The Impact of Mirrors on Sustainable Waste Behavior

Hisayo Saito, Jessica Chen, Joan Ayinor-Okafor, Natalie Paeth, Sara Azarshahi

University of British Columbia

PSYC 321

April 07, 2016

The Impact of Mirrors on Sustainable Waste Behavior

Sara Azarshahi, Hisayo Saito, Natalie Paeth, Joan Ayinor-Okafor, Jessica Chen
University of British Columbia

Psychology 321

April 7, 2016

Executive Summary

Prior research has shown that "self-focus [can] bring about self-evaluation and thus make meeting a goal more important" to an individual (Paul, 2012, p. 192). In this regard, self-focus and self-evaluation may be involved in the presence of mirrors. This research explored whether the presence of a mirror impacts sustainable waste behaviour of participants at the University of British Columbia. The Forestry Building and the Life Sciences Building were the two locations in this study. Within each building, there was a mirrored station, which was the experimental condition, and a non-mirrored station, which was the control condition. The researchers weighed each bin and noted the number of contaminants - operationalized as incorrectly disposed rubbish - within each container, resulting in a ratio of contaminants per kilogram. An independent samples t -test was used on the ratio of contaminants per kilogram in garbage, organics, paper, and recycling, all of which were statistically insignificant. Secondly, we used an independent samples t-test on the weight and number of contaminants in each bin; all contamination rates were statistically insignificant. Limitations to our research follow, as well as implications and recommendations for future studies in regards to sustainable waste behaviour.

Research Question and Hypothesis

In this study, we investigate whether the presence of mirrors impacts the accuracy of waste sorting behavior. We hypothesize that the presence of mirrors will lead to an increase in accuracy of participants' waste sorting behaviour, compared to that of the bins without mirrors.

Methods

Participants

Participants in this study were individuals passing through the Forestry and Life Science buildings at UBC. This included students, faculty members, staff, and visitors to both buildings. Without the ability to randomly selecting participants, our experiment was a quasi-experiment.

Conditions

For this experiment we had two conditions. Each of the two buildings had one experimental and one control condition. The experimental condition was the mirrored disposal bin stations, while the control condition was the non-mirrored disposal bin stations. One of the mirrored disposal bin stations was located near the entrance of the Forestry building, while the other was located outside Perugia Cafe in the Life Sciences building. The non-mirrored disposal stations were also located in each of the two buildings. One non-mirrored station was located outside the Tim Horton's of the Forestry building, while the other was located near the back exit of the Life Sciences building. Each disposal bin station had four bins, which included a section for garbage, organics, paper, and recycling.

Measures

The researchers collected the weight of garbage, organics, paper, and recycling bins in kilograms by using an industrial scale. The weight of the contents was recorded by subtracting the weight of an empty container from the weight of the container with the contents inside of it. Empty garbage cans were 3.6 kg, and empty paper, recycling and organics bins were 12.0 kg. Contamination numbers- the number of incorrectly sorted items in each bin- were counted in the Life Science and Forestry buildings for both conditions while using latex gloves. These were counted independently to produce more consistent results. The use of a 30cm ruler established consistency as to how far researchers were to reach into the bins. Contaminants were counted only within this parameter. After the data collection period, the data from the two buildings were combined, which resulted in two conditions; mirror versus non-mirror.

Procedures

Prior to conducting the experiment, the researchers were trained by playing the Zhao lab's "Sort It Out" game online until scoring 100% to ensure sufficient knowledge of waste sorting (Zhao, 2016). Two researchers collected data in the Life Sciences and Forestry buildings each day for their scheduled shifts, which were conducted from Monday to Thursday between the hours of 12:30pm-1:30pm for three weeks. These times were decided after communication with the custodial staff, combined with the researchers' schedule constraints. The data was collected from sixteen bins per day, for a total of ten days. Hence, N=160 bins, with N=80 in each condition. After measuring the weight, as well as the number of contaminants for both conditions on each day, the data was compiled collectively into one google spreadsheet and analyzed in SPSS.

Results

Using a Pearson's *r* correlation coefficient, our inter-rater reliability yielded *r*=.99. With the data, we first calculated the ratio of contaminants per kilogram each time we weighed a bin. Running an independent samples t-test gave us differences in the means for each bin across conditions (Figures 5-8). There was not a significant difference in the contamination ratio for garbage on bins with mirrors (M=12.72, SD=9.92), and no mirrors (M=12.54, SD=6.08); t(38)= -.72, *p*=.93. In terms of recycling, there was not a significant difference in the contamination ratio for bins with mirrors (M=7.34, SD=7.96), and no mirrors (M=4.25, SD=2.86); t(38)= -1.64, *p*=.11. In terms of paper, there was not a significant difference in the contamination ratio for bins with mirrors (M=1.60, SD=3.44), and no mirrors (M=1.15, SD=1.41); t(38)= -.53, *p*=.60. Finally, there was not a significant difference in the contamination ratio for bins with mirrors on organics (M=2.75, SD=2.15), and no mirrors (M=4.40, SD=4.56); t(38)=1.47, *p*=.15. Because we had tested the ratio of contaminants/kg, we decided to separate the weight and contaminants to see whether using the full weight of bins, while only assessing for contamination in the top 30cm of a bin, skewed the results. We ran independent samples t-tests again on the weight and the number of contaminants for each type of bin. This yielded 8 mean differences between conditions (Figures 8-16). Only one category was statistically significant; the difference in weight in organics with mirrors (M=2.3, SD=1.27), and without mirrors (M=1.59, SD=.87); t(38)= - 2.07, *p*=.045. The weight of paper (*p* =.662.), recycling (*p* =.973), and garbage (*p* =.394), all were statistically insignificant. None of the contamination rates between conditions were statistically significant: organic contaminants (*p* =.618), paper contaminants (*p* =.485), recycling contaminants (*p* =.280) and garbage contaminants (*p* =.672).

Discussion

Interpretation of Results

Because the ratio of contaminants per kilogram did not yield statistically significant differences between the conditions, we are unable to support our hypothesis that mirrors have an impact on sorting behaviour. Thus, we were unable to reject the null hypothesis. Moreover, the separation of contaminants per kilogram into number of contaminants and weight in each condition also yielded insignificant results in terms of contamination rates. The one exception was the statistically significant difference in the weight of the organics between the conditions. The weight of the organics was higher in the mirror condition, albeit with no bearings on contamination. The reason for this is unknown, but may be due to location effects, as both mirror conditions were situated near the main entrances of both buildings. However, there was high levels of standard error in contamination ratios across bins and conditions (see Figure 5-8). This suggests that there was huge variability in the sampling distributions of our means throughout our data collection period. This high level of variance of the means makes it very difficult for statistical significance to be present. This variability was likely due to the changing levels of participant traffic throughout the week. For example, in the Life Science building there would be minimal people present one day, and then a conference the next, resulting in high variance of our means**.** A longer data collection period would aid in the standard errors having smaller variance, and may result in the mirror conditions having an impact on sustainable waste sorting behaviour.

Limitations

There were a number of limitations that could have impacted the results of this study. The first limitation is that the mirrors were installed over the stations in September of 2015. This could have resulted in habituation of the mirrors for participants. We imply that those who regularly frequent the two buildings may no longer notice the mirrors due to repeated exposure and familiarity, thus affecting our final results.

Our second limitation is that when we were weighing and checking the bins, individuals who were throwing out their waste felt inclined to be more accurate in their sorting behavior, perhaps due to the social desirability bias. The bins were also emptied at random times throughout the day, despite communication with the custodial staff on disposal times. This could be another reason behind the high levels of variance within the means of the bins.

Our third limitation is that the openings for the paper bins were rectangular, which may have improved the sorting behavior for paper products. The shape of the opening could have primed the individual to sort their waste in a more accurate way. Furthermore, there were several instances where individuals had thrown out large bundles of newspapers, causing a large difference in those days in terms of weight for data collection. The opening for the garbage bins were the most accessible, while organics and recycling had covers on the bins to reduce the smell, making garbage disposal the most convenient. This may be why the garbage bins, regardless of the presence of mirrors, had the most contaminants per kilogram.

Our fourth limitation is that we only counted contaminants in the top 30cm of a bin's contents, as we were instructed by our client to reach into the bins at an arm's length. The potential for missing contaminants throughout the remainder of a bin is highly likely. This is a problem, as we measured the full weight of the bins, while only assessing for contamination in the top 30cm of a bin, thus skewing our results.

Finally, the experiment was subject to experimenter bias, due to all of the researchers knowing which condition they were recording while counting contaminants. The conditions were also not completely equivalent. In the Forestry Building, the majority of the waste was from the Tim Horton's attached to the building. Tim Horton's produces more garbage in general, as their containers are non-compostable. In the Life Sciences building, Cafe Perugia has less traffic and less waste due to the use of non-disposable plates.

Recommendations for the University of British Columbia

We recommend that students should be required to play the "Sort it Out" game online prior to registering for classes (Zhao, 2016). It is also recommended that students watch a short film which explains the long term negative effects of inaccurate waste sorting behaviour, in hopes that the game and video will act as catalyst for sustainable waste behavior. If the individual does poorly, they should try again until they receive 100% accuracy. This would ensure students would be less confused when sorting their waste.

In addition, it would be beneficial to increase the communication between vendors and waste management processing plants at UBC. UBC facilities cannot process certain compostable plastic products and food containers. These products can be processed in other Metro Vancouver areas. Therefore, the regulation differences between UBC and facilities outside of UBC needs to be addressed to vendors. In addition, clear signage about the regulation differences at sorting stations for customers would allow for less contamination in organic bins.

It must be noted that there were numerous complaints about the appearance of the mirrors, as some students voluntarily approached and told the researchers that the mirrors looked

"distorted", made them feel "uncomfortable", or that they tended to avoid the mirror stations. If mirrors were to be incorporated, we suggest installing better quality mirrors to replace the current mirrors, in hopes to eliminate the discomfort of facial distortion felt by those passing by. Also, seeing that the mirrors potentially have no effect due to habituation, we suggest an increase in the intensity of the stimuli. Past research has shown that what makes one stimulus more prone to habituation than another is the varying degrees of intensity of the stimuli (Alonso, Moreno, Vazquez, Santacreu, 2005, p.134). This could be done by incorporating lights around the edges of the mirrors to draw more attention to it.

Finally, had our research found an impact of mirrors on waste sorting, a possible confound could have been the eco-friendliness of the Forestry Building, as other research has shown that eco-friendly buildings themselves improve sorting behaviour (Wu, DiGiacomo & Kingstone, 2013, p. 1). Thus, building differences may confound future research that looks into adopting this methodology. We recommend that the next project take place in a building that does not prime people to be more sustainable. This would increase the certainty that the manipulation of mirrors is the only factor impacting sorting behaviour. Suggestions for future studies are as followed: a comprehensive study where we have an observational period to watch individuals actively dispose of their rubbish, in addition to weighing and counting the number of all contaminants found in the bins. If counting contaminants is to be done, it is important to count through all the contents of the bins, for more valid results, as opposed to 30cm of rubbish. Furthermore, having a formal interview with participants whom we have observed will yield more information on the opinions and thoughts on the intervention of the mirrors.

Appendix

There were some difficulties in terms of communication between the researchers and their client. We took issue with the methodology given to us despite the researchers being aware of the confounds. After a discussion with the Teaching Assistant and our client, we developed a hybrid methodology, specifically weighing the full weight of the bins but only counting 30 cm of the contaminants. Originally we had differing opinions in how the experiment was to be run, which would have involved observational methods for accuracy. For this experiment to be consistent with the client's terminology, the researchers utilized the word "Organics" rather than "Food Scraps" to describe the green bin.

Figure 1: Life Science Building, Experimental Condition.

Figure 2: Life Science Building, Control Condition.

Figure 3: Forestry Building, Experimental Condition.

Figure 4: Forestry Building, Control Condition.

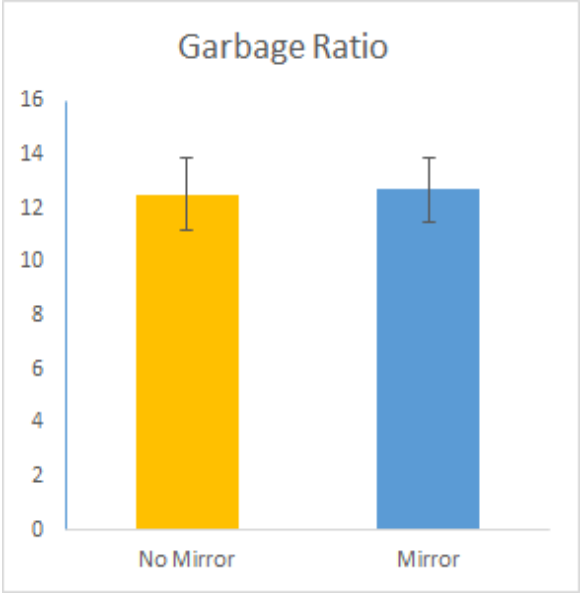

Figure 5. Garbage ratio. This figure illustrates the mean differences between the ratio of contaminants per kilogram for garbage with and without mirrors. The y axis indicates the number of contaminants per kilogram. Differences in means between the conditions was not statistically significant. Standard errors of the mean with no mirror=2.22; mirror=1.36.

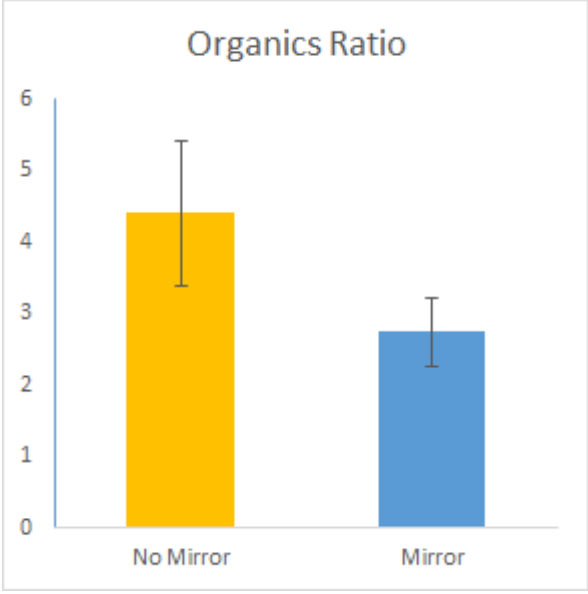

Figure 6. Organics ratio. This figure illustrates the mean differences between the ratio of contaminants per kilogram for organics with and without mirrors. The y axis indicates the number of contaminants per kilogram. Differences in means between the conditions was not statistically significant. Standard errors of the mean with no mirror=1.02; mirror=.48.

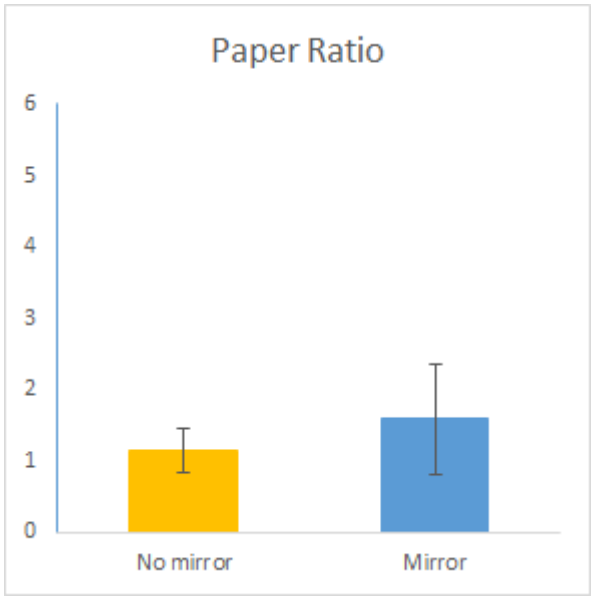

Figure 7. Paper ratio. This figure illustrates the mean differences between the ratio of contaminants per kilogram for paper with and without mirrors. The y axis indicates the number of contaminants per kilogram. Differences in means between the conditions was not statistically significant. Standard errors of the mean with no mirror=.34; mirror=.77.

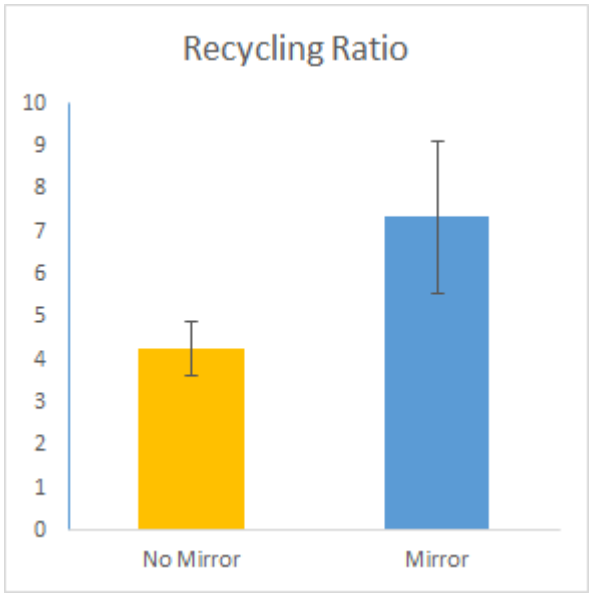

Figure 8. Recycling ratio. This figure illustrates the mean differences between the ratio of contaminants per kilogram for recycling with and without mirrors. The y axis indicates the number of contaminants per kilogram. Differences in means between the conditions was not statistically significant. Standard errors of the mean with no mirror=.64; mirror=1.78

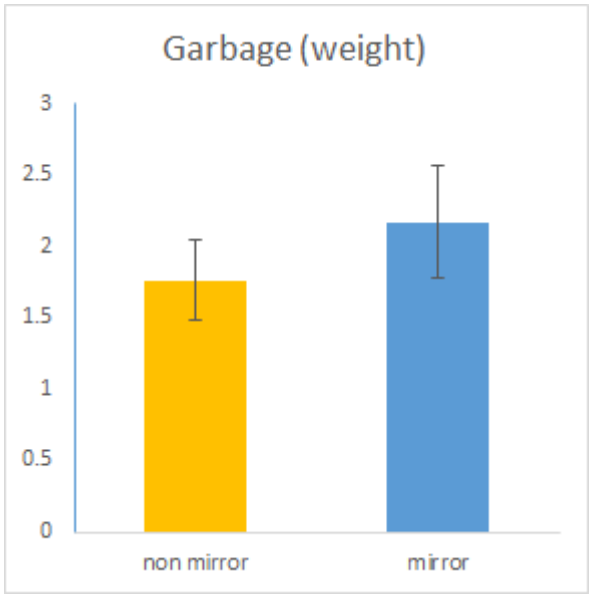

Figure 9. Garbage weight in kilograms. This graph describes the differences in mean weight of garbage across conditions. Differences in means between the conditions was not statistically significant.

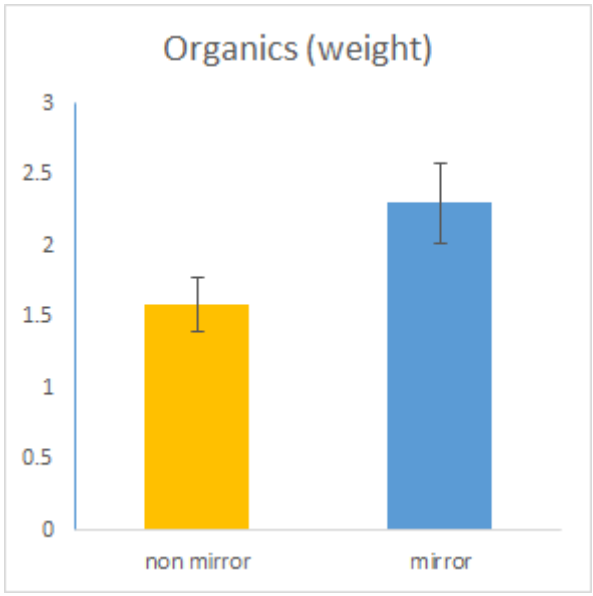

Figure 10. Organics weight in kilograms. This graph describes the differences in mean weight of organics across conditions. Differences in means between the conditions was statistically significant with mirrors (M=2.3, SD=1.27), and without mirrors (M=1.59, SD=.87); t(38)=- 2.07, *p*=.045.

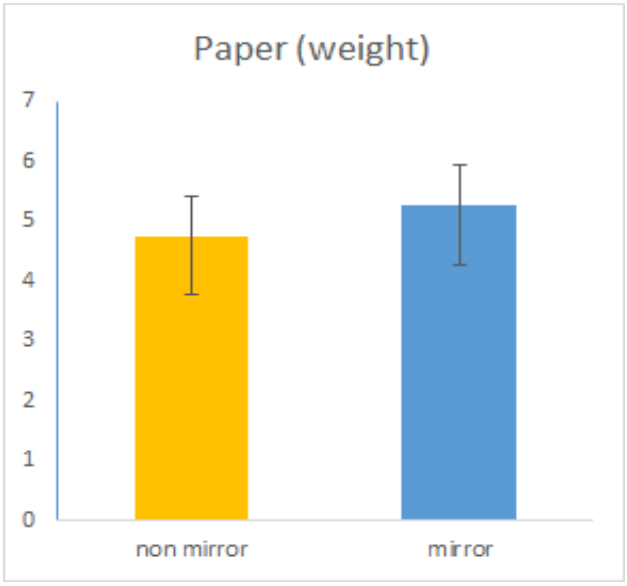

Figure 11. Paper weight in kilograms. This graph describes the differences in mean weight of paper across conditions. Differences in means between the conditions was not statistically significant.

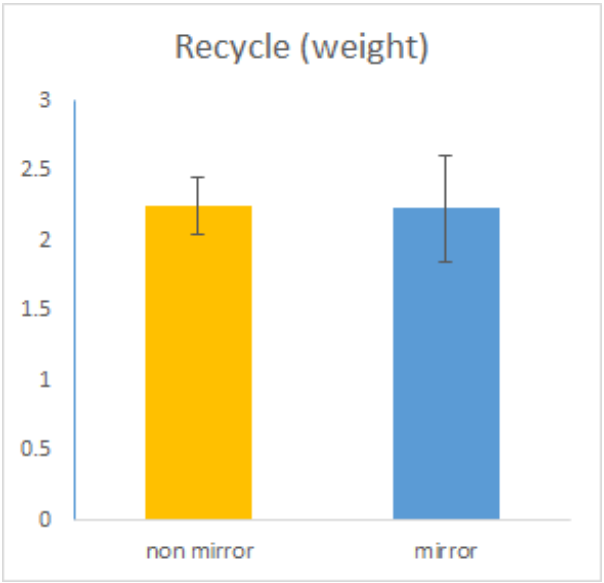

Figure 12. Recycling weight in kilograms. This graph describes the differences in mean weight of recycling across conditions. Differences in means between the conditions was not statistically significant.

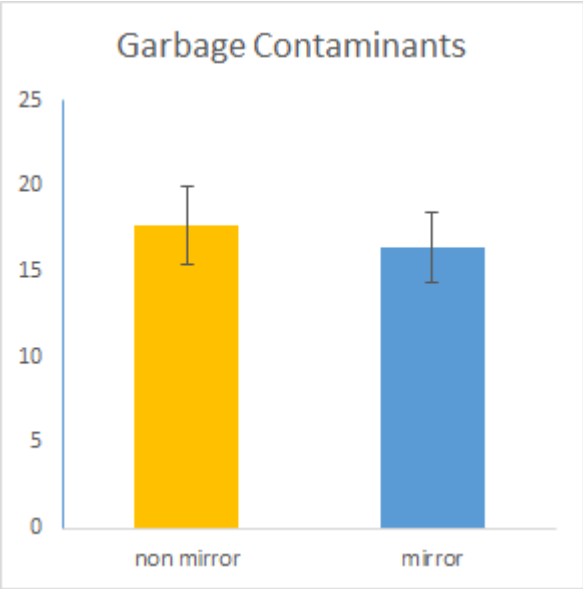

Figure 13

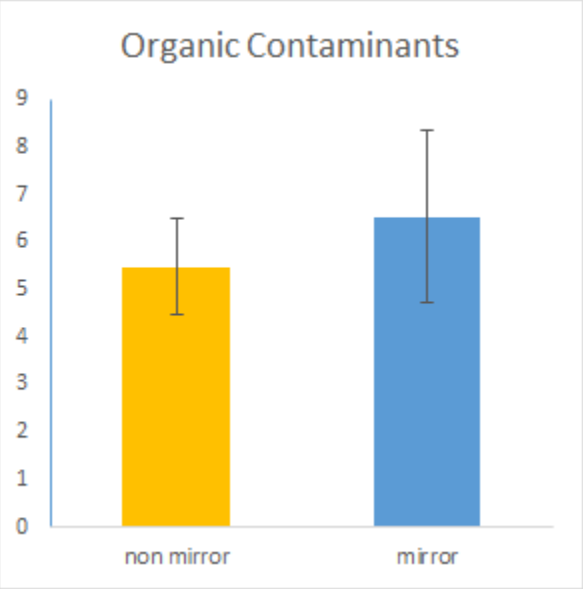

Figure 14

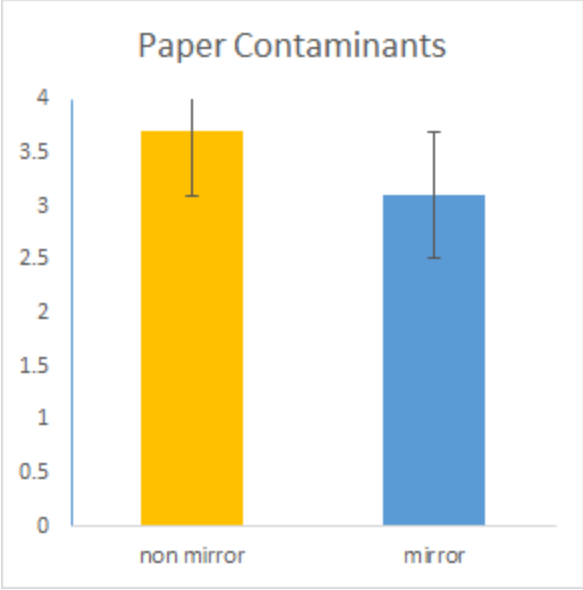

Figure 15

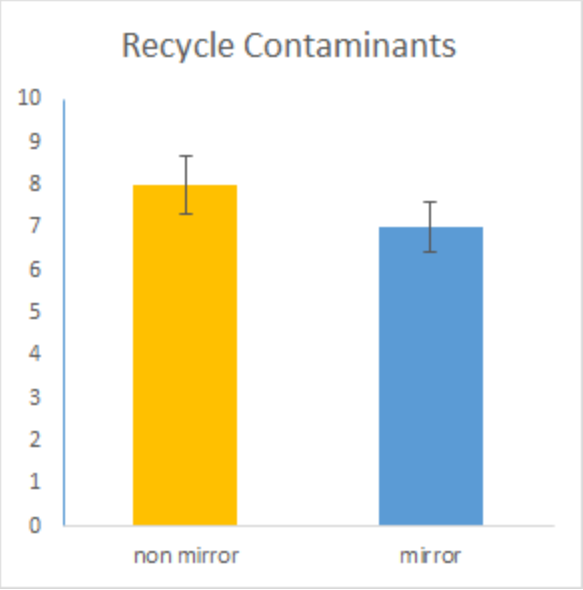

Figure 16

Figures 13-16. All figures describe the differences in the mean for each type of bin, between conditions. Weight in kilograms. Differences in means between the conditions was not statistically significant for any of the four graphs.

References

Alonso, L., Moreno, R., Vazquez, M., & Santacreu, J. (2005). Simulation of the filtering role of habituation to stimuli. *The Spanish Journal of Psychology, 8*(2), 134-141.

Paul, S. J. (2012). Mirrors, masks, and motivation: Implicit and explicit self-focused attention influence effort-related cardiovascular reactivity. *Biological Psychology, 90*(3), 192-201.

Wu, D. W.L., DiGiacomo, A., & Kingstone, A. (2013). A sustainable building promotes pro-environmental behavior: An observational study on food disposal. *PLOS One, 8*(1), 1-4.

Zhao, J. (2016, January). Sort it out. Retrieved April 5, 2016, from Zhao Lab website: http://zhaolab.psych.ubc.ca/studies/Sorting/