Improving Waste Sorting Behavior in a University Environment with Visual Prompt Stimulus

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Foreword

Submitted in partial fulfillment of the requirements of the BSc Psychology degree, Reykjavík University, this thesis is presented in the style of an article for submission to a peer-reviewed journal.

Abstract

The purpose of the study was to examine how well people at Reykjavík University were sorting waste under the current instructions and see if addition of prompt intervention would improve waste sorting. Participants in the study were students, staff and visitors at the university building during data collection. The experimental design used was multiple baseline across settings. The ratio for right and wrongly sorted waste in recycling bins was analyzed across 3 locations in the Reykjavík University. A prompt intervention was used in addition to current instructions on waste sorting. The prompt was a poster that displayed the word “Stop” and two instruction pictures. One picture depicted the most common error made in waste sorting and the other after it had been adjusted. The posters were placed on top of selected recycling bins. The findings revealed that a majority of the waste items were sorted incorrectly under the current instructions and that the intervention improved sorting behavior by decreasing the percent of incorrectly sorted waste. Ratio for wrongly sorted waste indicated that current instructions were ineffective and did not encourage appropriate waste sorting behavior. The effect of the intervention further suggested a need for revision of the current instructions with the aim of improving waste sorting behavior.

Keywords: Waste-sorting, recycling, prompt, multiple baseline, university environment

Útdráttur

Tilgangur rannsóknarinnar var að kanna hversu vel fólk við Háskólann í Reykjavík væri að flokka rusl undir almennum leiðbeiningum og hvort hægt væri að bæta flokkunarhegðun með stikkáreitis íhlutun (*e. Prompt intervention*). Þátttakendur voru nemendur, starfsfólk og gestir í skólanum á meðan að gagnasöfnun stóð. Rannsóknarsnið var margþætt grunnskeið yfir mismunandi staðsetningar (*e. Multiple baseline across settings*). Í rannsókninni var farið í gegnum innihaldið í endurvinnslutunnum og kannað hve hátt hlutfall af ruslinu var flokkað rétt og vitlaust í þremur tunnum í Háskólanum í Reykjavík. Íhlutunin var stikkáreitis leiðbeiningar í viðbót við almennar leiðbeiningar um flokkun á rusli. Stikkáreitið í þessari rannsókn var spjald sem á stóð „Stop“ og sýndi síðan tvær myndir. Eina mynd af algengustu mistökunum í ruslaflokkun og aðra eftir að þau voru leiðrétt. Spjaldið var fest ofan á lokið á ruslatunnunum. Niðurstöður rannsóknarinnar sýndu að meirihlutinn af rusli í tunnunum var vitlaust flokkaður undir almennum leiðbeiningum skólans. Þegar að íhlutun var bætt við þá batnaði flokkunarhegðun þar sem að dró verulega úr hlutfalli á vitlaust flokkuðu rusli. Hlutfallið af vitlaust flokkuðu rusli benti til að almennar leiðbeiningar stuðluðu ekki nægilega vel að viðeigandi flokkunarhegðun. Áhrif íhlutunar benti enn fremur á þörf til að endurskoða almennar leiðbeiningar með það að leiðarljósi að ná bættri stjórn á flokkunarhegðun.

Lykil hugtök: Ruslaflokkun, endurvinnsla, stikkáreiti, margföld grunnlína, háskólaumhverfi

Improving waste sorting behavior in university environment with visual prompt stimulus

Waste Increasing Problem

Increase in waste and pollution is a growing problem worldwide and harms the environment in multiple ways. Concerns have been increasing in Europe because many landfills are reaching their point of maximum capacity (Defra, 2002; Robertson & Walkington, 2009). It is estimated that around 165 million tons of plastic waste is already in the ocean, and about 250,000 plastic bottles are added every hour (Knight, 2012). In some states in Australia 44% of the landfills content is waste from construction sites, which is more likely than other types of waste to contain hazardous substances. This can lead to health risks due to pollution (Apotheker, 1992; Lahner & Brunner, 1993). Few countries are fully sufficient when it comes to the matter of recycling (Nicolli, Johnstone, & Söderholm, 2012). For example, the Environmental Protection Agency of the United States estimates that only 28% of solid waste from landfills is successfully recycled while 72% is either burned or buried, methods that lead to an array of environmental problems (Lehman & Geller, 2005). This has led policymakers in both developed and developing countries to encourage residents to recycle and decrease waste (Seung-Jun Kwak, Seung-Hoon Yoo, & Chan-Jun Kim, 2004).

On average, each resident of Reykjavík, the capital of Iceland, disposes 223 kilos of waste every year ("Úrvinnslusjóður," n.d.). In the year 2006 cardboard and paper contributed 19.000 tons to the total waste and plastic contributed 12.000 tons, of which 48% and 4% were recycled respectively. Despite this reality, the general public in Iceland has a very positive attitude towards recycling and according to a research made by Capacent Gallup in 2008 about 94% of Icelanders think recycling is important.

Recycling and Waste Sorting

Recycling is the process where materials are collected and processed for new production instead of throwing it away as waste. This process maintains a circulation of

materials in the nature (US EPA, n.d.). Recycling reduces pollution and keeps the environment in good repair and presentable for future generations. Furthermore it supports the economy by saving energy, conserving natural resources and creating jobs (Becker, Ayscue, Brockett, Scarola, & Kelley, 2014; US EPA, n.d.).

One step in recycling is waste sorting. Waste sorting is the prelude to recycling. This is a process where different materials like glass, paper, wood, metals and plastic are separated from the general waste. The materials sorted out are used to produce raw materials. This preliminary step is necessary in order for the materials to be recycled and used for new products (Viegas, Almeida-Silva, & Viegas, 2014).

How can we Improve Recycling and Waste Sorting Behavior?

The problem of increasing waste and pollution, that threatens the future of this planet, is fundamentally caused by human behavior (Lehman & Geller, 2005). Specialists in behavior analysis have found that human handling of waste can be changed for better environmental protection. For example, by researching how people alter their environments and how stimulus control methods like prompting can change behavior. Notwithstanding, findings on this subject are far from being complete and waste sorting is a behavior that needs to be examined more closely. Even though rules and procedures for waste sorting are provided, it does not guarantee that people sort waste according to them. Waste sorting behavior needs to be examined directly to observe if the guidance and procedures are effective, as well as to discover ways to make them more effective.

Environmental Alterations

Important factor for correct waste sorting behavior is accessibility of recycling bins (Robertson & Walkington, 2009; Timlett & Williams, 2008). The environment must provide opportunity for waste sorting and the access should be effortless. Key factor for better success in waste sorting behavior is to minimize barriers as much as possible or remove them

entirely. For example, needing to travel great distances in order to recycle poses a barrier to correct waste sorting behavior. If there are barriers, people are less likely to sort waste, even though their attitude towards recycling is positive (Robertson & Walkington, 2009).

In a research by O'Connor et al. (2010) findings indicated that when new recycling bins replaced ordinary waste bins, no significant change in waste sorting behavior occurred (O'Connor, Lerman, Fritz, & Hodde, 2010). Neither was a change observed when more bins were added to the common areas. On the other hand, waste sorting increased considerably when recycling bins were located in the classrooms. Their finding was that the classrooms were the most common location of consumption. An important factor in improving waste sorting behavior is decreasing effort by locating recycling bins closer to consumption. Environment that alliterates waste sorting is an important factor. Another important factor to consider is how instructions for waste sorting are arranged. Behavior analysts have research ways to improve how people follow instructions (Lehman & Geller, 2005).

Stimulus Control

Stimulus control is the concept of how behavior is triggered in some situations by the presence or absence of specific stimulus (Martin & Pear, 2011). The behavior is only valuable when it occurs in specific situations and timing that is appropriate. When a behavior is only reinforced in the presence of the specific antecedent stimuli the stimuli starts to control the occurrence of the behavior. The level of co-occurrence of the antecedent stimuli and the behavior is referred to as stimulus control. For example in situations with multiple recycling bins for different sorts of waste instructions must have effective stimulus control over desirable waste sorting behavior.

A study by O´Neill, Blanck and Joyner (1980) examined the possible reduction of littering and the frequency of items disposed in containers using stimulus control. Two identical containers were used and one of them was modified in order to provide stimulus

control. The word “Push” was painted on a door. When the door was pushed, a mechanical device lifted the top off the container. Exposing the word “Thanks” that was painted on the underside of the top of the experimental trash container. Conventional container and an experimental container were used concurrently during four football games. The two bins were located apart along an enclosure, which separated a spectator area from a playing field. The results showed that more than twice as many items were deposited within the experimental container. The trash was also about twice as heavy in the experimental container compared to the conventional one. This shows that small steps to improve friendliness to the environment can make a big difference and the harvest from these small steps can be very important for the planet in the long run.

Prompt

Another way of developing stimulus control is by using methods called prompt. Those methods have successfully been used for improving waste sorting behavior (Lehman & Geller, 2005; Martin & Pear, 2011). Prompts are additional antecedent stimulus. For example verbal or written preceding messages that indicate a target behavior that is more desirable and likely to happen. Prompting is most successful with behavior that is clearly defined, comparatively easy to perform and when the message is shown in close vicinity to the place where the behavior can be performed.

Austin and Hatfield (1993) were among the first to examine prompting in relation to the location of containers in their study of increased use of recycling bins. Waste container and recycling container were located beside each other in one setting. In another setting the containers were located 4 meters from one another. During baseline assessment the recycling containers had a small sticker with instructions identifying which recyclable items to deposit. During intervention the prompting was performed. Above the trash container for non-recyclable items, a red sign labeled “Trash” was posted which appointed the most appropriate

non-recyclable items to dispose. Above the recycling container a green sign labeled "Recyclable materials" was posted and appointed examples for each category of recyclable items. For each setting, there was a substantial increase from baseline in the use of recycling containers in the wake of prompting signs added above containers.

It is important to investigate to what extent people can be influenced to sort waste correctly (Lehman & Geller, 2005). The aim of the current study is to examine people's performance in waste sorting behavior at the Reykjavík University and see if waste sorting behavior can be improved with a specific prompt intervention. The current recycling instructions at Reykjavík University, rely on the colors of the bins with additional labeled instructions that inform how to sort waste correctly. The current study aims at analyzing whether the addition of picture prompts increases correct waste sorting behavior compared to the currently used instructions alone. The aim of the study is to at add further knowledge on the effectiveness of prompting techniques used to improve waste sorting behavior. The purpose of the current study is twofold: 1) To examine how well the students and faculty of Reykjavík University are sorting waste under the current instructions; 2) To examine to what extent an addition of prompt intervention can improve waste sorting at Reykjavík University.

Method

Participants and Setting

Participants in current study included students, visitors, faculty and other employees at the Reykjavík University. Three recycling stands in the Reykjavík University building were selected for data collection purposes. These stands were selected relatively far from each other in busy locations. One recycling stand was selected on each of the three main floors in the building. The recycling stand on the first floor was located in a hallway in front of a vending machine. The recycling stand on the second floor was located in front of a large

classroom and the recycling stand on the third floor was located in the center of the university building, in front of a quiet area with student reading booths.

Procedure and Measurement

The number and position of the recycling bins remained the same across all sessions. Information about the experiment was not revealed to staff, students or other possible participants in the study. The approval of the administrator of waste and recycling in the building was granted for the study. Every recycling stand consisted of four separated bins each for different waste products. Above the recycling stands were written instructions on how the waste should be appropriately sorted. The first of four bins in each recycling stand was colored black and was intended for unrecyclable items such as food scraps, plastic containers and cartons with food scraps, napkins, gum and gum wrappers. The second bin was blue and was intended for recyclable paper articles such as newspapers, magazines, office notes, notebooks, payment slips and corrugated cardboard. The third bin was red and was for clean recyclable beverage containers made of plastic, aluminum and glass. The fourth bin was green and was intended for clean empty containers, cartons and plastic. This included sandwich packaging, yoghurt cups and drinks cartons.

It was important that containers placed in the green bin were empty of all food related waste to be considered recyclable. Containers with food scraps were to be placed in the black bin and therefore not be recycled, but containers could be emptied and put in the green bin for recycling. The green bin was selected for analyzing as it required sorting of more diverse waste compared to the other two recycle bins. The most common error of sorting waste in the green bin was disposing of containers with food scraps. This was discovered by observations made before the experiment.

The conduct of the green bins was analyzed at three selected recycling stands. The total number of items in the green bins were counted and the number of correct and

incorrectly sorted items tallied. Correctly sorted items were defined as items placed in the green bin in accordance to the instructions, for example, empty drink cartons and yoghurt cups. Incorrectly sorted items were defined as items placed in the green bin that did not conform to the instructions as green bin waste, as well as falling into the category of being appropriate to sort in to one of the other three bins. This would entail for example containers with food scraps, newspapers and plastic beverage containers. The experimenter picked up each wrongly sorted item from the green bins and placed it in the appropriate bins until there was only appropriately sorted items left in the green bins.

During the baseline and intervention phase, the experimenter collected data on sorting behavior in the three green bins for 29 days. The observer collected data between 15:00 p.m. and 16:00 p.m. starting on the first floor and ending on the third floor. Each session was around 30 minutes. After a tenable baseline had been achieved on all floors, the intervention was introduced at the first location. Antecedent stimulus prompts were used for the intervention. The prompt in the current study was a poster (21.0 x 29.7cm) showing two instruction pictures pointing out the most common error made in waste sorting (see Appendix). The first picture portrayed waste that was frequently sorted incorrectly into the green bin, with the addition of a prohibition sign over the picture. The second picture portrayed the exact same type of waste as in the first picture, after it had been cleaned and emptied, and readily recyclable according to the green bin instructions. The second picture had the addition of a thumb up alongside the empty containers. The posters were placed on the top of the green recycling bins. The intervention was performed across all three settings starting on the first floor while the experimenter continued collecting baseline data for the second and third floor Next the intervention was performed on the second floor and at last on all three floors.

Experimental Design

The study was conducted in a multiple baseline across settings design. The independent variable was a stimulus prompt in the form of pictures of waste sorting instructions, added on top of the recycling bins. (see Appendix). The dependent variable was percentage of wrongly sorted waste during the baseline and the intervention phases.

Interobserver Agreement

Inter observer agreement was performed in 18 out of 29 sessions (62%) and was computed for each setting individually. The interobserver agreement percentage was calculated by adding agreements and disagreements which were then divided by total agreements and multiplied by 100. For recycling bin 1 the mean percentage for inter observer agreement was 94%, 78% for recycling bin number 2 and for recycling bin 3 it was 83%.

Results

The number of waste items placed in each green bin ranged from one to 46 items over all bins during the experimental period. The average number of waste items at the three locations were 17.6. The average number of waste items during the baseline periods was 21.8 and during the intervention periods the average number of items was 14.1.

Figure 1 depicts the mean number of items that were sorted incorrectly for each session across 29 days, during each condition. Mean number of items sorted incorrectly decreased during intervention, across all bins.

Figure 2 depicts the percentage of wrongly sorted waste for each day (session) during the experiment. Results across the three settings are displayed independently, during baseline and intervention in the three panels of figure 2. The mean percentage for incorrectly sorted waste decreased in all three settings during the intervention. In recycling bin 1 incorrectly sorted trash decreased from an average of 79% during baseline (range 75% to 88%) to 22% during the intervention (range 8% to 83%). In recycling bin 2 incorrectly sorted waste

decreased from 69% during baseline (range 38% to 100%) to 21% during intervention (range 0% to 100%). In recycling bin 3 incorrectly sorted waste decreased from 68% during baseline (range 35% to 100%) to 24% during intervention (range 0% to 50%). Mean percentage for all three situations combined, showed a decrease from 72% during baseline to 22% during intervention.

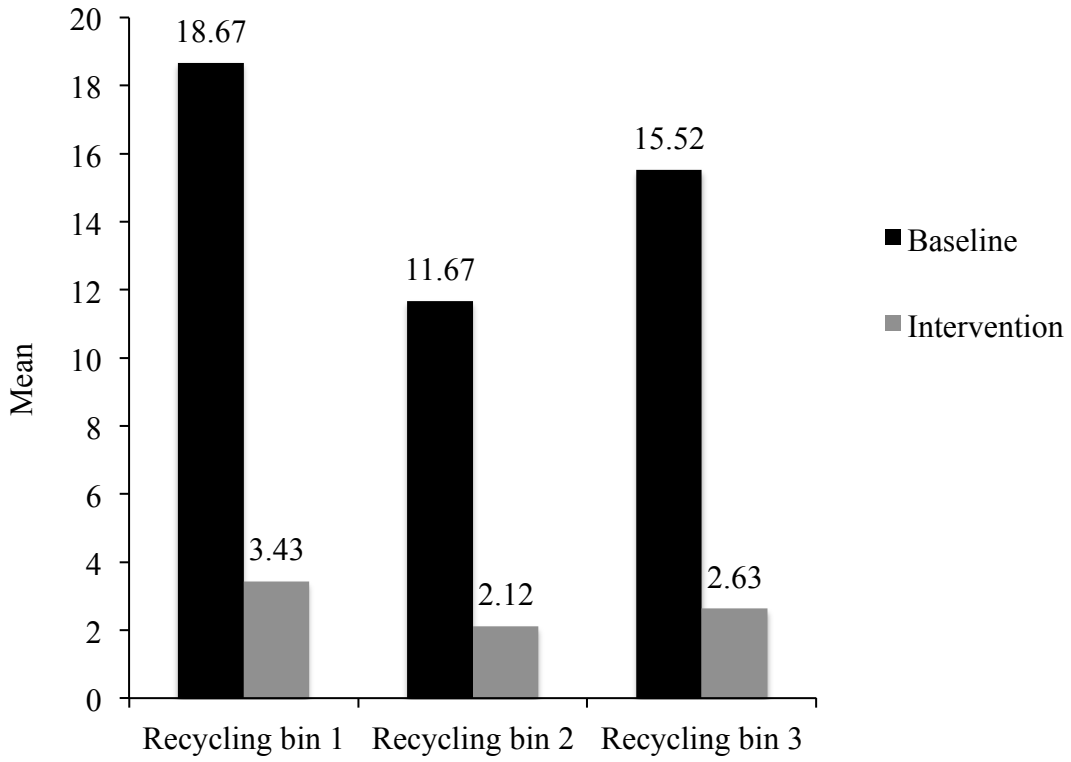

Figure 1. Mean number of wrongly sorted items. Displaying each recycling bin during baseline and intervention phase for comparison.

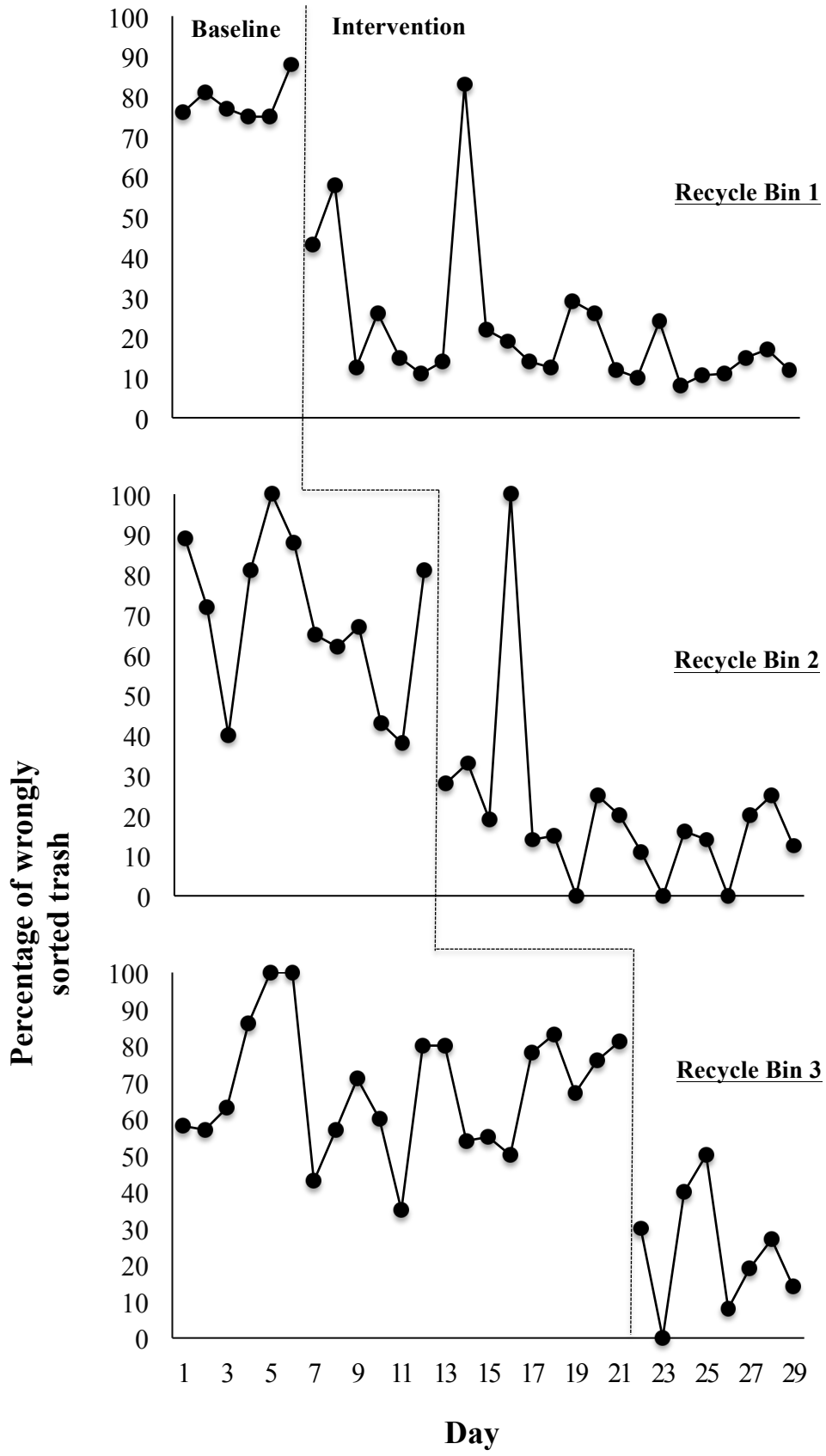

Figure 2. Percentage of wrongly sorted waste. The baseline and intervention for the three different settings are shown in separate panels.

Discussion

The purpose of the current study was to examine waste sorting behavior at Reykjavík University to investigate whether this behavior could be improved with the addition of visual prompts. The major findings showed that the majority of waste items were incorrectly sorted at baseline assessment and that the prompting intervention improved sorting behavior by decreasing the percent of incorrectly sorted waste items. To examine how well the students and faculty of Reykjavík University are sorting waste under the current instructions a baseline assessment was conducted by analyzing the content of three recycling bins at the University. The mean percentage of incorrectly sorted waste items across the bins showed that the majority of students and faculty were sorting waste incorrectly. The second aim of the study was to examine to what extent an addition of prompt intervention can improve waste sorting at Reykjavík University. The findings revealed that prompting intervention did improve sorting behavior, as incorrectly sorted waste decreased over time in all three situations.

The prompt intervention in the current study builds upon and extends the intervention used in the study by Austin and Hatfield (1993). The intervention used in the study of Austin and Hatfield (1993) resembles the instructions used at the university during the baseline phase. Findings by Austin and Hatfield (1993) showed improved waste sorting behavior during intervention with more frequent dispose of waste in the correct recycling bins. However, in the current study the baseline assessment indicated that the instructions were ineffective. A possible cause of this discrepancy was the number of recycling bins in the current study which were double what they were in the study of Austin and Hatfield (1993), requiring more complicated waste sorting behavior. The solution might be better stimulus control in the study's environment.

The current study supports the findings of Lehman and Geller (2005) that prompting method show the most success when behaviors are distinctly defined, are easy to perform, and the message is shown in close vicinity to the place where the behavior can be performed. In the current study, location of the prompt was selected to interact with the timing of the recycling behavior. It was necessary to lift the lid of the bin where the prompt was located, to dispose of waste in to the recycling bins.

It is important to verify the effectiveness of instructions in waste sorting (Lehman & Geller, 2005). Especially if the ineffective behavior occurs in situations where it is unlikely to be corrected. When people's waste sorting is defective, it is important to attempt to change in hope for improvement. Small improvements at individual level can lead to an improvement in waste recycling, instead of materials in perfect condition for recycling being buried, burned or treated with other methods that can have harmful effects on the environment. The results of the current study indicate that current waste sorting instructions were ineffective and serves to argue for the revision of current instructions.

Although the intervention in the current study was effective, we are unable to point out what specific variable was responsible for the change in waste sorting. It is possible that the location of the prompt instructions was the variable responsible for the change. It is also possible that modifying the instructions, using pictures rather than written instructions, was the variable responsible for the change in sorting behavior. Further research is needed to investigate how the location and prompt variables affects waste sorting behavior by examining each variable independently. Another limitation to the current study is that the interaction between the four bins on each stand was not computed. As mentioned above, each recycling stand consists of four bins for different recycling purposes. To see if there was a change in waste sorting for the other three bins, before and after the intervention.

The results of the current study are in concordance to previous studies (Austin & Hatfield, 1993; O'Connor, Lerman, Fritz, & Hodde, 2010; O'Neill et al., 1980), that recycling behavior can be improved with simple and inexpensive methods. It is an inspiration that such simple experiments have shown such great improvements in fundamental factors on waste sorting behavior. Recycling is expected to become more important in the future and therefore an understanding of improved waste sorting behaviors will be beneficial for the environment and the community as a whole. In bigger institutions where large amounts of waste are disposed of every day and waste sorting system is in use it would be beneficial and important to verify the effectiveness of the recycling systems. The waste sorting system studied by the author was not effective Institutions with ineffective waste sorting systems are good platforms for experiments on waste sorting behavior as there is great room for improvement and little risk if such attempts fail.

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Appendix

Prompt stimulus intervention