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# Comparing two procedures to teach conditional discriminations

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## Comparing Two Procedures to Teach Conditional Discriminations: Simple Discriminations With and Without S- Stimuli Present

#### A Thesis Presented

by

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The Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements for the degree of

**Master of Science** 

In the field of

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### **Comparing Two Procedures to Teach Conditional Discriminations: Simple**

#### **Discriminations With and Without S- Stimuli Present**

by

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Submitted in partial fulfillment of the requirements for the degree of Master of Science in Applied Behavior Analysis in the Bouvé College of Health Sciences Graduate School of Northeastern University, April 2011

#### Abstract

The present study systematically replicated Gutierrez et al. (2009) in which two methods of teaching a conditional auditory-visual discrimination were examined. Gutierrez evaluated relations taught either with or without an S- stimulus present during teaching. After teaching, a test of conditional discrimination was performed with all the taught relations. The authors found that sessions to mastery of the conditional discrimination were slightly higher for relations taught with S- stimuli. Although Gutierrez et al. used auditory-visual relations and only two stimuli as comparison stimuli, the author of the present study taught visual-visual relations (state names to state pictures) and three comparison stimuli. In this study, participants reached the mastery criterion for simple discrimination task, participants emitted more correct responses when presented with the relations that had been taught in the presence of S- stimuli.

# Comparing Two Procedures to Teach Conditional Discriminations: Simple Discriminations With and Without S- Stimuli Present

It is widely held that those with developmental disabilities benefit from methods of teaching different from the typical one teacher to an entire classroom model. Those different methods can include such techniques as discrete trial or task analyses. If academic, vocational, social, or self-help skills are to be acquired, then such techniques may be necessary (Green, 2001). Baer, Wolf, and Risley (1968) outlined principles of applied behavior analysis (ABA). These principles individualized education programs to ensure learners would acquire skills deemed most important for them; this included the use of positive reinforcement to develop appropriate skills, and the gradual change from simple to more complex skills. Comprehension and skills requiring conditional discriminations are often developed in a match-to-sample format using massed trials (the presentation of multiple, consecutive trials). Match-to-sample procedures (MTS) typically involve the presentation of a sample stimulus and comparison stimuli. Individuals learn to select a specific comparison stimulus in the presence of the corresponding sample stimulus.

Simple discrimination involves one response coming under the discriminative control of one stimulus. The response is reinforced in the presence of the discriminative stimulus and the function of the stimulus does not change conditional on the presence of other stimuli. Ahearn, MacDonald, Graff, and Dube (2007) provide an example of simple discrimination using a "form versus no form" task. A form is presented with no others in varying positions on a page. Touching the form is reinforced and touching anywhere else is not. The function of the form is not dependent on conditional stimuli.

Conditional discrimination involves responding to different discriminative stimuli given an initial conditional stimulus. Reinforcement is provided when one responds in the presence of

these two stimuli and reinforcement is withheld for responding in the absence of either or both. The most important aspect of a conditional discrimination is the change of function (S+ or S-) of discriminative stimuli conditional on the presence of other stimuli. An S+ is a discriminative stimulus in which the presentation of the S+ signals reinforcement is available. An S- is a discriminative stimulus in whose presence reinforcement does not follow the response; the presentation of an S- signals reinforcement is unavailable. An example of a skill taught in this way is reading comprehension. For example, upon providing the conditional auditory stimulus, "cat" and presenting comparison stimuli (i.e. pictures of a cat, dog, and elephant), reinforcement would be provided only for selecting the cat picture and not selecting the other pictures. The function of the comparison stimuli change depending on the conditional, ancillary stimuli; selecting the picture of the cat is correlated with reinforcement if and only if the auditory conditional stimulus "cat" was presented.

Sidman (1971) used MTS procedures to teach conditional discriminations (read printed words and match printed words to pictures) to teach a teenage boy with mental retardation. Spoken words served as sample stimuli and printed words served as comparison stimuli. Selection of the printed word related to the sample stimulus was followed by reinforcement. Once the relations among auditory and visual stimuli were established, the individual demonstrated relations among printed words and pictures, indicating reading comprehension: his responses were under the control of the words and pictures.

In teaching simple or conditional discriminations, one may use a trial-and-error procedure; however, error histories are not desirable and are often the outcome of trial-and-error procedures. According to Gollin and Savoy (1968), a technology that generates errors is likely to be less effective for teaching. Therefore, procedures have been developed to establish learning with the fewest errors possible. Terrace's (1963) study assessed the introduction of S- stimuli at varying times in discrimination training. Terrace suggested that introducing S- stimuli was effective in decreasing the number of errors.

Gollin and Savoy (1968) taught participants a discrimination whereby the image correlated with reinforcement (S+) was shown at full intensity and the image correlated with extinction, or no reinforcement (S-), was systematically faded in. Additional participants were taught the same discrimination using trial-and-error procedures. Following this, a test of conditional discrimination was performed for both groups. Participants who were taught the discrimination using fading procedures made fewer errors during teaching; however, those taught with trial-anderror procedures made fewer errors during the conditional discrimination task. The results of this study replicated previous findings in that individuals trained using errorless procedures responded fewer times to the S-. By fading in the S-, participants begin responding to the S+ initially because there is no other stimulus to respond to; however, in their discussion, Gollin and Savoy posit that the fading in of an S- may not provide the learner with enough comparative experience among stimuli to respond correctly in tests of conditional discriminations.

Discriminations among stimuli may also be established and trained by manipulating the physical configuration of stimuli, otherwise known as stimulus shaping. Schilmoeller, Schilmoeller, Etzel, and LeBlanc (1979) replicated and extended Gollin and Savoy's (1968) research. The authors added a group of individuals who were taught relations with stimulus shaping in addition to the trial and error and fading stimuli groups. Participants trained with either stimulus shaping or fading procedures performed almost errorlessly during training.

Both Gollin and Savoy (1968) and Schilmoeller et al. (1979) examined the progression from simple discrimination to conditional discrimination. Tests of conditional discrimination in the

Gollin and Savoy study demonstrated that individuals taught with a trial-and-error format performed with fewer errors, and Schilmoeller et al. showed that stimulus shaping was superior to stimulus fading in teaching the initial, simple discriminations.

Graff and Green (2004) examined two ways to teach a simple discrimination. One condition used a point as a prompt, and the prompt was systematically faded over time. The other condition involved a stimulus shaping procedure. Results of this study indicated that when teaching simple visual discriminations, a prompt procedure in which the onset of the prompt is delayed over subsequent trials resulted in accurate responding that remained at levels similar to baseline. The stimulus shaping technique resulted in near 100% accuracy.

In teaching a simple discrimination, S- stimuli may be present. Their selection, though, is not followed by reinforcement. An additional way to teach a simple discrimination is in isolation. This is the repeated presentation of the S+ without S- stimuli present. Green (2001) describes this method of teaching as common and capable of creating unwanted stimulus control as all the learner is required to do is touch what is presented. Discrimination among different sample *or* comparison stimuli is not required. After individuals respond accurately when only a sample and a single comparison are presented together, all sample and comparison stimuli are utilized in tests for conditional discrimination where the sample changes upon each presentation.

Comparisons of teaching simple discriminations before conditional and teaching conditional discriminations from the beginning are warranted given that both methods are utilized in the applied setting. Cuvo et al. (1980) compared three strategies for teaching object names. The authors compared the successive (teaching one relation at a time) and the simultaneous (teaching relations in the presence of other stimuli) instruction methods in this study, yet added a condition in which relations were first trained successively, and then trained simultaneously to observe if

the advantages of each method were apparent. The learning criterion of 15 independent and correct trials was met most rapidly when relations were taught one at a time (successive), followed by the combined condition, then the simultaneous condition. This study compared two methods for teaching and the experimenters found advantages and disadvantages to both. Meeting the learning criterion more rapidly when taught relations one at a time could be attributed to no distracter objects, massed trials, minimization of interference from other objects, and the repeated presentation of a stimulus. Disadvantages are also mentioned, however, for teaching in isolation and include a lack of comparison among stimuli and extinction effects produced when teaching switches from mass trials of one stimulus to another stimulus.

Gutierrez et al. (2009) also compared two methods for teaching conditional discrimination skills by starting with simple discriminations. Three participants, all of whom were 4 years old or younger, were taught auditory-visual discriminations. This means a spoken word served as the sample stimulus and was followed by the presentation of visual comparisons. In the first method, "simple to conditional discrimination," the target picture card was presented as the only comparison stimulus following the spoken sample stimulus. No S- stimuli were presented. Once the participants reached the mastery criterion for that discrimination (80% or more correct for two consecutive sessions) a second card was introduced as an S- or distracter card. The auditory stimulus remained the same as did the S+; therefore this second part of the simple to conditional method cannot truly be described as a conditional discrimination because the function of the stimuli were unchanged.

In the second method, "conditional only," a new target picture card was presented along with an S- on the initial trial and all subsequent trials. This differs from the above method in that the target picture card is never presented alone, but always with an S-. Note that the function of the S+ is still unchanging, making this, again, not a true conditional discrimination.

Last, cards that served as S+ stimuli in the simple to conditional method, and were never presented as S- stimuli before, were presented as incorrect comparison stimuli. This was the experimenters' test for conditional discrimination. For example, if a circle and a kite were both used as S+ stimuli separately in the simple to conditional discrimination, they would now serve as an S- stimulus for each other. This is a true conditional discrimination because stimuli that served one function now serve another, and that function is dependent on the presentation of the conditional stimulus (the auditory stimulus). Stimuli that were used in the conditional only procedure also now served as S- stimuli for each other in this final phase of the study. Again, only those that were S+ stimuli were presented together, with the role of the S- switching between the two.

More sessions were required to reach learning criteria when no S- stimuli were presented (simple to conditional phase). With regard to the final phase (the true conditional discrimination), the number of sessions to mastery of the conditional discrimination (80% or more correct for two consecutive sessions) were varied with respect to the two methods, but were slightly higher for the stimuli taught using the distracter stimuli for 2 of the 3 participants.

The authors noted that the inclusion of a condition with no S- stimuli may be wasteful and consist of unnecessary practice trials. Though Terrace (1963) demonstrated that the early introduction of S- stimuli enhanced discriminations, Gutierrez et al. (2009) indicates that may not be the case. A clear difference in rates of acquisition between teaching methods was not observed for 1 of the 3 participants who performed similarly on the conditional discrimination task for relations taught using both procedures.

The present study sought to evaluate participants' performances on conditional discrimination tasks when teaching starting with simple discriminations with and without S-stimuli present. This research replicated and extended the Gutierrez et al. experiment by examining visual-visual relations. This means that a visual stimulus served as the sample and was followed by visual comparisons. Also, the present study utilized three comparison stimuli rather than two.

#### Method

#### **Participants**

Two children diagnosed with an Autism Spectrum Disorders (ASD), who attended a preschool for children with ASD, participated in the current study. Leo was a 6-year-old boy and Charlie was a 5-year-old boy. Both communicated vocally with multiple word sentences and had been previously exposed to match-to-sample procedures.

#### **Materials and Setting**

Sessions were conducted in a small room equipped with a table and chairs. The experimenter and participant sat across from each other. A white foam board (hereafter referred to as a discrimination board) approximately 58 cm long and 15 cm wide was used to display sample and comparison stimuli. Other materials included participant-specific reinforcers and data sheets.

#### **Design and Procedure**

The experimental design for the current study was a within-subject alternating treatments design. The conditions alternated randomly between teaching without S- stimuli and with S- stimuli. The participant would experience one or two sessions of a condition, and the next time he was with the experimenter he would experience one or two sessions of the other condition. No more than two sessions of the same condition were conducted at a time. Each participant was

taught 12 visual-visual conditional discriminations using two different teaching methods that were implemented simultaneously. As a participant was learning relations without S- stimuli present, he was also learning different relations with S- stimuli present. Once he had three relations using one procedure, a conditional discrimination task was presented. Arbitrary stimuli were used to teach visual-visual discriminations (Tables 1 and 2). All stimulus-stimulus relations were tested in a pre-teaching assessment before the participant experienced any conditions. This assessment was performed under extinction in the aforementioned conditional discrimination format to ensure that the participants did not accurately or consistently relate stimuli to each other prior to teaching. If participants related stimuli to each other consistently in fewer than 40% of opportunities during the pre-teaching assessment, those stimuli were included in the study. During teaching, manual guidance was used to prompt correct responding after 2 s had elapsed with no response. All correct responses were followed by a preferred stimulus on a fixed ratio 1 (FR 1) schedule. Edibles shown as moderately to highly preferred on recent preference assessments were used as preferred stimuli. Each session consisted of nine trials and the relation among a set of stimuli was considered mastered when the participant responded correctly and independently in 89% or more of trials for two consecutive sessions.

Interobserver agreement and procedural integrity. All sessions were video-taped. A second observer independently collected interobserver agreement (IOA) and procedural integrity (PI) data from 33% of recorded sessions. IOA was calculated by subtracting the number of disagreements from the number of agreements, dividing that number by the total number of trials, and multiplying by 100. Average IOA for relations taught in the absence of S- stimuli was 97% (94%-100%). Average IOA for relations taught in the presence of S- stimuli was 97% (95%-100%). Data were recorded for PI for 33% of sessions. The same second observer

collected data on the delivery of the preferred stimulus, correct stimuli location, correct designated S+, and correct prompting procedure. Average PI for relations taught in the absence of S- stimuli was 99.5% (99%-100%). PI for relations taught in the presence of S- stimuli was 99%.

**Pre-teaching assessment.** Before teaching began, an assessment was conducted to ensure the participants did not relate the stimuli to each other consistently prior to teaching. The preteaching assessment included the presentation of one of three state names (e.g. Louisiana, Alabama, West Virginia printed in 20 point Times New Roman font) on the discrimination board. Following the presentation of the sample stimulus was the presentation of three comparison pictures (e.g. geographical representations of Louisiana, Alabama, and West Virginia printed in black ink). To begin teaching using one of the procedures, the participants had to relate stimuli correctly in 40% or fewer of opportunities. The pre-teaching assessment was conducted without any differential reinforcement. This procedure was conducted with each set of three relations prior to teaching.

**Teaching simple discrimination with no S- stimuli.** Teaching began with the presentation of a sample stimulus in the experimenter's hand approximately 30 cm to 60 cm away from the participant's face. An observing response of either touching or reading the sample was required and touching was manually guided if 2 s had elapsed without either response. The experimenter then presented the comparison stimulus on the discrimination board with the sample stimulus affixed to the top of the board. The stimulus was the same for each session. After each trial, the position of the comparison stimulus was altered. Correct independent responses were defined as the participant pointing independently to the correct comparison stimulus and correct prompted responses were defined as the experimenter physically guiding the participant to point to the

correct stimulus. Incorrect responses were defined as the participant pointing to any stimulus other than the one designated by the experimenter as correct. Once the mastery criterion (89% correct, independent for two consecutive sessions) was met for the first relation (A1 to B1), two additional relations were taught (A2 to B2 and A3 to B3) using the same procedure; again, during the teaching of each relation, the sample stimulus remained the same for each session. The purpose of this phase was to determine the number of trials required to teach a simple discrimination when no S- stimuli were present.

**Teaching simple discrimination with S- stimuli**. During this phase, the visual-visual relations were taught with S- stimuli present from the beginning. S- stimuli were arbitrary forms (Table 1) which never functioned as S+ stimuli. The purpose of this phase was to determine the number of trials required to teach a simple discrimination when the S- stimuli were present from the beginning of teaching. Teaching began with the presentation of a sample stimulus (A4) in the experimenter's hand approximately 30 cm to 60 cm from the participant's face. This was followed by the presentation of three comparison stimuli on the discrimination board: the one designated as correct by the experimenter (B4 in this case) alongside with two of the aforementioned forms as S- stimuli. The sample stimulus was affixed to the top of the discrimination board. The definitions of a correct independent response and of a correct prompted response were the same as in previous conditions. After each trial, the positions of the comparison stimuli were altered to ensure that the comparison stimuli appeared the same number of times in each position. Teaching continued until the mastery criterion was reached (correct responding for 89% or more for two consecutive sessions). Once the mastery criterion was met, the second (A5 to B5) and third (A6 to B6) relations were trained. Similar to the simple

discrimination without S- stimuli procedure, the sample stimulus remained the same for each session.

**Teaching conditional discriminations.** The purpose of this phase was to determine the number of trials required to teach a conditional discrimination after each of the two methods for teaching a simple discrimination had been used. The stimuli used in this phase were the same as the ones used in aforementioned phases. During both previous conditions, the function of the comparison stimuli never changed. In the current phase the response depended on the conditional stimulus (the printed state name). Now, the participant could not just touch the single form to receive reinforcement, but must choose the form designated correct. This was dependent on the conditional stimulus presented each trial. The current phase involved the changing of stimuli's functions, making the discriminations conditional.

For the relations A1 to B1, A2 to B2, and A3 to B3 (trained with no S- stimuli), B1, B2, and B3 now served as comparison stimuli for each other. The experimenter held up a sample stimulus (A1, A2, or A3) in pre-determined order, and the participant was expected to touch or read the sample stimulus followed by a touch to the correct comparison stimulus (B1, B2, or B3) presented on the discrimination board. The sample stimulus was affixed to the top of the discrimination board. The definitions of a correct independent response and of a correct prompted response were the same as in previous conditions. After each trial, the positions of the comparison stimuli were altered to ensure that comparison stimuli positions changed and that stimuli were presented the same number of times in each position. Sessions continued until the participant responded independently and correctly in 89% of trials for two consecutive sessions.

#### **Replication of previous conditions.**

Once all relations had been taught either using a without S- stimuli or with S- stimuli procedure, six additional relations were taught identically for a within subject replication. Again, three relations were taught using S- stimuli and three relations were taught without S- stimuli in an alternating treatments design. Following each of the procedures, the relations were presented as a conditional discrimination identical to those previously described. The participant was again required to reach the mastery criterion.

#### Results

Figure 1 shows accuracy measures for Leo for each session in the without S- stimuli condition. Leo did not respond consistently to any of the relations presented in the pre-teaching assessment. For the stimuli taught without S- stimuli (A1 to B1, A2 to B2, and A3 to B3), Leo responded correctly in 33% of trials in the pre-teaching assessment. In subsequent teaching sessions, all three relations were acquired in two sessions each. Leo responded correctly and independently in 100% of all opportunities. During the conditional discrimination task, Leo required four sessions the reach the mastery criterion. He responded independently and correctly in 55.56%, 77.78%, 100%, and 89% of opportunities, respectively. For the second set of stimuli taught without S- stimuli (A7 to B7, A8 to B8, and A9 to B9), Leo responded correctly in 22% of trials in the pre-teaching assessment. In subsequent teaching sessions, all three relations were acquired in two sessions each, identical to the first set of stimuli. Leo responded independently and correctly in 100% of all opportunities. During conditional discrimination, Leo responded independently and correctly in 100% of all opportunities.

Figure 2 shows accuracy measures for Leo for each session in the with S- stimuli condition. For relations taught with S- stimuli (A4 to B4, A5 to B5, and A6 to B6), Leo responded correctly in 33% of trials in the pre-teaching assessment. In subsequent teaching sessions, relations were acquired in two, two, and three sessions respectively. Leo responded independently and correctly in 100% and 100% of teaching opportunities for A4 to B4, in 89% and 100% of teaching opportunities for A5 to B5, and in 77%, 100%, and 100% of teaching opportunities for A6 to B6. During conditional discrimination, Leo responded independently and correctly in 100% and 100% of opportunities for two consecutive sessions. For the second set of stimuli taught with S- stimuli (A10 to B10, A11 to B11, and A12 to B12), Leo responded correctly in 33% of trials in the pre-teaching assessment. In subsequent teaching sessions, Leo responded independently and correctly in 100% of all opportunities for two consecutive sessions per relation. During conditional discrimination, Leo responded independently and correctly in 100% of all opportunities for two consecutive sessions per relation. During conditional discrimination, Leo responded independently and correctly in 100% and 100% of opportunities for two consecutive sessions. It is important to note that no responses from Leo were prompted. He consistently responded independently within 2 s.

Figures 3 shows accuracy measures for Charlie for each session in the without S- stimuli condition. Charlie responded correctly in 44% of trials in the pre-teaching assessment. In subsequent teaching sessions, Charlie responded independently and correctly in 100% and 100% of teaching opportunities for two consecutive sessions for relations A1 to B1 and A2 to B2. Charlie required four sessions to acquire the relation A3 to B3 and responded independently and correctly in 100%, 67%, 100%, and 89% of teaching opportunities. Multiple responses during teaching of A3 to B3 were prompted. Similarly, four sessions were required to meet the mastery criterion during the conditional discrimination task. Charlie responded independently and correctly in 44%, 77%, 89%, and 100% of teaching opportunities. For the second set of stimuli taught without S- stimuli (A7 to B7, A8 to B8, and A9 to B9), Charlie responded correctly in 11% of trials in the pre-teaching assessment. In subsequent teaching sessions, Charlie acquired

relations A7 to B7, A8 to B8, and A9 to B9 in two sessions each, responding independently and correctly in 100% of opportunities. During conditional discrimination, he responded independently and correctly in 100% and 89% of teaching opportunities for two consecutive sessions.

Figure 4 shows accuracy measures for Charlie for each session in the with S- stimuli condition. Charlie responded correctly in 22% of trials in the pre-teaching assessment. In subsequent teaching sessions, Charlie responded independently and correctly in 44%, 100%, and 100% of teaching opportunities for three consecutive sessions for relation A4 to B4. Charlie responded independently and correctly in 100% and 100% of opportunities for two consecutive sessions for relation A5 to B5. In teaching opportunities for A6 to B6, Charlie responded independently and correctly in 89% and 89% of opportunities for two consecutive sessions. During conditional discrimination, Charlie required three consecutive sessions to reach mastery, responding independently and correctly in 66%, 88%, and 100% of opportunities. A second set of relations were taught with S- stimuli. Charlie responded correctly in 44% of trials in the preteaching assessment. In subsequent teaching sessions, Charlie responded independently and correctly in 100% of opportunities for two consecutive sessions for both relations A10 to B10 and A11 to B11. For relation A12 to B12, Charlie responded independently and correctly in 89% and 100% of opportunities for two consecutive sessions. During conditional discrimination, Charlie responded independently and correctly for 89% and 89% of opportunities for two consecutive sessions.

#### Discussion

It is unclear if teaching relations in the presence of S- stimuli facilitates acquisition of conditional discriminations. Participants sessions to mastery of conditional discriminations were

fewer for relations taught with S- stimuli present; however, sessions to mastery of individual relations were fewer when no S- stimuli were present. The unclear difference in teaching methods is consistent with the findings of Gutierrez et al. (2009).

Fewer sessions to mastery for relations taught without S- stimuli could be attributed to resemblance of this procedure to the "form versus no form" task examined by Ahearn, MacDonald, Graff, and Dube (2007). Touching the form was followed by a preferred stimulus whereas touching no form was followed by the presentation of the next trial. This is also similar to Green's (2001) discussion of creating unwanted stimulus control reinforcing touching a stimulus without attending to it. When the comparison stimulus was presented to participants for the relations taught without S- stimuli, no other stimuli were presented. Leo and Charlie touched the form; however, this did not mean they were attending to the conditional stimulus, as this was the only comparison for them to select. When presented with the conditional discrimination task, this was the participants' first experience in the study seeing any of the stimuli alongside other stimuli in the comparison array. In addition, the same comparison stimulus was not always correct. Participants were now required to attend to the conditional stimulus. The low percentage of independent and correct responses could be attributed to participants never having seen stimuli alongside each other in the comparison array.

When the without S- stimuli condition was replicated with additional relations, the sessions to mastery of the conditional discrimination were fewer than in the original without S- stimuli condition. By this time in the experiment, the participants could have been familiar with the condition and were expecting a conditional discrimination task.

Relations taught with S- stimuli present required participants to select from three comparison stimuli. Reinforcement was not guaranteed to follow touching any form, only the correct form.

This was the first experience in the study learning a single relation with S- stimuli present from the beginning. Now the correct comparison stimulus was presented alongside two S- stimuli, and the participant needed to touch the correct form to receive the preferred stimulus. During the conditional discrimination task, participants now had experience in the study choosing from an array of three comparison stimuli. As indicated above, Gollin and Savoy (1968) suggested that introducing an S+ alongside an S- later may not give an individual enough comparative experience. By the time the experimenter presented the conditional discrimination, participants had experience selecting one comparison from an array of three (one S+ stimulus alongside two S- stimuli).

Charlie acquired all relations in slightly more sessions than Leo. While relations A1 to B1 and A2 to B2 were both taught in two sessions each with 100% independence and accuracy, A3 to B3 required multiple prompts to select the single comparison stimulus. This was attributed to a decrease in attending. During the conditional discrimination task, Charlie required four sessions to reach the mastery criterion. This, again, may be attributed to fact that stimulus function of the comparison stimuli was now changing and conditional on the sample. The without S- stimuli teaching procedure only presented one comparison stimulus; touching the form without necessarily having to attend was followed by a preferred stimulus. The conditional discrimination task was the first experience Charlie had with comparing the stimuli considered mastered to any other comparisons. Conditional discriminations taught with S- stimuli for Charlie were acquired in a similar way to those of Leo. Charlie now was required to compare comparison stimuli to the conditional stimulus for each trial.

Cuvo et al. (1980) mentioned advantages and disadvantages to teaching in isolation (without S- stimuli) and one advantage was evident in the results of the current study: fewer sessions to

mastery were observed. However, the disadvantages were apparent as well—lack of experience evaluating three comparison stimuli and selecting one.

Teaching conditional relations with an initial no S- step could be wasteful of valuable teaching time as evidenced by these results. The difference between sessions to mastery of conditional discriminations for relations taught with or without S- stimuli was low. This may lead educators to choose either procedure because there is no clear evidence to support one over the other. However, choosing a teaching procedure that requires more time and does not guarantee better results is inefficient.

A limitation of this study was the acceptance of either a touch or vocal observing response. A touch to the sample did not ensure the participant attended to the stimulus; however, reading the sample stimulus did.

Future research may also evaluate a teaching protocol in which trials of simple discrimination are intermixed in the same session. For example, per nine trials, three trials would be A1 to B1, three trials would be A2 to B2, and three trials would be A3 to B3. Additional experimenters evaluating the introduction of S- stimuli may also use blank stimuli in place of S- stimuli during the without condition.

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## Table 1

Forms Used as S- Stimuli



## Table 2

## Visual Representations of US States





*Figure 1*. Percent correct independent responses for participant Leo in the without S- stimuli condition.



*Figure 2.* Percent correct independent responses for participant Leo in the with S- stimuli condition.



Participant: Charlie

*Figure 3*. Percent correct independent responses for participant Charlie in the without S- stimuli condition.



Participant: Charlie

*Figure 4*. Percent correct independent responses for participant Charlie in the with S- stimuli condition.