Changes in Waste-Sorting Behaviour with the Presence of Mirrors and Messages

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Executive Summary

Waste-sorting behaviour has become increasingly prevalent in Metro Vancouver in recent years due to concerted efforts of governmental organizations, educational institutions, and social media. The present paper discusses how the presence of mirrors and messages can influence individuals' waste-sorting behaviour by demonstrating that mirrors and message above waste sorting bins can increase the precision of waste-sorting behaviour. This article questions whether the presence of mirrors and messages impact waste-sorting behaviour. Our study consists of one control and three conditions: mirrors, message, and, mirrors with message. An unobtrusive research method was conducted while a total of 400 UBC students, staff, and visitors were observed in a 4-group between subjects design. The data include results from compost or food, plastic or metal, paper, and waste. Each category has their own individual accuracy score to measure whether the participant has correctly identified their waste disposal. Results show that the hypothesis is supported and the conditions increase proper waste disposal in comparison with the control group.

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Research Question and Hypothesis

In this current study, we are interested in the effects the presences of mirrors and messages have on people's waste-sorting behaviour. Our hypothesis is that the presence of either mirrors or messages will lead to an increase in the accuracy of waste-sorting behaviours. Specifically, the presence of mirrors and messages combined will have the most significant impact on people's sorting behaviour, followed by the presence of the mirrors, and then the presence of the messages.

Methods

Participants

A total of 400 random UBC students, staff and, visitors at the Point Grey campus were observed in conditions of a 4-group between subjects design. There were 100 participants examined during peak lunch hours in each of the conditions throughout the span of a week.

Conditions

For our experiment, we focused on the disposal unit located against the wall in Ike's Café of the Irving K. Barber building at UBC. This location was chosen because it is central on campus and welcoming for students and staff from all faculties to intersperse. This disposal unit in particular is located near a microwave and seats, therefore is an ideal location to track the flow of waste disposal of a representative sample. For the control condition, we observed the compost, plastic, paper, and garbage bins without any manipulation (see figure 1).

Message. On the third and fourth day of experimentation, the message condition was conducted. The short message is used to stimulate the thought process of the participant to think whether they are about to sort their waste correctly or not. The message, "Do you sort your waste?" was chosen due to the length of the sentence being short enough for participants to quickly read while disposing their waste. The font Cambria in size 60pt was chosen for its eye-catching size and the readability of serif fonts (see figure 2). The message was printed four times and taped above each disposal bin at eye-level (see figure 3). A napkin provided by Ike's Café, measuring at 16.5cm in length, was used to determine the height above the disposal bins the message would be (see figure 4).

Mirrors. The mirror condition was conducted on the fifth and sixth day of our experiment. As per the research question, mirrors were used to identify how the presence of someone watching the participants as they disposed their waste impacted or improved their sorting behaviour. The mirrors are thought to have a greater impact on the participants' sorting behaviour than the message due to the presence of someone watching evoking participants to not hastily throw everything into the garbage bin. One small head sized mirror measuring at 14cm by

21cm, were placed at eye-level with the same distance from the disposal bins as in the message condition (see figure 5). Four individual mirrors were taped to the wall as opposed to one long mirror to place across the entire disposal unit so those who dispose waste into a particular bin are not affected by the reflection of the actions done at the other bins.

Mirrors with message. During the final two experimentation days, we conducted the mirror with message condition. In addition to the mirrors taped to the wall, the "Do you sort your waste?" messages from the message condition were taped underneath the mirrors as well (see figure 6). This was done to see whether the self-awareness induced by the appearance of someone watching the participants as they sorted their waste would have a further impact on them as they consciously read the message that corresponds to their actions.

Measures

Two coders were assigned to each condition conducted in the experiment. Observational measures were conducted to gather data as participants sort their waste in the compost or food, plastic or metal, paper, and waste bins. Each bin has its own accuracy rating in order to determine whether the participants sorted the right item into the correct bin. If he or she threw the item into the wrong bin, that participant would receive a zero in the data's accuracy measure. For example, if the participant had three items (paper, plastic, and compost), and disposed all three in waste that person will receive 0 for accuracy in all three categories of paper, plastic, and compost. Unobtrusive research methodologies were employed and participants were observed without their knowledge to avoid the possibility of experimenter bias.

Procedures

The experiment was executed consistently during 12:30 to 15:30 on Tuesdays, Wednesdays, and Thursdays in Ike's Café from March 10-21, 2015. Two experimenters out of five were paired up for data collection each time at Ike's cafe in Irving K. Barber Learning Centre based on their scheduled time shift. After the arrival of the two experimenters, they set up the experimental setting according to the conditions in implementation. A painter's green tape was used to stick the mirrors and messages to the wall to ensure no damage would be done to the wall paint. All experimenters made their observations from an available table near the disposal unit. The data was then recorded on a shared Google document on the experimenters' laptops. At the end of each experimental session, the experimenters took down all the experimental setting they set up initially and restored the station to its original state.

Results

Mean was used to analyze the observed data of the participants' average performance on accuracy of sorting behaviour in each condition (see table 1). The result of the presence of mirrors, messages, as well as mirrors with message on the accuracy of participants' sorting behaviour show statistically significance differences compared to the control condition. To be

more specific, the mean score of accuracy in sorting behaviour from the presence of mirrors (μ = 74), presence of the message (μ = 0.71), and presence of mirrors with message (μ = 0.73) are all larger than the accuracy of participants' sorting behaviour from the control condition (μ = 0.54).

Standard deviation was used to measure the spread of scores within a set of data in each condition (see table 1). The results of the standard deviation for the mirrors condition (σ = 0.41), messages condition (σ=0.38), mirrors with message condition (σ = 0.41), and control condition (σ = 0.47) all show that the samples collected from this experiment rarely had extreme cases.

T test was used to determine if two sets of data are significantly different from each other (see table 2). In this study, the alpha level is set as $p = 0.01$, and the data for the presence of mirrors, messages, as well as mirrors with message on the accuracy of participants' sorting behaviours are compared with the data from the control condition. Moreover, in this study, the data of the presence of mirrors, messages as well as mirrors with messages on the accuracy of participant's sorting behaviours are also compared between each other. The results show that there is a statistical significant difference between the comparison of the mirrors condition to the control condition ($p = 0.001$), message condition to the control condition ($p = 0.006$), and mirrors with message condition to the control condition ($p = 0.003$). However, the results also show that there is no statistical significant difference between the comparison of the mirrors condition to the mirrors with message condition ($p = 0.86$), or from the mirrors with message condition to the message condition ($p = 0.73$), and the mirrors condition to the message condition ($p = 0.59$).

A one-way between subjects ANOVA was used to analyze the data because the four conditions in this study are treated independently (see table 3). The effect of the presence of mirrors, messages, as well as mirrors with messages on the accuracy of participants' sorting behaviours is compared with the effect of the control condition. The results show that there is statistical significance between the control condition and the three experimental conditions ($F = 5.02$, $P = 0.002$). To be more specific, the degree of freedom ($F = 5.02$) is larger than F=1, which means that the null hypothesis is rejected because there is no difference between the experimental and control conditions. As the p-value ($p = 0.002$) is smaller than 0.01, the difference between the control condition and the three experimental conditions is significant; the observed difference is not random. This means that the presence of mirrors, messages, as well as the combination of both mirrors and messages have increased the accuracy of people's waste-sorting behaviour.

Discussion

In the present study, we have shown that all the three experimental conditions – the presence of mirrors, the presence of messages, as well as the presence of both mirrors and messages – have significantly increased the accuracy of participants' waste-sorting behaviours. According to our statistical analysis, no significant difference is found between those conditions.

In other words, all three conditions have an equivalent influence on participants' waste-sorting behaviours.

Interpretation of Results

One possible explanation of the research results could be that the presence of mirrors have induced participants' self-awareness and in turn changed their waste-sorting behaviours. Mirrors were used in previous studies as means to induce people's self-awareness in order to change their behaviours. According to Carver and Scheier (1978), self-awareness-inducing stimuli such as mirrors lead to an increase in dominant responses. In another study in which mirrors were used as a way to induce the participants' objective self-awareness, the participants' performance in simple tasks also improved (Wicklund & Duval, 1971). In our study, the presence of mirrors could first increase the participants' self-awareness and thus make them conscious of their waste-sorting behaviours. As we are surrounded by promotional messages of waste-sorting and recycling on UBC campus, the self-consciousness arisen by the presence of mirrors could lead to an introspection of peoples' attitude toward waste-sorting, thus resulting in their behavioural change through the influence from the promotional messages. Nonetheless, our study has not measured the change of participants' self-awareness. Measuring subjects' change of self-awareness is highly recommended in follow-up studies in the future.

Limitations

Although the experiment was conducted on numerous days, a limitation of this study is that the findings from this sample may not be generalized to the greater population due to its limited sample size and experimental location. We chose Ike's Café in the Irving K. Barber Learning Centre as the experimental location because it is one of the most frequently visited places by UBC students, however, Ike's Café only attracts a small portion of the UBC population during the lunch hours on the days we collected our data. No data collection was done to a bigger population. In addition, our data collection was done during the lunch rush, thus people might not have time to properly sort their waste. People might be more inclined to sort their waste during less busy time periods.

A second limitation of this study is the potential observation flaws resulted from more than one participant disposing a number of waste simultaneously. While there is more than one participant sorting waste into multiple bins, the angle and distance from which the two experimenters gauged activity may have prevented them from a flawlessly accurate view. We tried to tackle this problem by having two experimenters record data simultaneously. In future follow-up studies, one more experimenter could be added as a result checker.

A potential third limitation can be resulted from experimenter bias as well as experimenter-participant interaction. Although our experimenters have tried to remain as unobstructed as possible during observation, it is possible that some participants who are regular

customers of Ike's Café detected the experimenters' presence changed their waste-sorting behaviours. Another possible bias could be that we made mistakes in recording the subjects' waste disposal accuracy due to our subjective awareness of the change in the experimental conditions. Experimenters' eye contact with the participants may also have caused a change of their waste-sorting behaviours.

Recommendations for UBC

Several recommendations are generated from our study. First, placing mirrors and/or messages advocating for proper waste-sorting behaviour at the disposal stations on campus will effectively increase the accuracy of peoples' waste-sorting behaviour. Second, establishing a Waste Disposal Education Program to teach students the importance of waste-sorting as well as educating them the function for each disposal bin is necessary. We observed in our study that some participants tried to sort their waste into the appropriate bins but still failed due to a lack of knowledge of the acceptable materials for each bin. As a part of the program, for example, posters explaining importance of recycling, the sustainability plans of UBC, and recycling facts can be placed on high traffic locations such as washroom doors or at bus stops. The education program will help to shape a sustainable future by providing everybody with clear instructions so that students will have a better idea of how they could correctly sort their waste.

References

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    Mirror presence, and Audience presence. *Journal of Personality and Social Psychology,*

    36(3), 324-332.

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Appendix A

Figure 1: Control Condition

Figure 2: Message for Message Condition

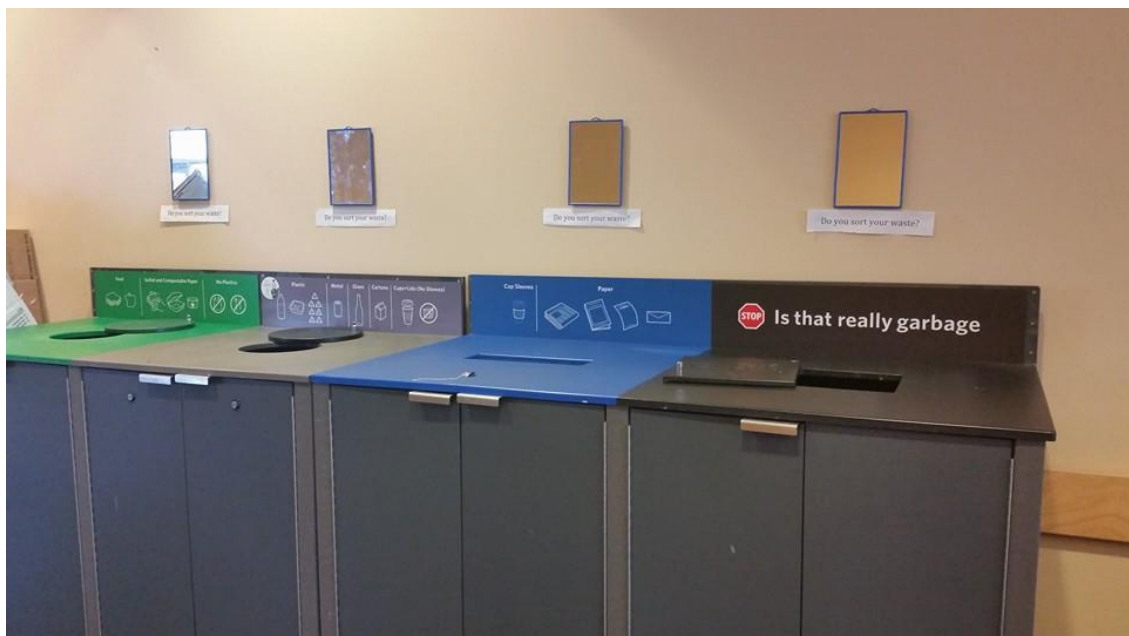Do you sort your waste?

Figure 3: Message Condition

Figure 4: Paper Napkin to Measure Distance of Message and Mirrors from Bins

Figure 5: Mirror Condition

Figure 6: Mirror with Message Condition

Appendix B

Table 1

Means and Standard deviations of 4 conditions

Conditions	n	Mean	Standard Deviation
Control	100	0.54	0.47
Mirrors	101	0.74	0.41
Messages	100	0.71	0.38
Mirrors&Messages	99	0.73	0.41

Table 2

T-test performed between the control conditions and the 3 experimental conditions; T-test performed to compare between each experimental conditions

	Mirrors vs. Control	Messages vs. Control	Mirror & Messages vs. control
P-value	0.001	0.003	0.006
	Mirrors vs. Messages	Mirrors vs. Mirror & Messages	Messages vs. Mirror & Messages
P-value	0.59	0.86	0.73

Table 3

One-Way between subjects ANOVA

	F-value	P-value
Factor (across conditions)	5.016	0.002