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Effectiveness of Visual Prompts on Correct Disposal of Trash and Recyclable Materials

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Table of Contents

Abstract

Recycling is an important and socially significant behavior for which behavior analytic interventions could be greatly beneficial. In the present study, the effectiveness of various visual prompts on increasing correct disposal of trash and recycling items was evaluated with four graduate students. Three visual prompts of varying complexity were compared in an alternating treatments design. The results indicated that visual prompts are an effective way to increase correct disposal of recycling and trash items. However, the results did not show differentiation between the visual prompts for three of the four participants.

Keywords: antecedent interventions, conditional discrimination, recycling

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The largest percent of municipal solid waste reduction in 2017 can be attributed to the recycling of paper products (EPA, 2017). Recycling 44.2 million tons of paper products is equivalent to removing more than 30 million vehicles from America's roads for one year. However, an additional 18.1 million tons of paper products were placed in the landfill in 2017 (EPA, 2017). Colleges and Universities are essentially small cities in which a great deal of waste is generated each year on their campuses. Stanford University (2020) has a waste reduction and recycling program that, in 2016, conserved enough energy from recycling to power approximately 613 homes for a year. From the recycling of paper products alone, Stanford saved 32,115 trees that year (Stanford, 2020). Within the behavior-analytic literature, several researchers have investigated approaches for increasing correct disposal of recyclable materials (Austin et al., 1993; Brothers et al., 1994; Fritz et al., 2017; Ludwig et al., 1998; O'Connor et al., 2010). This study will focus on those which implemented antecedent interventions to increase recycling in school-based settings.

The implementation of multicomponent antecedent interventions is common within the recycling literature. For example, Ludwig et al. (1998) evaluated the effects of placing recycling bins in each classroom of two university buildings and placing a sign above the recycling bin prompting students to recycle their aluminum cans. During intervention the number of aluminum cans recycled increased by between 23-36% relative to baseline. This increase resulted in 71% of aluminum cans being recycled in one of the buildings (Ludwig et al., 1998). Because the authors' intervention included several components, however, it is unclear whether the increase in recycling of cans was a result of moving recycling bins to the classroom, increasing the number of recycling bins, adding signs, or a combination of those variables.

O'Connor et al. (2010) addressed the limitations mentioned above by implementing individual intervention components during successive phases. First, the school's large grey recycling cans were replaced with smaller blue bins with green tops and a recycling label. In the next phase, the number of recycling bins was increased, and the bins were placed outside of classrooms in the hallways. In the final phase, the recycling bins were moved inside each of the classrooms beside the trashcans. The results indicated that the placement of recycling bins inside the classroom was necessary to increase recycling from baseline levels. During the final phase of intervention, percent of plastic bottled recycled in one of the buildings increased to 71% (O'Connor et al., 2010). Interestingly, the new bins and increased number of bins were insufficient to increase the rate of recycling. Sequence effects may occur in studies where the phases are implemented in a fixed order across participants. Recycling increased the most in the final phase of intervention. However, it is difficult to say if that is because this was the most effective intervention, or if the sequence of interventions in succession increased recycling over time.

More recently, Fritz et al. (2017) implemented a more cost-effective recycling intervention, wherein all trashcans were removed from the classroom and only one was placed beside each recycling bin in the hallways. During intervention, a visual prompt (i.e. sign) in the classroom stated that students could dispose of trash and recycle in the hallway. The percent of correctly recycled materials was calculated by dividing the number of correctly recycled materials placed in the recycling bin by the total number of recyclable materials that were disposed of that week in the recycling and trash receptacles combined. The results indicated that moving the trashcan to beside the recycling bins, while keeping a sign in the classroom, increased correct recycling of materials to 69% (Fritz et al., 2017).

Taken together, these studies have demonstrated that both location of recycling bins and the presence of visual prompts are important factors for increasing recycling. However, these interventions have been unable to increase recycling above 71%. At this time a comprehensive comparison of methods to increase recycling has not been conducted. Specifically, an analysis of visual prompts for recycling is invited. Visual prompts have been demonstrated as an effective behavior change strategy for adults in organizational settings (Clayton & Blaskewicz, 2012; Rubio & Sigurdsson, 2014). Furthermore, visual prompts are inexpensive and require low response effort on the part of the experimenter. However, it is unclear which aspects (i.e. features) are ideal for an effective visual prompt in the context of recycling.

Austin et al. (1993) evaluated the effects of visual prompts being placed above the trash and recycling bins in two departments at a university. The sign above the trash bin was red and said "TRASH" with pictorial examples of nonrecyclable items. The sign above the recycling bin was green and said, "RECYCLABLE MATERIALS" with pictorial examples of recyclable materials. The results indicated that the signs were effective in increasing correct recycling in both departments. However, the authors were unable to decipher which elements of the signs were effective. One possibility is that the pictorial examples may have been informational and therefore increased correct recycling. Alternatively, the signs in and of themselves may have served as reminders for individuals to recycle.

One way to compare effects of various prompts is a rapid assessment procedure. Such procedures are commonly used when comparing the effectiveness of interventions (Cariveau et al., 2020). An adapted alternating treatments design is used when comparing two or more interventions for which the effects cannot be reversed. This intervention could be used to refine the recycling interventions. Using this design, the recycling behavior of individuals can be

examined rather than examining permanent product data aggregated across many individuals (e.g., all items disposed in a receptacle of a university building). When examining aggregate data, it is impossible to know which individuals are responsible for which recycling errors (and to what extent these errors are differentially affected by various interventions). Evaluating individual recycling behavior in a controlled setting would allow more precise examination of the circumstances under which individuals incorrectly dispose of items and begin to address the question of the extent to which such errors are consistent across individuals.

Evaluating the effectiveness of a single class of interventions, such as visual prompts for recycling, using a rapid assessment procedure may be a good first step for such an analysis. Visual prompts are an effective way to teach conditional discriminations (e.g., matching pictures of cards to their spoken word; Fisher et al., 2007; Kodak et al., 2011), and recycling behavior can be conceptualized as a conditional discrimination. A conditional discrimination is when reinforcement for a particular response is conditional upon another stimulus (Cooper et al., 2007). A common conditional discrimination is used in match-to-sample procedures (Fisher et al., 2007). For example, when teaching a client the names of animals, the therapist may present a card with the written word “Bear” (i.e., sample stimulus) and two animal pictures (i.e., comparison stimuli, e.g., a bear and a dog). Reinforcement for placing the card on top of the bear picture (i.e., “matching” the stimuli) is conditional on the word depicted on the card. Individuals are presented with a similar task when recycling. For example, placing an item in the recycling bin is only reinforced (i.e., correct) if the item is recyclable. In the recycling task, the sample stimulus is the to-be-disposed item, and the comparison stimuli are the recycling and trash bins (a schematic showing an example of the stimuli involved in a conditional discrimination is shown in Appendix A).

Furthermore, recycling may be a particularly challenging conditional discrimination task because the stimuli involved are complex. Take, for example, a to-go cup of coffee. There are three materials that are present in this scenario: a paper cup, a plastic lid, and a cardboard sleeve. The coffee cup itself and the lid are non-recyclable, but the coffee cup sleeve is recyclable. If the learner is unable to discriminate between those three components, at least one disposal error is likely to be made. Additionally, fluency is an important aspect of recycling behavior. Individuals engage in recycling quickly, in passing, making it likely that errors will occur if the individual isn't fluent in recycling. Perhaps most importantly, the stimulus classes involved in recycling are broad, including items with very little formal similarity (e.g., an aluminum can and a piece of copier paper). Thus, one way to effectively intervene on recycling may be to address recycling behavior in a similar way to how errors are addressed in the conditional discrimination literature, specifically, by evaluating the prompts that are necessary and sufficient to increase correct responding.

Simple text prompts are one form of visual prompt for which there is moderate support in the recycling literature (e.g., signs stating that there are recycling bins in the hallway; Fritz et al., 2017). There is not much data available on the effectiveness that visual prompts which contain pictures have on recycling behavior. It is a reasonable question of whether a visual prompt with a single image of a recyclable item would be sufficient to increase recycling. A single image included on the visual prompt may be salient enough to increase the saliency of the prompt such that the individual response correctly. However, if the recycling error resulted from under-generalization of the stimulus class "recyclable items," multiple images of topographically distinct items may be necessary to make a correct discrimination. This has yet to be evaluated experimentally.

Recycling research thus far has focused primarily on prompting individuals to engage in a skill that they were presumed to already have mastered. Viewing recycling as a discrimination problem is a novel approach which invites further investigation. By collecting data for each learner on items correctly recycled or placed in the trash in the presence of various visual prompts, we can evaluate which prompt leads to the quickest acquisition of correct recycling behaviors. Therefore, the purpose of the present study was to evaluate the effects of various visual prompts on students' correct disposal of recyclable materials on a college campus. An adapted alternating treatments design embedded within a nonconcurrent multiple baseline was used to evaluate a) whether visual prompts would increase correct recycling at the individual level, and b) which visual prompt(s) were most effective.

Method

Participants and Setting

The participants were four graduate students at Rollins College. All sessions took place in a research lab on campus. The lab contained four 2.4 m by 2.7 m observation rooms where the separate conditions occurred, as well as one central room which was used for data collection and for the participants to wait between conditions.

Materials

Two black trash receptacles and two blue recycling receptacles (60 cm by 30 cm by 71 cm) were used throughout the study. These were the standard receptacles used by the college. There was one table (91 cm by 121 cm) in each of the condition rooms, for a total of four tables. Table 1 summarizes the disposable items that were used in each condition. Six trash items and six recyclable items were present in each of the conditions, for a total of 48 disposable items (see Table 1). To help prevent against multiple treatment interference across conditions, matched

items were identified such that four variations of each item type were included, and these items were randomly assigned to each condition. Condition labels were printed on white paper for each session and an iPhone 11 was used to produce a photographic record of the participant's disposal of items in each condition. There were laminated signs printed on white printer paper for each of the visual prompt conditions (see Appendix B). All signs, consent forms, data sheets, and Treatment Integrity (TI) checklists were kept in a lab binder.

Measurement and Reliability

After the participant completed each session, the items in the trash and recycling bins were placed on the floor beside condition labels to be photographed. The photographs of each condition were used as a permanent product from which data were recorded. The primary dependent variable was the percent of correctly disposed (trash and recycling) items in each condition. This was calculated as the number of correctly disposed items divided by the total number of items and then multiplied by 100. If an item was not disposed, or was not visible in the photograph, it would be marked at "not disposed" and counted as incorrect. However, this did not occur in any sessions.

Interobserver Agreement (IOA) was recorded for 35% of the sessions. An independent observer took data on the disposal of each item as either placed in the trash receptacle, the recycling receptacle, or not disposed. IOA was calculated by dividing the number of agreements by agreements plus disagreements and then multiplying by 100. IOA was 97% across all conditions.

Prior to the start of each condition, the room was photographed to obtain a record of how the condition was arranged. These photographs were then used to measure procedural integrity using a checklist for 35% of the sessions. Procedural integrity was measured as the number of

correct items completed on the integrity checklist (see Appendix C) divided by the total number of items on the list and then multiplied by 100. Procedural integrity was 100% across all conditions.

Experimental Design

An alternating treatments design embedded within a nonconcurrent multiple baseline was used for this study. The participants remained in the Baseline phase for a minimum of the number of baseline sessions (as assigned) or until responding was stable, as determined by visual analysis. The participants then rapidly alternated between the three visual prompt conditions until the mastery criterion (at least 90% correct disposal across three consecutive trials) was met in one of the conditions or until responding was stable, as determined by visual analysis. The assessment was then terminated. The assessment could also be terminated if the participant did not meet the mastery criterion within an hour and a half, however, this did not occur for any of the participants.

Procedure

Prior to beginning the assessment, the participant was provided with a consent form. The participant was then be informed that the experimenters could not answer any of their questions about the study while the conditions were being conducted. Once the participant completed the assessment, they were debriefed and their questions regarding the study were answered.

Baseline

During the Baseline phase, there was be one black (i.e., trash) and one blue (i.e., recycling) receptacle placed beside each other against the wall. There were 12 items sitting on a table in the room and the experimenter instructed the participant to, “Dispose of these items to the best of your ability and let me know when you are finished.” This phase was designed to

assess recycling under the conditions that were in place at the college at the beginning of the study.

Visual Prompts Comparison

Following baseline, three conditions were presented in an alternating treatments design. The three intervention rooms were set up identically, with the only difference being the visual prompt(s) placed above the recycling and trash receptacles.

Textual Signs. In a second room the textual signs condition was presented. This condition was identical to the Baseline phase, except that above the black receptacle was a laminated sign that says, “Landfill,” and above the blue receptable was a laminated sign that says, “Recycling” (see Appendix B). The instructions were the same as in the Baseline phase.

Textual + Pictorial Signs. In the third room a textual + pictorial signs condition was set up, wherein there was one black and one blue receptacle placed beside each other against the wall. Above the black receptacle was a laminated sign that said, “Landfill,” with a photograph of one of the candy wrappers included in the disposable items (see Appendix B). Above the blue receptacle was a sign that said, “Recycling,” which had a photograph of one of the aluminum cans included in the disposable items. The instructions were the same as the previous conditions.

Multiple Exemplar Sign. The multiple exemplar sign condition was in the fourth room. In this condition there were one black and one blue receptacle placed beside each other against the wall. A single sign was present in this condition, which was centered above the receptacles. One side of the sign was green and said, “Recyclable,” with multiple photos of items that were recyclable. The other half of the sign was red and said, “Not recyclable” and there were multiple photos of items that were trash. This sign was identical to signs that were displayed on the wall

in some classrooms on the campus (see Appendix B). The instructions were the same as in previous conditions.

Baseline Probe

Once the Visual Prompts Comparison phase was completed, the experimenters conducted one Baseline probe which was identical to the Baseline phase. The purpose of the condition was to assess whether the participants had learned to correctly dispose of trash and recycling items as a result of the Visual Prompts Comparison phase and could maintain this responding in the absence of prompts, or if the removal of visual prompts would result in a lowered percent of correct disposal.

Results

Figure 1 shows the results for all four participants. The first panel shows the results for Participant 1. Participant 1 was in the Baseline phase for three sessions, during which they correctly disposed of 83% of the recycling and trash items in each session. During the Visual Prompt Comparison phase, Participant 1 correctly disposed of 91% of items regardless of the visual prompt condition. In the Baseline probe the participant's disposal remained at 91% correct.

The second panel in the multiple baseline shows the results for Participant 2. This participant was also in the Baseline phase for three sessions wherein they consistently correctly disposed of 75% of the trash and recycling items. During the Visual Prompt Comparison phase, the percent correct disposal of items generally increased. The first session in which the participant engaged in at least 90% correct disposal was Session 7 (the second session of the textual signs condition) and the participant engaged in at least 90% correct disposal across all sessions thereafter. The Multiple Exemplar Sign condition was the only condition in which

Participant 2 engaged in 100% correct responding (i.e., Session 12). During the Baseline probe, disposal decreased to 83% correct.

The third panel shows the results of Participant 3. During the five sessions of the Baseline phase, this participant's disposal of trash and recycling items ranged between 66% and 83% correct. The participant's responding during the Visual Prompt Comparison condition took longer to meet the mastery criterion than other participants. The participant scored above 90% correct in the first textual prompt condition, but then responding decreased again in the following three sessions. By Session 12 the participant was consistently engaging in above 90% correct disposal of items. There was no clear differentiation in this participant's responding between the three visual prompt conditions. The first condition to meet the mastery criterion was the textual + pictorial condition. In the Baseline probe the participant's responding remained at 91% correct disposal.

The final panel shows the results of Participant 4. This participant was in the Baseline phase for seven sessions. In the first session the participant disposed of 58% of the trash and recycling items correctly. In the following six sessions the participant consistently correctly disposed of 75% of the items. During the Visual Prompt Comparison phase, there was clear differentiation between the three conditions. The participant's disposal in the text and text + pictorial prompt conditions ranged between 66% and 91% correct. The participant's disposal in the Multiple Exemplar condition, however, ranged between 91% and 100% correct, and this was the first condition to meet the mastery criterion. Participant 4's disposal remained at 100% correct during the Baseline probe.

In summary, correct disposal increased for all participants in the Visual Prompts Comparison phase relative to baseline levels. This indicates that visual prompts are effective in

increasing correct disposal of trash and recycling items. However, the results for only one of the four participants indicated that one of the visual prompt conditions (i.e. multiple exemplar prompt) clearly resulted in a higher percent of correct disposal than the other visual prompt conditions. Additionally, during the Baseline probe, correct disposal remained higher than the Baseline phase levels. This may indicate that the participants acquired skills related to correct disposal of trash and recycling items during the Visual Prompts Comparison condition. However, further analysis is needed in order to determine if correct disposal would maintain over time in the absence of visual prompts.

Additionally, the researcher conducted an analysis of the types of disposal errors (i.e., recycling or landfill) that each participant engaged in the most frequently. These data are shown in Figure 2. Percent of disposal errors for placing recycling in the trash was calculated by dividing the total instances that the participant incorrectly disposed of a recycling item by placing it in the trash by the total instances of incorrect disposal that the participant engaged in during intervention, multiplied by 100. The percent of disposal errors for placing trash in recycling was calculated by dividing the total instances that the participant incorrectly disposed of a trash item by placing it in the recycling by the total instance of incorrect disposal that the participant engaged in during the intervention, multiplied by 100. As seen in Figure 2, the results indicated that for Participant 1, Participant 3, and Participant 4, 100% of disposal errors consisted of placing trash items in the recycling bin. For participant 3, 93% of disposal errors consisted of placing trash items in the recycling bin. Thus, errors in disposal nearly exclusively consisted of placing trash items in the recycling bin.

To further analyze the pattern of errors in disposal at the individual level, the researcher identified which stimulus classes the incorrectly disposed items belonged to. Table 2 shows the

most-frequently incorrectly disposed item for each participant. The following were the stimulus classes in which items were most frequently incorrectly disposed for each of the participants: plastic food container (Participant 1, 100%; Participant 2, 91%; and Participant 4, 66%), and plastic bag (Participant 3, 50%). Thus, there was some consistency in the stimulus classes that were most likely to result in incorrect disposal across participants. Taken together with the prior-discussed results, this primarily consisted of trash items (i.e., plastic food containers) incorrectly deposited into the recycling bin.

Discussion

The present study investigated the effects of various visual prompts on the recycling behavior of students on a college campus. Consistent with prior investigations (e.g., Fritz et al., 2017; Ludwig et al., 1998; O'Connor et al., 2010), the results indicate that visual prompts are effective in increasing correct disposal of trash and recycling items. Under the conditions used in the present study, correct disposal was increased to at or above 91% for all participants, with three of the participants disposing of items 100% correctly in at least one session. Use of a multiple baseline design allowed the experimenter to demonstrate experimental control, as there was a clear level change between participant's disposal of items in the Baseline phase and one or more conditions in the Visual Prompts Comparison phase, across all participants. Although the effects were relatively small in magnitude, increasing recycling from an average of 77% across participants in the Baseline phase to at or above 91% in the Visual Prompts Comparison phase could be a socially significant improvement in recycling. This suggests that organizations who would like to increase correct recycling may benefit from placing visual prompts near disposal receptacles in their facility.

To the author's knowledge, this was the first behavior analytic study to evaluate individual's recycling behavior as opposed to evaluating recycling at the organizational level. This was beneficial in that it allowed the researcher to evaluate the extent to which disposal errors were consistent within and across participants. Interestingly, some participants incorrectly disposed an item from the same stimulus class in each session across many sessions. Therefore, there is a question of what stimulus control these persistent errors were under, if not the variables manipulated in the present study. One variable to consider may be features of the items themselves. In the post-study debriefing, Participant 1 stated that even though the multiple exemplar sign shows that a plastic food container is not recyclable (according to the college's recycling program), the plastic food containers used in the present study have a recycling symbol on them. This observation reflects a general challenge with respect to the recycling task. In the present study, as in naturalistic settings, in accordance with local or organizational rules items may not be recyclable even if there is a recycling symbol displayed on the item. Therefore, if the symbol on the item is a more salient stimulus to the participant than the multiple exemplar sign, that participant may incorrectly dispose of the item. Based on the present data, it seems that visual prompts alone are unlikely to address such errors in the categorization of recyclable items. Thus, future researchers should consider evaluating whether additional intervention components, such as contingent feedback (e.g., the researcher informs the participant of which items they are disposing of incorrectly) may be necessary to observe 100% correct disposal.

Notably, all the participants in the present study engaged in relatively high levels (i.e. an average of 77%) of correct disposal of trash and recycling items during the Baseline phase. Relatively lower percentages of correctly disposed recycling items were observed in the Baseline phase in prior studies. For example, of the studies previously cited, Ludwig et al. (1998) had the

next highest percent of correct disposal during the Baseline phase at 40%. For the present study, this may have caused a ceiling effect, though that did not prohibit demonstrating experimental control. Several procedural differences between the present study and prior investigations could account for the higher baseline levels of correct disposal observed relate to. One difference being that the present study was conducted in a laboratory setting, as where prior studies were conducted in a naturalistic setting (e.g., two buildings in a school as per Ludwig et al., 1998). Another difference which may have contributed to a higher baseline is that the participants in the present study were graduate students, as where in the prior studies the participants were anyone who disposed of items in that building (e.g., students, employees, and visitors as in Fritz et al., 2017) Additionally, it is possible that since the recruitment information provided to potential participants stated that the study would involve recycling, the individuals who chose to participate in the study may have had a behavioral history of reinforcement for recycling behaviors. As a result, it is unclear if the visual prompts employed in the present study would similarly effective if employed with participants with lower baseline levels of correct disposal. Future researchers should evaluate this approach with individuals who engage in lower levels of correct disposal in the Baseline phase, for example, younger (e.g., 4-year-old) participants acquiring recycling.

Relatedly, the levels of correct recycling observed in the Visual Prompts Comparison phase of the present study were generally higher than the levels resulting from visual prompts in previous studies. For example, of the articles previously cited, O'Connor et al. (2010) had the previously highest percentage of correct recycling at 71% during the intervention condition. One reason for this difference may be that in the present study, there was only one opportunity to make an error with each item in a stimulus class (e.g., there was only one opportunity to dispose

of a plastic food container per session). In contrast, in a naturalistic study in which recycling is measured at the organizational level, there are numerous opportunities for many individuals to incorrectly dispose of items from the same stimulus class. Another difference is that in a naturalistic study, there may be a few individuals who recycle incorrectly at a high rate and therefore decrease the overall percentage correct. This illustrates how evaluating recycling behavior at the individual level, as in the present study, may result in a better understanding of the environmental variables controlling this behavior.

However, the limited number of the participants in the present study as well as the recruitment of only graduate students may limit the external validity as it is unknown how effective the visual prompts would be building-wide or with a different population. Furthermore, it is unknown how effective the visual prompts would be outside of a controlled laboratory setting. There is a question of how well the results of the present study would maintain in the long term. Prior studies have shown that the effects of visual prompts can maintain for up to 4 months (Clayton & Blaskewicz, 2012; Rubio & Sigurdsson, 2014). Thus, we would expect these effects to maintain for comparable durations, but this hypothesis invites further investigations.

One of the limitations of this study is that there was not one visual prompt intervention which was consistently more effective across all participants and the experimenter was thus unable to demonstrate experimental control via the alternating treatments design. Participant 4 was the only participant whose responding showed clear differentiation between the three interventions, with the multiple exemplar sign resulting in the highest percentage of correct disposal of recycling and trash items, relative to all other visual prompt conditions and the Baseline phase. The other three participants consistently engaged in 91% correct disposal across all three visual prompts. It is difficult to determine if the present pattern of results occurred

because each of the conditions were equally effective in increasing correct recycling, or if multiple treatment interference may have occurred. The experimenter took measures to increase the discriminability of the experimental conditions by a) including matched items across conditions (such that distinct variations of each item type were presented in each condition) and b) conducting each condition in a separate room. However, multiple treatment interference is always a potential limiting factor when implementing an alternating treatments design. Future researchers could address this concern by conducting each condition separately until responding is stable (i.e., in multiple baseline experimental design). However, this approach would have the limitation of exposing participants to the treatments in a fixed/escalating order, and this limitation was previously discussed for other prior studies (O'Connor et al., 2010).

Another limitation was that stimulus equivalence was not formally assessed for the present study. One of the defining features of an adapted alternating treatments design is that each of the conditions has a separate set of stimuli (Cariveau et al., 2020). This is done to decrease the chance of carryover effects occurring. In the present study, this was achieved by including four variations of each stimulus class: one in each of the conditions. However, if each of the conditions have different stimuli, it's necessary to ensure that all of the stimuli included in each condition is of equal difficulty. According to Cariveau et al. (2020), equating the difficulty of stimuli is not typically assessed using an experimental procedure. Instead, many authors have stated that they used a logistical analysis. One type of logistical analysis described is equating stimuli based on visual properties. For example, in the present study it is assumed that correct disposal of a grey, black, white, or brown plastic grocery bag is of equal difficulty. However, it is more difficult to assume that a paperback book, a magazine, and academic journal, and a newspaper (the items included in the stimulus class "paperboard") are of equal difficulty to

dispose correctly. Future research should develop a method for equating stimuli based on visual properties so that those methods can be replicated.

In the multiple exemplar sign condition, the sign chosen was one that was already in place at some disposal locations on the college's campus. The experimenter chose to evaluate the effectiveness of the sign that the college had already created in order to determine if the sign should stay in use at the college, or if it would be beneficial to alter some aspect of the sign. However, one limitation of this decision is that there were many differences between the textual + pictorial sign and the multiple exemplar sign (i.e. color, language choice, and added labels under the pictorial examples). Therefore, it is unknown which element of the sign may have made it more effective for the participant for which there was differentiation between this condition and the other visual prompts. Future research should evaluate other variations of the multiple exemplar sign in order to determine which aspects are necessary.

Interestingly, the analysis of disposal errors indicated that nearly all disposal errors consisted of placing trash items in the recycling bin. This is concerning in that this error type results in greater loss of recycled materials than placing a recycling item in the trash does. For example, placing a plastic food container in the recycling bin at this college could result in the entire bin being discarded. However, if paperboard is placed in the trash only the one recycling item is lost. Future investigations could evaluate the effectiveness of a visual prompt that would indicating that individuals should avoid that error type (e.g., "when in doubt, throw it out") in decreasing the amount of trash disposed incorrectly in the recycling bin.

During the course of this study, the college where the study was conducted discontinued their recycling program. The primary reason cited for this was errors in disposal. Specifically, in the announcement of this change to the campus community, campus staff noted that the

recycling program was “ineffective” and that the primary concern was “contamination” resulting from placing trash and recycling receptacles side-by-side. This highlights the importance of this study’s findings. The present study, consistent with numerous investigations in the recycling literature, suggests that visual prompts are needed to increase correct recycling to a socially significant level. However, this conclusion may be encouraging, given that visual prompts are an antecedent intervention strategy that is inexpensive and requires relatively low response-effort. One way in which the findings of this study could be implemented at the campus-wide level would be to ensure that there are visual prompts at all disposal locations on the campus. The prompt provided in the multiple exemplar condition is one that has previously been used on the campus, but inconsistently. There is a question of if the multiple exemplar prompt had been consistently used in disposal locations if this would have resulted in sufficient improvements in disposal such that the recycling program could have continued. Further research is needed to understand how sufficiently high levels of correct disposal might be achieved, and to ensure the feasibility of such interventions, so that termination of recycling programs can be prevented.

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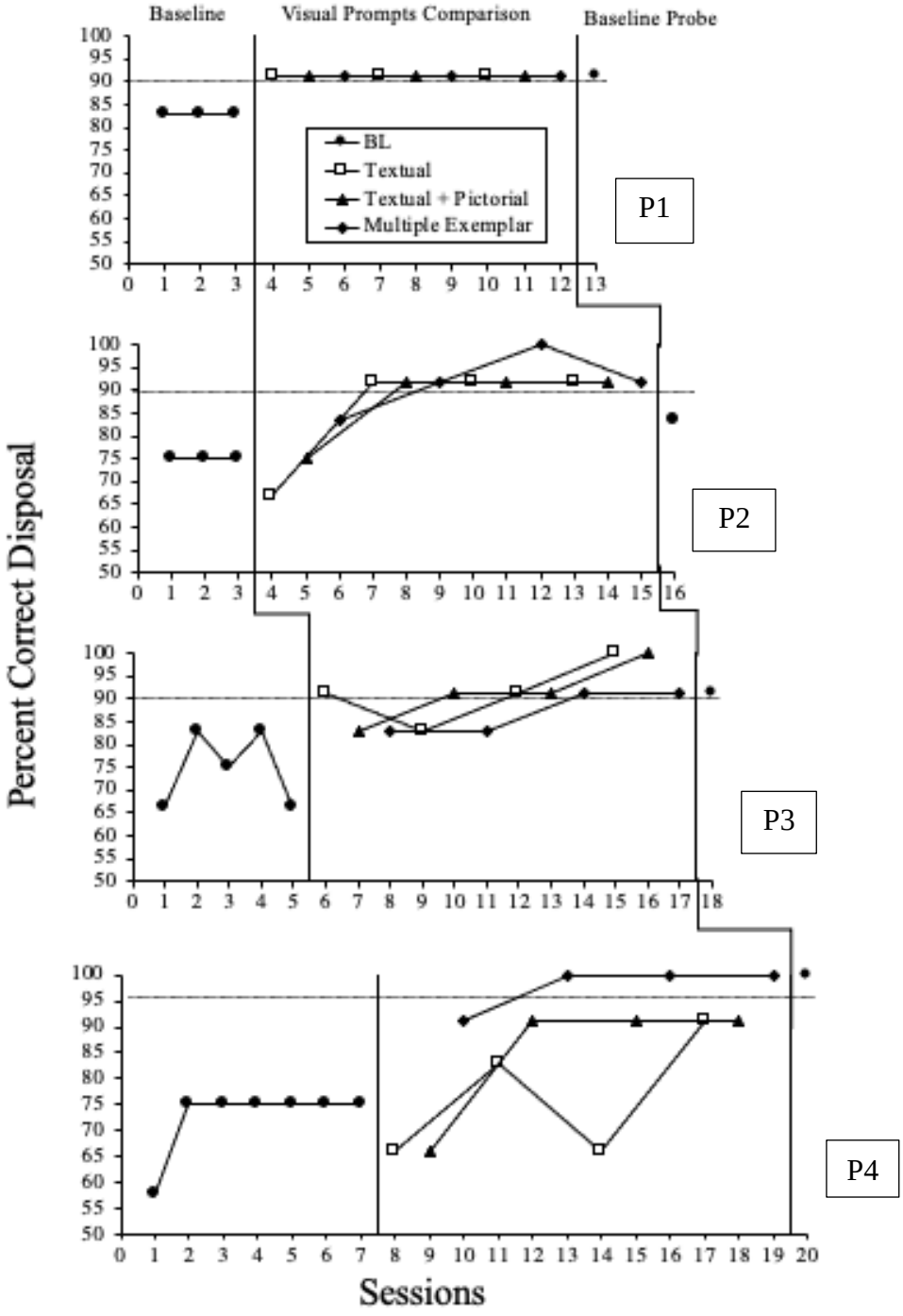
Figure 1

The Percent of Correctly Disposed of Items in Each Condition



Note. The horizontal dotted line indicates the at 90% mastery criterion.

Figure 2

The Percent of Recycling and Trash Disposal Errors for Each Participant

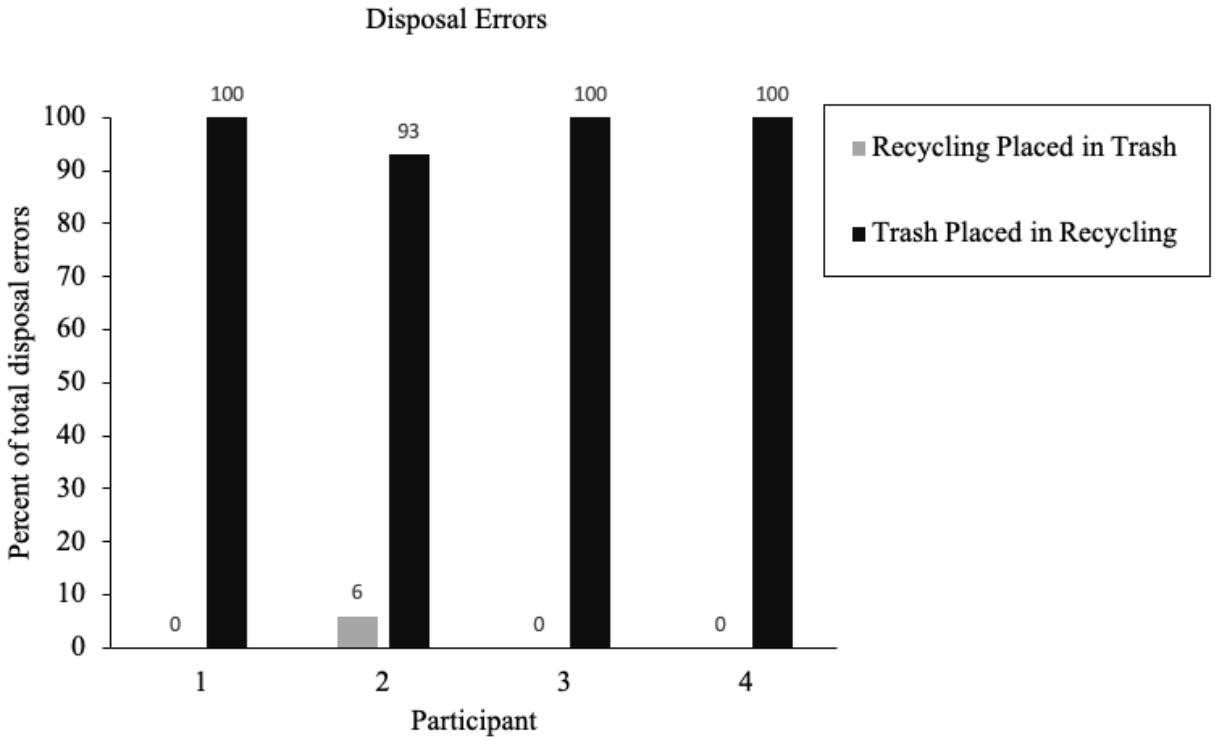


Table 1

Recycling and Trash Items in Each Condition

Category	Stimulus Class	Baseline	Textual	Textual + Pictoral	Multiple Exemplar
Recycling	Aluminum can	Regular Coke	Ginger Beer	Grapefruit Polar	TJ's Lime Seltzer
Landfill	Paper cup	small white paper cup	Coke fountain cup	Starbucks cup	Foxtail cup
Landfill	plastic food container	sushi container	turkey & cheddar	grape container	Blueberry container
Recycling	Envelope	Blank white greeting card	S&C green wedding	the depriests	save the date
Recycling	Copier paper	Blank white	Mindful	Office hours	Rollins calender
Landfill	Styrofoam Cup	Plain white coffee cup	Chick fil A Cup	Tiajuana Flats Cup	Polar Pop Cup
Recycling	Plastic Bottle	coke bottle	diet tonic water	water bottle	Gatorade bottle
Landfill	Candy wrapper	KitKat	Reese's	Snickers	Milkyway
Landfill	Plastic silverware	white plastic spoon	clear plastic spoon	clear plastic fork	clear plastic knife
Recycling	Paperboard	paper towel tube	grape wrapper	selzer box	brown rice box
Recycling	Printed materials	paperback book	rollins magazine	academic journal	newspaper
Landfill	Grocery bag	brown	white	gray	black

Table 2

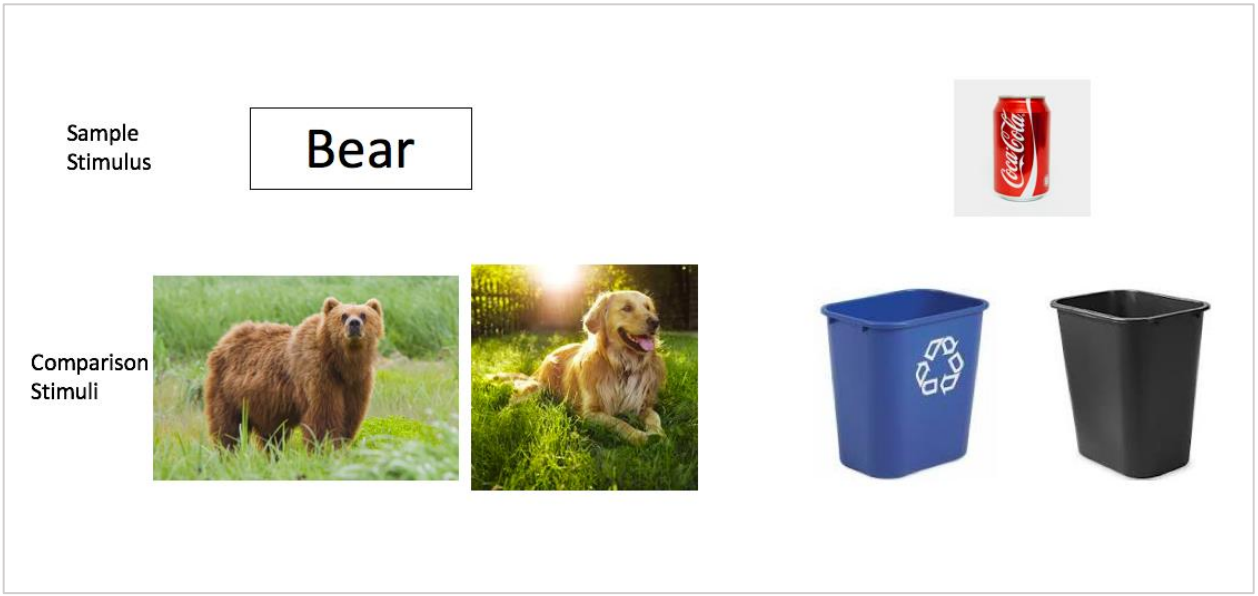
Most Frequent Disposal Errors for Each Participant

Stimulus Class with Most Frequent Errors	Participant 1	Participant 2	Participant 3	Participant 4
Plastic Food Container	100%	91%	---	66%
Plastic Bag	---	---	50%	---

Note. Percentages were calculated by dividing the number of errors in each stimulus class by the total number of errors made by the participant. Dashes indicate stimulus classes that were not the most frequent class of errors for that participant.

Appendix A

Conditional Discrimination Schematic



Appendix B

Signs for Visual Prompts

Landfill

Recycling

Landfill

Recycling

Appendix C

Treatment Integrity Checklist

Data collector 1:		Date:	
Data collector 2:			
Series number:			
		Initials	Initials
Condition	Necessary features:		
Baseline	Two side-by-side blue and black bins against wall		
	White recycling symbol on blue bin is visible to participant		
	12 items are located on table approx. 3 ft. from first available bin		
Textual Signs	Identical to baseline, with the addition of textual signs		
	Recycling sign taped on wall over blue bin		
	Landfill sign taped above black bin		
	12 items are located on table approx. 3 ft. from first available bin		
Pictorial + Textual Signs	Identical to baseline, with the exception of textual + pictorial signs		
	Recycling sign with picture taped above blue bin		
	Landfill sign with picture taped above black bin		
	12 items are located on table approx. 3 ft. from first available bin		
Multiple Exemplar Sign	Identical to baseline, with the exception of multiple exemplar sign		
	Multiple exemplar sign taped between the two bins		
	12 items are located on table approx. 3 ft. from first available bin		