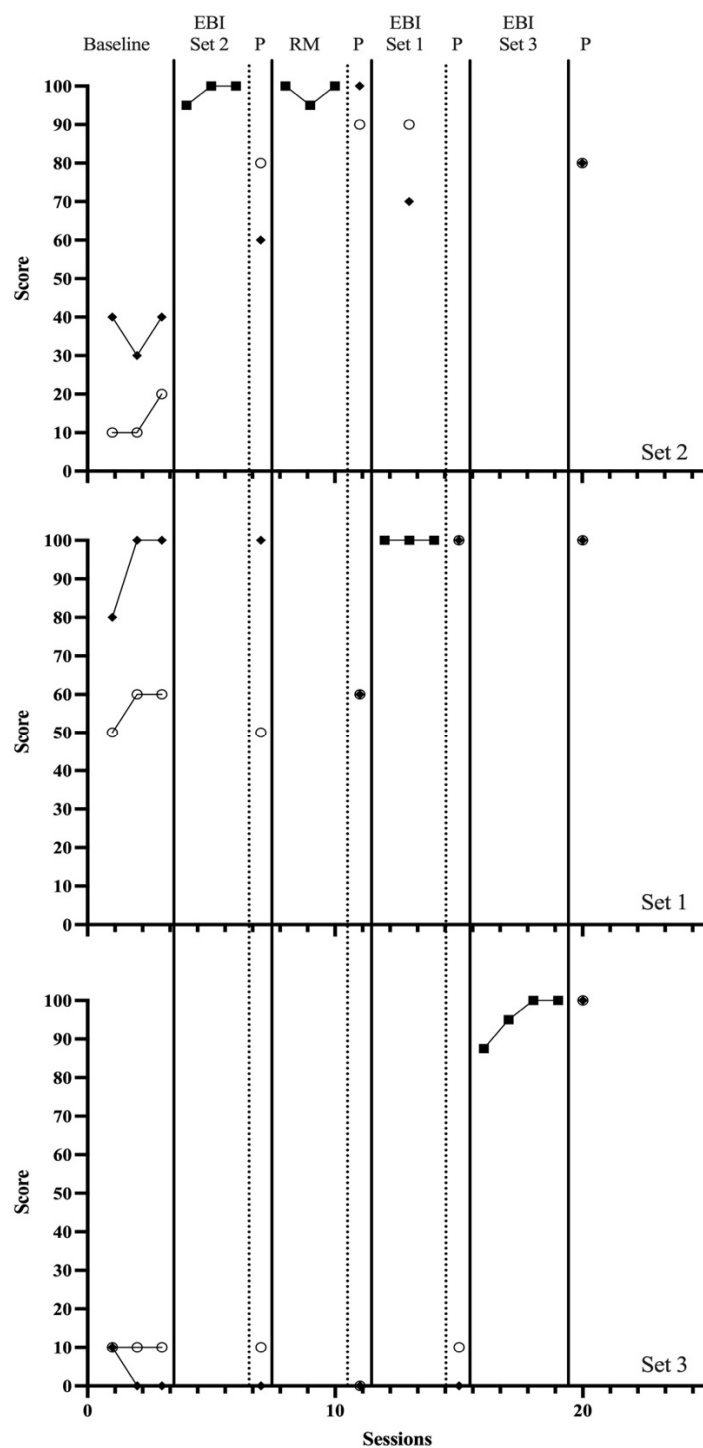
Eliza

Eliza's intraverbal probes and EBI teaching sessions can be found in Figure 5. Scores on BA relations ranged from 0% to 100% across stimulus sets on the first three intraverbal probes in the baseline condition. The CA relations scores across stimulus sets ranged from 0% to 60% in the first intraverbal probe condition. Eliza started the study with stimulus set 2. It took Eliza three EBI teaching sessions to reach mastery criteria for stimulus set 2. She then scored a 60% on BA relations and 80% on CA relations on the intraverbal probe for stimulus set 2. Scores on both relations for stimulus sets 1 and 3 remained at baseline level (range, 0% to 100%). Eliza completed three remedial training sessions for stimulus set 2 and improved her BA score to a 100% and CA score to a 90% (with sets 1 and 3 remaining at baseline levels). This met mastery criteria for stimulus set 2, therefore, Eliza moved onto the next randomly assigned stimulus set (set 1).

Eliza reached mastery criterion for stimulus set 1 after three EBI teaching sessions. She scored 100% on BA relations and 100% on CA relations on the intraverbal probe for stimulus set 1. Her scores for the previously taught stimulus set 2 remained above baseline levels at 70% for BA relations and 90% for CA relations, and scores for stimulus set 3 remained low.

Eliza then completed four EBI teaching sessions for stimulus set 3 to reach mastery criterion. Her scores on BA and CA relations for stimulus set 3 were both 100%. She scored 80% on both relations for stimulus set 2 and scored 100% on both relations for stimulus set 1.

Figure 5. Graphical Display of Eliza's Probe, EBI, and Remedial Training Data



Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

Kelly

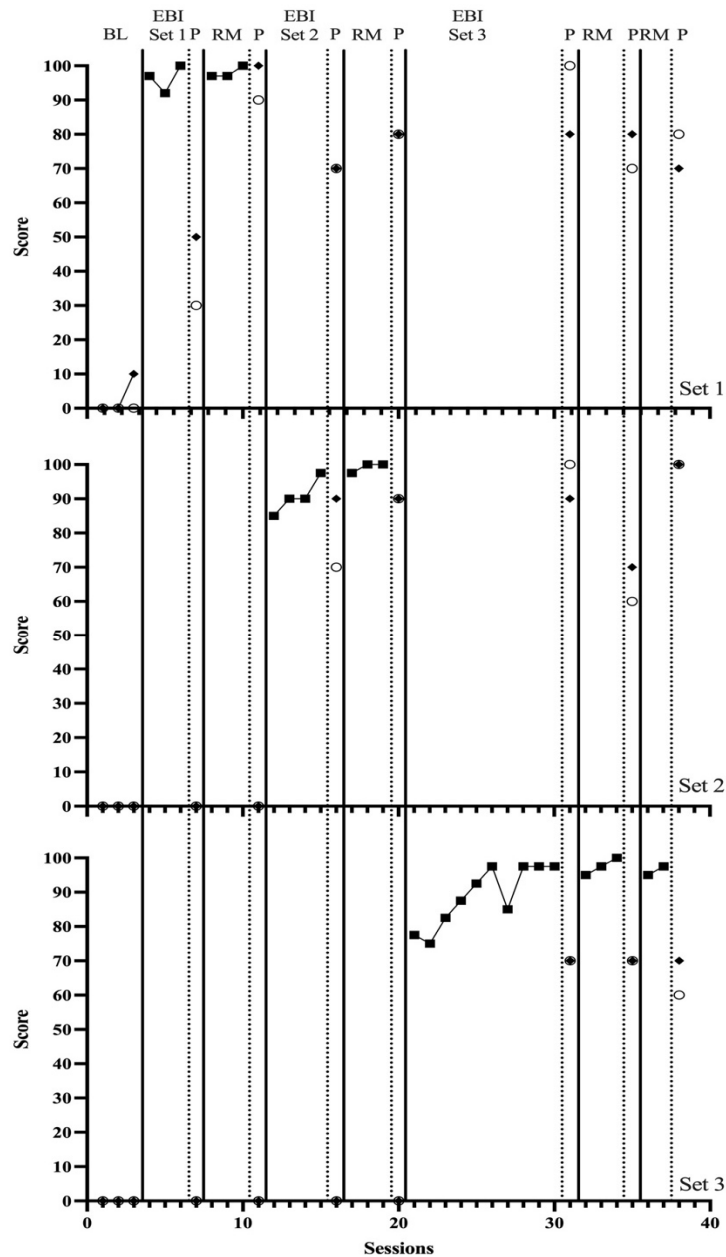
Data for Kelly's intraverbal probes and EBI teaching sessions can be found in Figure 6. Scores on both BA and CA relations ranged from 0% to 10% across stimulus sets on the first three intraverbal probes in the baseline condition. Kelly started the study with stimulus set 1. It took Kelly three EBI teaching sessions to reach mastery criteria for stimulus set 1. She then scored a 50% on BA relations and 30% on CA relations on the intraverbal probe for stimulus set 1. Scores on both relations for stimulus sets 2 and 3 remained low (0%). Kelly completed three remedial training sessions for stimulus set 1 and improved her BA score to a 100% and CA score to a 90%. This met mastery criteria for stimulus set 1, therefore, Kelly moved onto the next randomly assigned stimulus set (set 2).

Kelly reached mastery criterion for stimulus set 2 after four EBI teaching sessions. She scored 90% on BA relations and 70% on CA relations on the intraverbal probe for stimulus set 2. Her scores for the previously taught stimulus set 1 remained above baseline levels at 70% for both relations. Kelly completed three remedial teaching sessions for stimulus set 2 and improved both her BA and CA relation scores to 90%. Scores for stimulus set 1 remained at mastery criteria at 80% for both relations and scores for stimulus set 3 were below baseline levels.

Kelly then completed ten EBI teaching sessions for stimulus set 3 to reach mastery criterion. Her scores on BA and CA relations for stimulus set 3 were 70%. She scored 80% on both relations for stimulus set 1 and scored 90% on BA relations and 100% on CA relations for stimulus set 2. Kelly completed three remedial training sessions for stimulus set 3 and both her BA and CA relation scores remained at 70%. This still did not meet mastery criteria for stimulus set 3, therefore, Kelly completed two additional remedial training sessions. Kelly maintained her BA score of 70% and CA score decreased to 60%. Kelly did not meet mastery criteria for the last

stimulus set before the study ended. However, BA and CA relations for previously taught stimulus set 1 remained above baseline levels for both relations (range, 70% -100%), and scores for stimulus set 2 remained above baseline levels (range, 60% - 100%) for both relations.

Figure 6. Graphical Display of Kelly's Probe, EBI, and Remedial Training Data



Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

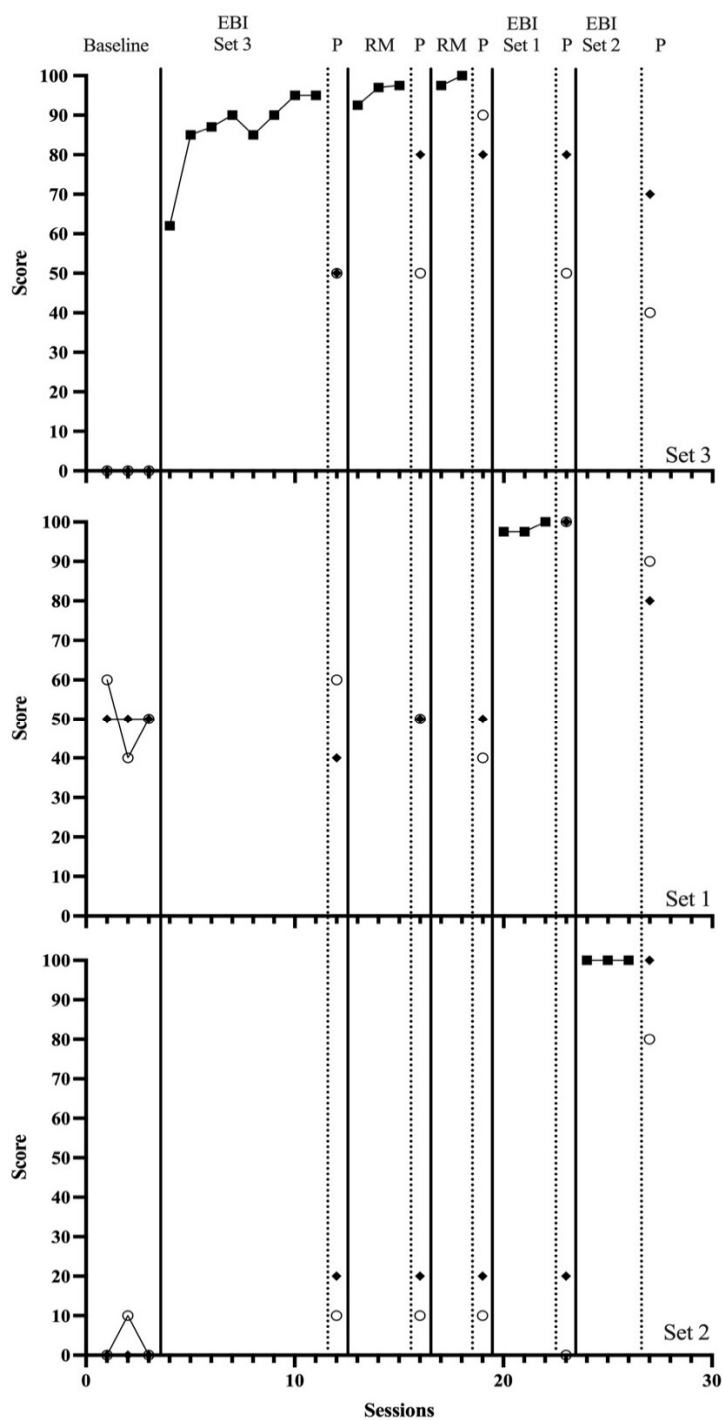
Rachael

Data for Rachael's intraverbal probes and EBI teaching sessions can be found in Figure 7. Scores on BA relations ranged from 0% to 50% across stimulus sets on the first three intraverbal probes in the baseline condition. The CA relations scores across stimulus sets ranged from 0% to 60% in the baseline condition. Rachael started the study with stimulus set 3 and it took Rachael eight EBI teaching sessions to reach mastery criterion. She then scored a 50% on both BA and CA relations on the intraverbal probe for stimulus set 3. Scores on both relations for stimulus sets 1 and 2 remained at baseline levels (range, 0% to 60%). Rachael completed three remedial training sessions for stimulus set 3 and improved her BA score to 80% and CA score to 50%. This still did not meet mastery criteria for stimulus set 3, therefore, Rachael completed two additional remedial training sessions. Rachael improved her BA score to 80% and CA score to 90% and moved onto the next randomly assigned stimulus set (set 1).

Next, Rachael reached mastery criterion for stimulus set 1 after three EBI teaching sessions. She scored 100% on BA and CA relations on the intraverbal probe following EBI teaching sessions for stimulus set 1. Her scores for the previously taught stimulus set 3 remained above baseline levels at 80% for BA relations but fell to 50% for CA relations.

Rachael then completed EBI teaching sessions for stimulus set 2 and met mastery criterion within 3 sessions. Her scores on BA and CA relations for stimulus set 2 were 100% for BA relations and 80% for CA relations. She scored 70% on BA relations and 40% on CA relations for stimulus set 3 and scored 80% on BA relations and 90% on CA relations for stimulus set 1.

Figure 7. Graphical Display of Rachael's Probe, EBI, and Remedial Training Data



Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

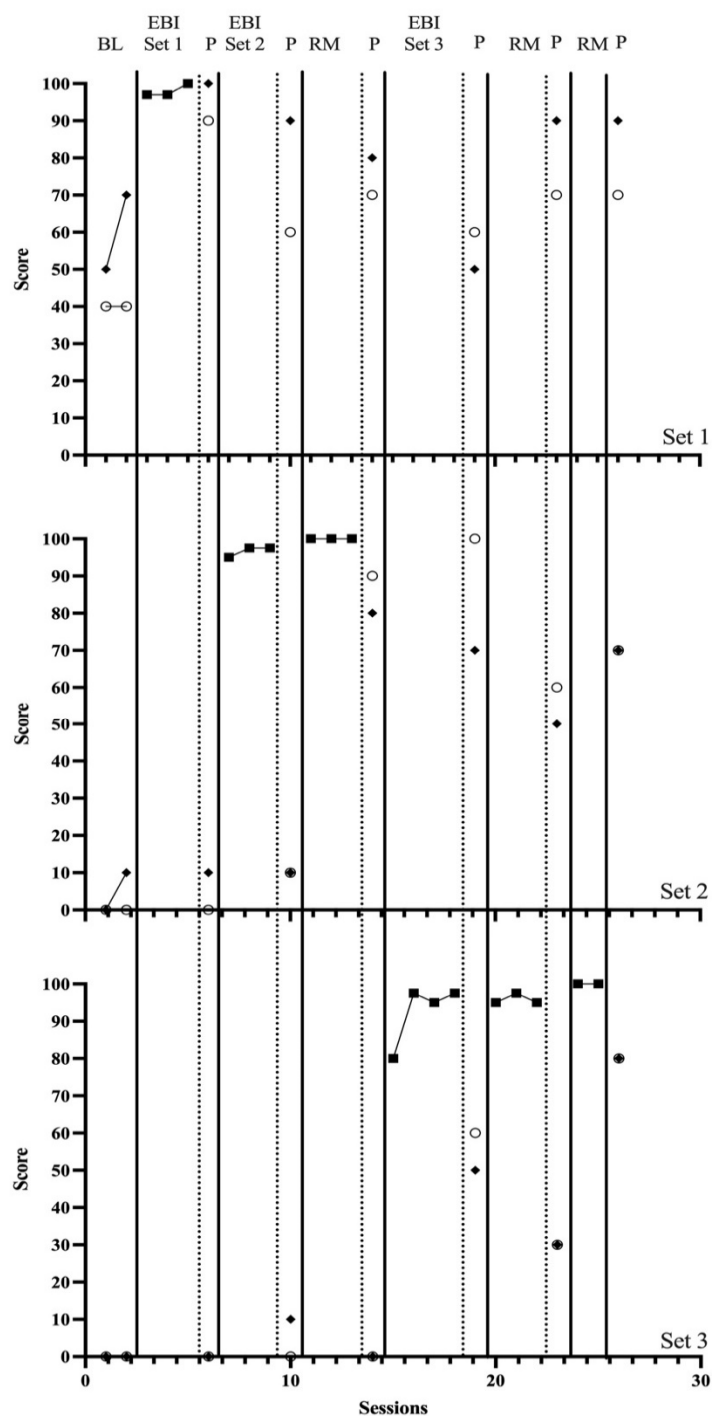
Julia

Data for Julia's intraverbal probes and EBI teaching sessions can be found in Figure 8. Scores on BA relations ranged from 0% to 70% across stimulus sets on the first two intraverbal probes in the baseline condition. The CA relations scores across stimulus sets ranged from 0% to 40% in the baseline condition. Julia started the study with stimulus set 1. It took Julia three EBI teaching sessions to reach mastery criteria for stimulus set 1. She then scored a 100% on BA relations and 90% on CA relations on the intraverbal probe for stimulus set 1. Scores on both relations for stimulus sets 2 and 3 remained at baseline levels (range, 0% to 10%).

Next, Julia completed EBI teaching sessions for stimulus set 2 and reached mastery criterion after three sessions. She scored 10% on BA relations and 10% on CA relations on the intraverbal probe for stimulus set 2. Her scores for the previously taught stimulus set 1 remained above baseline levels at 90% for BA relations and 60% for CA relations. However, a 10% for both BA and CA relations for stimulus set 2 did not meet mastery criteria. Julia then completed three EBI teaching sessions and improved her BA score on the intraverbal probes to 80% and CA score to 90%.

Julia then completed four EBI teaching sessions for stimulus set 3 to reach mastery criterion. Her scores on BA and CA relations for stimulus set 3 were 50% and 60%, respectively. She scored 50% on BA relations and 60% on CA relations for stimulus set 1 and scored 70% on BA relations and 100% on CA relations for stimulus set 2. Julia then completed three remedial training sessions, as she did not meet mastery criteria for stimulus set 3. Julia's scores decreased in both relations to 30% for stimulus set 3. This still did not meet mastery criteria for stimulus set 3, therefore, Julia completed two additional remedial training sessions. Julia improved her BA and CA scores to an 80% and moved on to the posttest.

Figure 8. Graphical Display of Julia's Probe, EBI, and Remedial Training Data



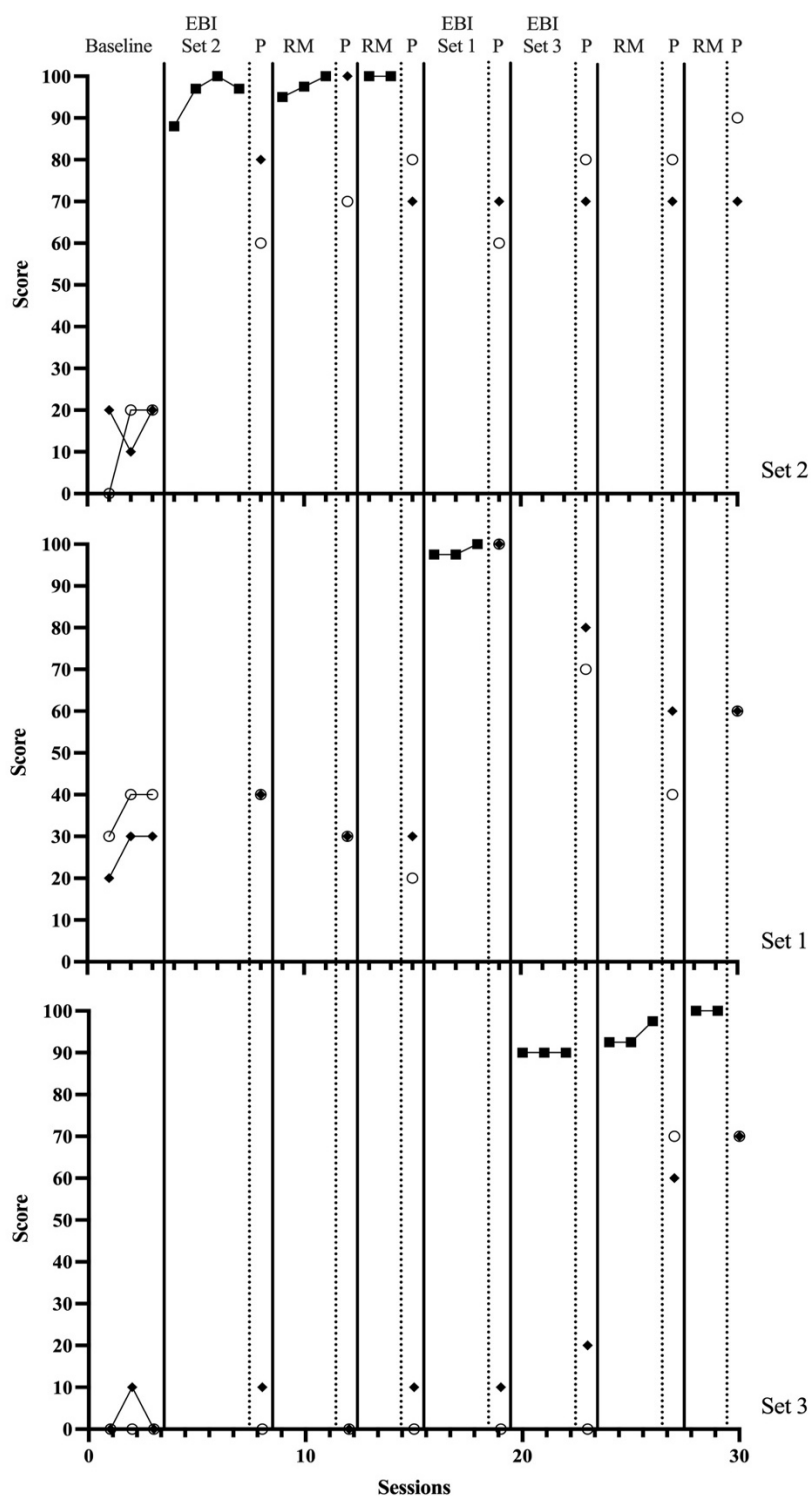
Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

Sarah

Data for Sarah's intraverbal probes and EBI teaching sessions can be found in Figure 9. Scores on BA relations ranged from 0% to 30% across stimulus sets on the first three intraverbal probes in the baseline condition. The CA relations scores across stimulus sets ranged from 0% to 40% in the baseline condition. Sarah started the study with stimulus set 2 and met mastery criterion within four EBI teaching sessions. She then scored an 80% on BA relations and 60% on CA relations on the intraverbal probe for stimulus set 2. Scores on both relations for stimulus sets 1 and 3 remained at baseline levels (range, 0% to 40%). Sarah completed three remedial training sessions for stimulus set 3 and improved her BA score to a 100% and CA score to a 70%. This still did not meet mastery criteria for stimulus set 2; therefore, Sarah completed two additional remedial training sessions. Sarah decreased her BA score to a 70% and increased CA score to an 80% and moved onto the next randomly assigned stimulus set (set 1).

Next, Sarah reached mastery criterion for stimulus set 1 after three EBI teaching sessions. She scored 100% on BA relations and 100% on CA relations on the intraverbal probe for stimulus set 1. Her scores for the previously taught stimulus set 2 remained above baseline levels at 70% for BA relations and 60% for CA relations. Sarah then completed three EBI teaching sessions for stimulus set 3 to reach mastery criterion. Her scores on BA and CA relations for stimulus set 3 were 20% and 0%, respectively. She scored 70% on BA relations and 80% on CA relations for stimulus set 2 and scored 80% on BA relations and 70% on CA relations for stimulus set 1. Sarah completed three remedial training sessions for stimulus set 3 and improved her BA score to 60% and CA score to 70%. This still did not meet mastery criteria for stimulus set 3, therefore, Sarah completed two additional remedial training sessions. Sarah improved her BA score to 70% and CA score to 70% and moved on to the posttest.

Figure 9. Graphical Display of Sarah's Probe, EBI, and Remedial Training Data



Note. Diamonds depict BA relations. Opened circles depict CA relations. Squares depict EBI teaching sessions. Solid lines depict a phase change. Dotted lines depict a probe phase.

Pretest to Posttest Improvement (All Relations)

On average, out of a total of 210 possible points participants scored 114.43 (SD= 36.66) on the pretest, and significantly increased their scores on the posttest to an average of 188.57 (13.75), $t(6) = -5.75, p < .001$. Andy scored a 37% on the pretest and improved his score to 85% on the posttest. Alice scored a 56% on the pretest and improved her score to a 78% on the posttest. Eliza scored a 75% on the pretest and improved her score to a 98% on the posttest. Kelly scored a 25% on the pretest and improved her score to a 91% on the posttest. Rachael scored a 63% on the pretest and improved her score to a 91% on the posttest. Julia scored a 61% on the pretest and improved her score to a 95% on the posttest. Sarah scored a 64% on the pretest and improved her score to a 91% on the posttest (see Table A8).

Examining scores for each set more closely, responding was slightly more variable. On average, for set 1 participants scored 46.29 (13.29) out of a possible 70 points on the pretest and significantly increased their scores to 65.14 (4.84) on the posttest, $t(6) = -3.91, p = .004$. For set 2, participants scored 42.39 (17.03) on the pretest and significantly increased their scores to 66.29 (4.03) on the posttest, $t(6) = -3.79, p = .005$. And for set 3, participants scored 25.86 (8.47) on the pretest and significantly increased their scores to 57.14 (8.01) on the posttest, $t(6) = -11.42, p < .001$). All participants' pretest and posttest data across the three stimulus sets can be found in Tables 9, 10, and 11.

Generalization to Cooper et al. (2020) Definitions

The majority of participants (6 out of 7) displayed generalization of the simplified definitions of the terms to the standard definitions in the Cooper et al. (2020) textbook across all stimulus sets. On average, for set 1 participants scored 47.14 (17.04) on the pretest and increased their scores to 70.00 (11.55) on the posttest, $t(6) = -3.55, p = .012$. For set 2, participants scored

60.00 (9.00) on the pretest and significantly increased their scores to 82.86 (20.59), $t(6) = -1.99$, $p = .047$. Last, for set 3 participants scored 30.00 (8.16) on the pretest and increased their scores to 71.43 (13.45), $t(6) = -6.97$, $p < .001$. See Table A12.

Discussion

EBI involves the principle of emergent relations in which some relations are taught and then the learner develops a new relational understanding without direct training (O'Neill & Rehfeldt, 2014). MTS is a common approach used to teach these emergent relations within EBI (Brodsky & Fienup, 2018). The present study assessed whether simplifying definitions of ABA terminology impacts results and maintenance of emergent responding within intraverbal probes and multiple-choice responding. There were four main findings from this study.

First, participants were able to learn the relations between the terms, definitions, and examples using EBI via MTS teaching. These results provide further evidence of the effectiveness of EBI in selection-based responding (AB and AC relations). Instructors of individuals working towards their BCBA® certification may consider using EBI teaching via MTS format when teaching ABA terminology, and examples. However, despite the success of EBI training, the present study also highlighted issues in the transfer to and maintenance of topography-based responding.

Second, despite acquisition of AB and AC relations during EBI, performance was variable when assessing BA and CA relations on post-training intraverbal probes. All participants required remedial training for at least one set in the study. Further, once participants met mastery criterion on intraverbal probes, not all participants-maintained criterion level performance throughout the study. These results are similar to those reported by Hemwell (2020), where EBI teaching was effective in producing emergent selection-based responding across AB and AC relations but responding did not transfer to written topography-based intraverbal responding (BA and CA relations), nor did it maintain over time. Still, although several participants were unable to reach mastery criterion for intraverbal probes, all participants

showed improvement from their baseline scores. Further research on EBI and its effects on topography-based responding is needed.

Despite text simplification, not all participants in the present study were able to reach mastery criterion and maintain intraverbal responding. Hemwell (2020) also found limited efficacy in EBI teaching via MTS promoting emergent topography-based responding. While previous studies have demonstrated emergent topography-based responding when teaching approximately 15 concepts or less (Albright et al. 2016; O'Neill & Rehfeldt, 2014; Sella et al., 2014; Walker et al., 2010), Hemwell (2020) hypothesized that the larger the number of terms in her study may have been too cumbersome for the participants to learn and maintain overtime. Future research may look into the acquisition and maintenance of emergent topography-based responding with ABA terminology with less material or material taught over a greater time.

Third, all participants demonstrated emergent symmetrical and transitive selection based responding across stimulus sets from pre-to-posttest (e.g., AD, AB, AC, BA, CA, CB, BC). The finding that untrained relations emerge following the training of some relations is similar to results of previous EBI studies evaluating EBI as an effective teaching method for untrained relations to emerge (Albright et al., 2016; Brodsky & Fienup, 2018; Greville et al., 2016). Interestingly, improvement differed by stimulus set. Although performance improved across all three stimulus sets from pretest to posttest, performance on stimulus set 3 was still close to chance responding at posttest. This difference in performance could have occurred due to external variables (e.g., previous experiences, previous training); on the other hand, variability may have occurred because of the terms and definitions within the given stimulus set. It is possible that the terms, definitions, and/or examples within stimulus set 3 were still more difficult to comprehend due to the complexity and difficulty of the concepts. For example, terms

in stimulus set 2, such as “response generalization” and “response maintenance” may not be as difficult concept compared to those in set 3 (e.g., XYZ).

Fourth, all participants improved performance on AD relations, matching the term to the Cooper et al. (2020) definitions, indicating generalization of the simplified definitions. Previous studies have shown that text difficulty impacts comprehension of material (Siddharthan, 2014). The findings from the current study indicate that after participants were taught simplified definitions of ABA terms, they were able to generalize these terms to more complex, untaught definitions from the Cooper et al. (2020) textbook. Further research can be conducted to further evaluate the implications of text simplification and EBI. For example, it would be beneficial for future instructors to know when text simplification is most appropriate for their students. In addition, future researchers may investigate the most effective and evidence-based approach to text simplification. Perhaps developing a task analysis for text simplification would be a beneficial tool for future instructors when teaching abstract concepts. Last, because participants were able to generalize these simplified definitions to more complex principals, instructors should consider how to simplify definitions when first teaching terms, such as removing complex jargon, to help students better understand and comprehend the overall principle.

Text Simplification

An important component of the current study was the inclusion of simplified definitions to teach ABA terminology. Results from the present study indicated that participants were able to generalize simplified definitions to more complex definitions from the Cooper et al. (2020) textbook. These findings highlight that the use of jargon or overly nuanced definitions may not always be necessary when first introducing ABA terms and concepts. However, despite simplifying the text, some terms were still more difficult than others for participants to learn.

Participants took more EBI teaching sessions to complete stimulus set 3 terms compared to stimulus sets 1 and 2. Future research should examine a more systematic way of simplifying terms to ensure difficulty is consistent across concepts and relations.

Future research may also examine how the simplification of ABA definitions translates to applied settings. Studies may examine how this training impacts performance on the BCBA® certification exam or how the simplification of definitions impacts the use of jargon by BCBAs in their everyday role. Finally, future research should examine under what circumstances it is appropriate to use text simplification. Understanding the implications of text simplifications and when it is most important would help future instructors effectively teach individuals preparing for the BCBA exam.

In addition, given the variable responding, lack of transfer to intraverbal responding, and lack of maintenance, text simplification may not have been enough. Future research may examine additional strategies that could be added to the EBI teaching to enhance the emergence of untrained relations. For example, future research could examine whether performance on intraverbal probes is further improved if participants are provided a tool/aid (e.g., word bank, cheat sheet) for assistance. Such an aid could help participants to remember the terms during topography-based responding, and the experimenter could systematically fade the use of the aid as the participants progress through the study. Another consideration for future replication is to incorporate a more systematic feedback system following intraverbal probes. Participants in the current study did not receive any feedback on their performance; it is possible that performance may have improved if they received feedback on which terms they scored incorrectly on, and why.

Limitations

It is important to note this study is not without limitations. First, midway through their participation in the study, some participants were assigned to read the Cooper et al. (2020) chapters that contained the terms being taught in this study for an ABA course. This occurred due to the study timeline extending further than anticipated because of the length of time it took some participants to complete a stimulus set. The introduction of this material may have impacted performance on some participants' EBI teaching sessions or posttest results. While participants had access to Cooper et al. (2020) material during the study, the use of Lockdown Browser ® limited the ability for participants to look up the terms during the intraverbal probes or posttest.

Second, only two baseline probes were obtained for Julia before she began EBI training on her first stimulus set. and moved Julia into the next study phase. Ideally, Julia would have completed a total of three baseline probes to establish a stable baseline, but she was moved to intervention before the third probe in error. Third, the current study was conducted during the COVID-19 pandemic. Some participants contracted the virus and were displaying mild symptoms of COVID-19 while completing the EBI teaching sessions, intraverbal probes, or posttest. It is possible their illness may have impacted performance.

Despite these limitations, the present study provides further evidence on the effectiveness EBI has on teaching ABA terminology, and examples in a selection-based format. In addition, this study provided further explanation on the effects of text simplification and how it can be paired with EBI training to develop untrained relations. It is a requirement from the BACB® for individuals pursuing their BCBA certification to have an effective and comprehensive understanding of ABA terminology, definitions, and examples. Upon receiving a BCBA

certification, it is also expected for the BCBA to effectively simplify ABA terminology when discussing programming with parents, clients, or students at the beginning stages of learning ABA. Understanding and comprehending ABA terminology is an important skill and can be difficult for first time students to understand and learn. The results of the current study indicate that the use of EBI and MTS, with the addition of text simplification, may lead to acquisition of the skill.

APPENDIX

APPENDIX

Tables

Table 1. List of Terms and Definitions for Stimulus Set 1 (Verbal Behavior)

Term (A)	Definition (B)
Echoic	When the learner repeats what the other person says.
Mand	When the learner asks for what they want.
Tact	When the learner labels objects, events, or actions in the environment.
Intraverbal	When a learner responds to a question or a fill in the blank statement.
Taking Dictation	When a learner writes down exactly what a speaker says
Textual	When a learner reads written words out loud.
Generative Learning	When a learner gains new skills due to previous learning.
Copying Text	When a learner rewrites written words.
Private Events	The learner's internal thoughts you don't see or hear.
Autoclitic	Verbal behavior about verbal behavior.

Table 2. List of Terms and Examples for Stimulus Set 1 (Verbal Behavior)

Term (A)	Example 1 (C)	Example 2 (C)	Example 3 (C)
	Intraverbal probe A	Intraverbal probe B	Pretest/Posttest
Echoic	Child says “cup” after mom says “cup.”	Client says “train” after hearing therapist say “train.”	You say “book” and your child says “book.”
Mand	Saying “cookie,” and someone gives you a cookie.	Saying “I want to watch TV” and someone turns on the TV.	Your client hands you a picture icon of an iPad and you give her the iPad.
Tact	Seeing an apple and saying, “There’s an apple.”	Telling someone you’re sad.	Pointing to cows on the side of the road and saying “cow.”
Intraverbal	Client says “bus” after hearing “The wheels on the...”	Friend asks you when your birthday is, and you respond “September 2 nd .”	You ask your client “what TV show do you like?” and they say, “PJ Masks.”
Taking Dictation	Writing down someone’s name after they tell you it.	Writing down the time of an appointment when told over the phone.	Typing a direct quote from your professor during class.
Textual	Seeing “C-A-T” and saying “cat.”	Seeing the number 5 and saying “Five.”	Seeing the written word “bowl” and saying “bowl.”
Generative Learning	Client asks for the ball after teaching her to label a ball.	Client labels a picture of a dog after teaching him to select a picture from a dog from an array of 3 stimuli.	Your child selects a picture of juice from an array after teaching her to request juice.
Copying Text	Writing down a restaurant’s address after finding it on the website.	Writing down key terms from the textbook you’re reading.	Writing down titles of books you want to read while looking at a list of recommendations.
Private Events	Thinking about what you want for dinner.	Having a headache.	Thinking about which movie you want to watch.
Autoclitic	“It might be snowing.”	“I think I’m going on vacation.”	“I know tomorrow is Tuesday.”

Table 3. List of Terms and Definitions for Stimulus Set 2 (Generalization and Maintenance)

Term (A)	Definition (B)
Response Generalization	When a learner knows how to do something because they learned how to do something similar.
Multiple Exemplar Training	Using a lot of examples in your teaching.
Indiscriminable Contingency	When the learner does not know if their behavior will result in reinforcement.
Teach Loosely	Changing things in the environment to help teach.
Response Maintenance	When the learner continues to perform the behavior after being taught.
Generalization probe	Assessing to see if the behavior occurs in an untaught situation.
Naturally Existing Contingency	When reinforcement or punishment occurs naturally.
Program Common Stimuli	Making the teaching setting similar to other settings, so the behavior occurs in more places.
Setting/Situation Generalization	When the behavior occurs in a context other than in the one that it was taught.
Instructional Setting	The environment where the behavior was originally taught to occur.

Table 4. List of Terms and Examples for Stimulus Set 2 (Generalization and Maintenance)

Term (A)	Example 1 (C)	Example 2 (C)	Example 3 (C)
	Intraverbal probe A	Intraverbal probe B	Pretest/Posttest
Response Generalization	Teaching someone to answer “cookies” when asked their favorite food, and they answer “crackers” the next time the question is asked	Teaching someone to wave to say bye and they also say “bye”	You teach your child to flip a light switch to turn it on. Without any teaching they press a button that also turns the light on
Multiple Exemplar Training	Saying “do this” “copy me” and “do the same” during imitation training	Showing a picture of an eagle, a pigeon and a hummingbird during tact training of the word “bird”	Running one step imitation with objects with a ball, a car, and a train
Indiscriminable Contingency	Providing tokens on a VR-3 schedule of reinforcement	Allowing a break from the table when client asks for a break on average every 5x they ask.	Giving a child access to an iPad on a VI-5 minute schedule of reinforcement
Teach Loosely	Setting up a child’s workplace in one area of the classroom during one session and moving to a new location in the classroom for the next session.	Teaching someone to form patterns with red, blue and green blocks during one session and purple, green and yellow beads during another session	Using different stimuli every time you teach a client to identify shades of green
Response Maintenance	You begin teaching a child to recite his phone number by showing a visual prompt of all of the numbers. Over time you fade the numbers shown until you do not show any numbers. You ask the child their phone number and they recite it without the visual prompt;	You teach a child to play Pop the Pig. A month after mastery/discontinuing teaching, you play pop the pig with the child and they independently perform all of the steps correctly.	You learned how to say hello in French (Bonjour) in high school. 5 years later you are still able to say “Bonjour” when someone asks you how to say hello in French

Table 4. (cont'd)

Generalization probe	Having a new therapist ask a client how old she is after being taught this skill by another therapist	Asking a client to tact a novel picture of her sister.	Having a client mand for information on the playground after teaching this skill in the classroom
Naturally Existing Contingency	A girl is leaning back in her chair and the chair falls resulting in injury.	Putting on a sweater when it's cold out makes you feel warm.	You feel an itch on your arm and scratch it and it goes away
Program Common Stimuli	Using a bar of soap instead of a bottle to teach client to wash their hands because you know the family uses bars of soap at home.	Teaching a student to read their name in print and cursive because you know future teachers will display their name using different fonts	Using a picture of the client's dog when teaching him to label a dog
Setting/Situation Generalization	A learner is taught to complete a photographic activity schedule in their classroom and independently completes one in the gym.	Teaching a client to brush their teeth at home, and then they independently brush their teeth when sleeping over at their grandparents' house.	You taught your child to ask for a fork for their dinner at home. Your child then independently asks for a fork when you are at a restaurant
Instructional Setting	The basement of a client's home where ABA therapy sessions are conducted.	The client's classroom where ABA therapy sessions are conducted	The treatment space at the clinic you work at

Table 5. List of Terms and Definitions for Stimulus Set 3 (Equivalence-Based Instruction)

Term (A)	Definition (B)
Symmetry	When the directions of matching relationship can be reversed (if $AB = BA$).
Reflexivity	Matching two identical things ($A = A$).
Transitivity	When the learner understands that item A equals item B and that an item equals item C, then without teaching, when shown item A the learner selects item C. $A = B$, $B = C$, then $A = C$.
Conditional Discrimination	A discrimination that depends on the stimulus context.
Simple Discrimination	When the learner responds differently in the presence of different things.
Higher-Order Operant Class	A group that includes within it other groups that can themselves be their own class.
Class-Specific Reinforcement	Where a learner is taught they must respond differently when shown different things, and will receive different reinforcement based on their response.
Class Expansion	Adding an additional item to a set of items to increase the number of items in a group.
Contextual Control	The function of a behavior can change based on the context or situation.
Training Structure	The process of procedural set-up used when teaching how things differ in different contexts.

Table 6. List of Terms and Examples for Stimulus Set 3 (Equivalence-Based Instruction)

Term (A)	Example 1 (C)	Example 2 (C)	Example 3 (C)
	Intraverbal probe A	Intraverbal probe B	Pretest/Posttest
Symmetry	A learner is taught that a picture of a dog is the same as a real dog and is able to understand without teaching that a real dog is the same as a picture of a dog	A learner is taught that the written word “phone” is the same as a picture of a phone and understands that a picture of a phone is the same as the written word “phone” in the absence of any reinforcement	A learner is taught that picture of a toothbrush is related to a picture of toothpaste and knows that a picture of toothpaste is related to a toothbrush without any direct teaching
Reflexivity	Matching a picture of a slide to another identical picture of a slide without any previous teaching or reinforcement	Matching the written word “ball” to another written word “ball” without any direct teaching	Matching a pencil to another identical pencil without any direct teaching or reinforcement
Transitivity	Teaching that the spoken word “tree” is the same as a picture of a tree. Teaching that a picture of a tree is the same as the written word tree. Client knows that the spoken word “tree” is the same as the written word tree without direct teaching.	Teaching that the spoken word “pen” is the same as a picture of a pen. Teaching that a picture of a pen is the same as the written word pen. Client knows that the spoken word “pen” is the same as the written word pen without direct teaching.	Teaching that a picture of a nickel is the same as a real nickel. Teaching that a real nickel is the same as the written words “5 cents”. Client knows that a picture of a nickel is the same as the written words “5 cents” without direct teaching.
Conditional Discrimination	Someone points to a picture of a cookie in an array of three different pictures when shown a 3-D toy cookie	Someone points to a blue card in an array of three different colored cards when they hear the word “blue”	A child places a picture of a car on top of another picture of a car in an array of 3 when told to “put with same”
Simple Discrimination	You put a single ball in front of your client and say “hand me the ball.” They hand you the ball	You clear a table and put a train in front of your client and say “point to the train.” They point to the train	Your friend tells you to ring the doorbell when you arrive at her house. There is only one button next to her door. You press the button to ring the doorbell.

Table 6. (cont'd)

Higher-Order Operant Class	Generalized imitation	Generalized manding	Generalized instruction-following
Class-Specific Reinforcement	When selecting a picture when given the written word, you receive a veggie straw, and when selecting the written word when given the spoken word you receive a high five.	When selecting a picture when given the spoken word, you receive a skittle, and when selecting the written word when given the picture you receive social praise.	When selecting a picture when given the spoken word, you receive a toy car, and when selecting the picture when given the written word, you receive a chip.
Class Expansion	Teaching that the spoken word “candle” is the same as the written word and a picture of a candle, then introducing an actual candle and teaching that it is the same as the picture, the spoken word and the written word.	Teaching that the written word “lamp” is the same as the spoken word and an actual lamp, then introducing a picture of a lamp and teaching that it is the same as the actual item, the spoken word and the written word	Teaching that a picture of a hairbrush is the same as the written word “hairbrush” and an actual hairbrush, then introducing the spoken word “hairbrush” and teaching that it is the same as the actual item, the picture and the written word
Contextual Control	Matching an apple to the word “fruit” when presented with “fruit,” “vegetable” and “grain,” but matching an apple to the word “food” when presented with “food,” “toy,” and “appliance.”	Matching a red car to a picture of a vehicle when presented with vehicles, animals and furniture, but matching a red car to other red items when presented with red, blue and green items	Matching a hat to the word “clothing” when presenting with “clothing,” “silverware,” and “electronics,” but matching a hat to a picture of snow when presented with pictures of snow, sun and rain
Training Structure	One-to-many	Linear Series	Many-to-one

Table 7. Results of Social Validity Survey by Participant

Question	Participant						
	Andy	Alice	Eliza	Kelly	Rachael	Julia	Sarah
The information I learned is relevant to my schoolwork.	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
The information I learned is relevant to my fieldwork.	Strongly Agree	Strongly Agree	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
I feel more confident in my understanding of the terms following participation in the study.	Strongly Agree	Strongly Agree	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Disagree
Participation in this study was too time consuming.	Disagree	Strongly Agree	Disagree	Disagree	Agree	Agree	Neutral
The EBI teaching sessions (i.e., Google Slide trainings) were easy to navigate.	Agree	Agree	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Agree
I had a strong understanding of these terms before participating in the study.	Strongly Disagree	Disagree	Neutral	Strongly Disagree	Strongly Disagree	Disagree	Strongly Disagree
The probes were easy to navigate.	Neutral	Agree	Strongly Agree	Agree	Agree	Strongly Agree	Strongly Agree

Table 8. Pretest and Posttest Data Final Scores, All Stimulus Sets

Participant	Pretest		Posttest	
	Score	Percent	Score	Percent
Andy	68/210	33%	178/210	85%
Alice	117/210	55%	164/210	78%
Eliza	157/210	75%	205/210	98%
Kelly	52/210	25%	191/210	91%
Rachael	133/210	63%	191/210	91%
Julia	128/210	61%	200/210	95%
Sarah	140/210	66%	191/210	91%

Table 9. Pretest and Posttest Data by AD Relation (Percent Correct)

Participant	Set 1		Set 2		Set 3	
	Pre	Post	Pre	Post	Pre	Post
Andy	70	60	60	90	30	70
Alice	30	60	70	40	40	60
Eliza	60	90	90	100	40	90
Kelly	30	70	20	90	30	70
Rachael	50	80	80	100	30	60
Julia	60	70	40	80	20	90
Sarah	30	60	60	80	20	60

Table 10. Pretest and Posttest Data by Relation for Stimulus Set 1 (Percent Correct)

	Andy		Alice		Eliza		Kelly		Rachael		Julia		Sarah	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
AD	70	60	30	60	60	90	30	70	50	80	60	70	30	60
AB	100	100	70	90	100	100	30	100	90	100	100	100	80	100
BA	70	100	70	100	90	100	50	100	80	100	50	100	90	100
AC	50	100	80	80	60	80	20	100	70	100	80	100	60	100
CA	30	90	50	80	80	100	10	90	100	100	70	100	80	100
BC	40	100	60	90	90	100	20	100	100	100	80	100	100	100
CB	50	90	70	80	90	100	40	100	90	100	80	100	100	100

Table 11. Pretest and Posttest Data by Relation for Stimulus Set 2 (Percent Correct)

	Andy		Alice		Eliza		Kelly		Rachael		Julia		Sarah	
Relation	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
AD	60	90	70	40	90	100	20	90	80	100	40	80	60	80
AB	20	100	80	100	100	100	20	100	90	100	90	90	90	90
BA	40	100	90	100	90	100	20	100	70	100	80	100	60	100
AC	20	80	50	100	90	100	40	90	70	100	40	100	60	100
CA	10	90	60	80	70	100	30	90	70	100	90	100	70	100
BC	10	100	50	80	90	100	20	90	80	100	70	100	80	100
CB	50	100	90	80	90	100	10	100	60	100	60	100	70	100

Table 12. Pretest and Posttest Data by Relation for Stimulus Set 3 (Percent Correct)

	Andy		Alice		Eliza		Kelly		Rachael		Julia		Sarah	
Relation	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
AD	30	70	40	60	40	90	30	70	30	60	20	90	20	60
AB	20	80	20	100	80	100	10	80	30	100	50	100	90	90
BA	10	90	30	80	50	100	30	90	40	80	40	100	50	80
AC	20	60	30	60	60	100	10	90	20	80	50	100	50	100
CA	20	60	50	70	40	100	40	90	50	70	50	100	40	90
BC	40	60	60	50	70	100	20	90	30	70	50	100	50	80
CB	20	60	30	60	50	90	20	80	30	70	20	70	40	80

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