Can Emily Help UBC Students Sort it Out?

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Executive summary

The aim of this study is to examine sorting behaviour at the University of British Columbia (UBC) based on exposure to a campus wide sustainability ambassador named 'Emily,' a cartoon character. The experimental condition consisted of a waste disposal unit with four streams: organics, recycling, paper, and garbage with the poster of Emily. The control condition consisted of these four streams of waste disposal units at a different location, without the poster of Emily. The study was performed over a two-week period, yielding 10 days of measurement. Researchers weighed each of the four bins in the control and experimental condition, and then sorted through the bins in order to identify the number of contaminants in each bin. It was hypothesized that the presence of Emily would increase sorting behaviour, thereby yielding a higher mean kg/contamination ratio. Qualitative measures included most incorrectly sorted contaminant count and change in mean kg/contamination ratio over time. Findings from this study conclude that the presence of Emily had no impact on sorting behaviours. Also cutlery was found to be highy incorrectly sorted. Further analysis will be needed to determine what education people will need in order to effectively sort waste.

Research Question and Hypothesis

Over the course of the past few years, The University of British Columbia (UBC) has implemented several programs and policies in place in order to increase its sustainability efforts, including; the addition of 636 courses related to sustainability (University of British Columbia, n.d., p.8), the replacement of 568 individual garbage cans with 400 recycling stations (UBC, n.d., p.21), and the inclusion of public signage to promote sustainable behaviour. One of these sustainability campaigns is the Ripple Effect, which was created and implemented in 2013, with its sustainability ambassador Emily (Samson, 2015). Emily is an animated caricature with the purpose of motivating UBC students, faculty, and staff to be more environmentally sustainable; to adopt behaviours that have a positive impact on the environment. While Emily is involved in several sustainability efforts at UBC, such as advocating for transit use and biking, the focus of our paper is the impact of Emily on 'sorting behaviour.' Emily posters, such as the one depicted in Figure 1, have been incorporated in several disposal unit signage; with the hope of increasing 'sorting behaviour' amongst users. The purpose of this study, and the main research question, was to determine the impact of Emily on waste sorting behaviours. Researchers hypothesized that the presence of Emily, around waste disposal units, would improve sorting behaviour among UBC students, faculty, staff and guests thereby increasing the mean kg/contamination ratio across both conditions.

Methods

Participants

The participant population in this study includes the students, staff, faculty and guests who disposed of their waste in Ike's Café, located in the Irving K. Barber Library, at the University of British Columbia.

Conditions

The design employed in this study was a between-subjects, quasi-experimental non-observational, comparison between the two experimental conditions; an experimental condition involving the presence of Emily, and a control condition with Emily absent. Within the experimental condition, there were disposal units consisting of four sorting streams; organics (identified as food scraps and compostable containers), recycling (clean containers with recycle logo), paper products (non-soiled paper), and garbage (anything that cannot be thrown in the other streams). The two disposal units were located in a transient environment in Ike's Café; situated near the main entrances and exists. Due to the quasi-experimental non-observational nature of this study, subjects were not randomly assigned to either condition, and nor were they observed during their interaction. Individuals self-selected the disposing units they utilized, and the data was collected after-the-fact. The dependent variable of this study was the mean kg/contamination ratio of the four streams in the disposal units, whereas the independent variable was the presence or absence of the Emily poster above the disposal units.

Measures

Both quantitative and qualitative measures were taken in this study, in order to determine the effect of Emily on sorting behaviour. The quantitative measures include the following; a mean kg/contamination ratio, mean bin weight (kg), and mean contamination count, comparing between the two experimental conditions, across all four streams. The qualitative measures include: the change in kg/contamination ratio over time, and the most incorrectly sorted contaminant count. Bin weight, measured in kilograms, was obtained by measuring the individual weight of the bins using a standard scale measuring to the nearest gram, across both conditions. Contamination was operationally defined as 'any item that was not correctly sorted' in each bin. This contamination criterion was based off of UBC's sustainability *Sort it Out* guidelines (Figure 2). To determine the level of contamination in each bin, researchers sorted through the disposal units by hand, counting the number of mis-sorted items in each.

Procedure

This experiment took place over a two-week period, excluding weekends, totaling 10 days of measurement in the month of March. Custodial staff emptied the disposal units at 23:00 the day prior to the measurements taken by researchers, and the following day between 16:00 and 17:00. The waste units were not emptied between 23:00 and 16:00 hours, allowing 17 potential hours for waste disposal. The tenth day of measurement was excluded due to unexpected janitorial clean up, where the bins were emptied just prior to measurement. Each bin was individually weighed on a scale, and the weight in kilograms was recorded. The recorded weight included the bin weight with contaminants in each bin. Prior to the measurement recordings, the researchers estimated the waste capacity of each bin. If the bin was at a sixty percent capacity or greater, the researchers sorted through the first 10 percent of the bin, and estimated the remaining number of contaminants. When the bins were less than a sixty percent capacity, the researchers sorted through the waste in its entirety. The total number of contaminants and the type of contaminants within each bin were then recorded.

Results

Quantitative

Two different statistical analysis tests were conducted in this study; a one-way ANOVA and an independent samples t-test. The first set of independent samples t-tests conducted compared the mean kg/contamination ratio of each stream, organics, recycling, paper and garbage, between the two conditions, experimental (Emily present) and control (Emily absent). The mean kg/contamination ratios, for each stream within the two experimental conditions, is displayed in Figure 3. The independent samples t-tests yield the following non-statistically significant results; organics-experimental ($M= 0.88$, $SD= 0.49$) and organics-control ($M= 0.68$, $SD= 0.26$), $t(16) = 1.08$, $p=0.15$; recycling- experimental ($M= 1.36$, $SD= 0.47$) and recycling-control ($M= 1.71$, $SD= 0.71$), $t(16) = -1.23$, $p=0.12$; paper- experimental ($M= 3.48$, $SD= 4.17$) and paper-control ($M= 3.54$, $SD= 2.42$), $t(16) = -0.04$, $p= 0.48$; and garbage- experimental ($M= 0.15$, $SD= 0.06$) and garbage-control ($M= 0.14$, $SD= 0.02$); $t(16) = -0.22$, $p=0.42$.

The second set of independent samples t-test conducted compared the mean bin weight, measured in kilograms (kg), of each stream, between the two conditions; this is displayed in Figure 4. The independent samples t-tests yield the following non-statistically significant results; organics-experimental ($M= 17.47$, $SD= 2.83$) and organics-control ($M= 16.20$, $SD= 0.87$), $t(16) = 1.29$, $p= 0.11$; recycling-experimental ($M= 13.61$, $SD= 1.47$) and recycling-control ($M= 14.62$, $SD= 0.70$), $t(16) = -1.86$, $p= 0.06$; paper-experimental ($M= 13.98$, $SD= 0.75$) and paper-control ($M= 12.78$, $SD= 0.96$), $t(16) = -2.93$, $p= 0.10$; and garbage-experimental ($M= 6.5$, $SD= 1.34$) and garbage-control ($M= 5.82$, $SD= 0.51$); $t(16) = 1.41$, $p= 0.17$.

The third set of independent samples t-test was conducted on the contamination count of each stream, between the two conditions; the results are displayed in Figure 5. The independent samples t-tests yield the following non-statistically significant results; organics-experimental ($M= 24.66$, $SD =11. 28$) and organics-control ($M= 26.55$, $SD= 8.90$), $t(16) = 0.39$, $p= 0.34$; recycling-experimental ($M= 11.88$, $SD = 6.77$) and recycling-control ($M= 9.44$, $SD= 2.55$), $t(16) = -1.01$, $p= 0.33$; paper-experimental ($M= 6.77$, $SD = 6.35$) and paper-control ($M= 7.77$, $SD= 8.15$), $t(16) = 0.29$, $p= 0.45$; and garbage- experimental ($M= 46.66$, $SD = 19.66$) and garbage-control ($M= 40.66$, $SD= 6.65$); $t(16) = -1.30$, $p= 0.21$.

The last statistical analysis conducted on the data, to calculate the overall effect of Emily on the two conditions, is a one-way ANOVA. The mean kg/contamination ratio of each experimental condition is depicted in Figure 6. The one-way ANOVA, comparing the mean kg/contamination ratio between the two conditions, yields no statistically significant difference in kg/contamination ratio for experimental ($M= 1.55$, $SD = 2.39$) and control conditions ($M= 1.41$, $SD= 1.73$); $F(1,70)= 0.01$, 0.29, $p= 0.48$.

Qualitative

The two qualitative measures taken in this study include; the contamination ratio over time, and the most incorrectly sorted contaminant count. The 'most incorrectly sorted contamination count', related to the experimental and control conditions, are displayed in Figure 7 and 8 respectively. An analysis of the results suggests that cutlery, compostable containers, and soiled tissue were the top most wrongly sorted items across both conditions. As can be seen from Figure 7, the most frequently contaminated streams within the experimental conditions include; organics, with cutlery being the top contaminant, followed by garbage, with cutlery and compostable containers being the top contaminants. The least contaminated streams include; recycling, with soft plastic being the top contaminant, followed by paper, with soiled paper being the top contaminant. In the control conditions, as can be seen displayed in Figure 8, the most frequently contaminated streams include; organics, with cutlery being the top contaminant, followed by garbage, with cutlery, soiled tissue and compostable containers being the top contaminants. The least contaminated streams include; recycling and paper, with soiled tissue being the top contaminants in both.

The 'kg/contamination ratio over time,' related to the experimental and control conditions, are displayed in Figure 9 (a-d). As can be seen in Figure 9a, the kg/contamination ratio in the organics stream, regardless of experimental condition, decreased over time. In Figure 9b, the kg/contamination ratio in the recycling stream had a slight increase during day six; with the control condition resulting in a higher kg/contamination ratio than the experimental condition. In Figures 9c-d, there was a slight increase in kg/contamination ratio during day five; with the experimental conditions, in both the paper and garbage stream, producing higher kg/contamination ratios.

Discussions

The results of this study suggest that while a slight difference was present between the experimental and control conditions, when comparing the mean kg/contamination ratio, mean weight and contamination count across all streams, these results were not statistically significant. The hypothesis was refuted; the presence of Emily did not show a significant increase in the sorting behaviour, regardless of the stream. We can conclude that the differences observed between the experimental and control conditions, regardless of the measures used, was not attributed to the impact of Emily.

Upon examination of the data, there were certain patterns which the researchers observed that pertain to waste-sorting behaviour. The three types of waste items that were most frequently sorted incorrectly were: soft plastic, cutlery, and soiled paper. In addition to this, a tendency for individuals to group items, such as food, cutlery, and soiled paper, into containers was regularly observed during the data collection process. The high contamination from cutlery across both conditions occurred as a result of individuals' tendencies to place all of their eating materials into a single food container; throwing this material away as a single unit, rather than separating and sorting. This is evident from the fact that most of the cutlery the researchers' measured was located within food containers. The same reasoning could be extended for the high contamination from compostable containers in garbage. Perhaps people do not have the motivation to sort through the now soiled materials that they have packed in the container and thus end up throwing everything in the garbage bin. However, contamination from soft plastic probably arises because people are unable to distinguish between hard and soft plastic.

Limitations

Some potential limitations of this study should be noted. The first limitation of this study is the lack of proper measuring tools. Without the use of measuring tools, such prongs or rods, which would enable us to reach the bottom of the bins, it was not possible to thoroughly sort through - and subsequently identify - all contaminants. For trash bins that were filled to 60% or more, we were able to account for all contaminants sorted in the first 10%, after which we estimated contamination count for the remaining amount.

The second limitation includes the brief time period permitted to for data collection (approximately two weeks). Having a greater amount of time to take measurements, and gather more information, may have helped to confirm the significance of the patterns which we found. In addition, on the last day of measurement (May 18, 2016), there was an unexpected emptying of bins shortly prior to measurements being taken. Inclusion of this outlying information would have resulted in skewed data. As a result, we chose to exclude measurements taken on the last day, and were left with a total of nine days' worth of data, as opposed to ten.

The third limitation involves the location of the bins. The location of the control (Emily absent) and experimental (Emily present) bins which we used to collect data were predetermined; preventing us from moving the poster to counter-balance the presentation of Emily. Both bins were located in relatively close proximity to each other within Ike's Cafe, at Irving K. Barber Learning Centre. Exposure to Emily is highly dependent on one's chosen path of entry into IKB. Despite the decision to approach the control bins, participants may have been exposed to the Emily poster which may have had a lasting effect on their waste sorting behaviour.

Lastly, our entire study was conducted on the assumption that UBC students, faculty, staff, and guests are fully aware of Emily, and her role as a sustainability ambassador in the community.

Recommendations to the Client

Future studies that aim to investigate the effects of a particular figure, or campaign effort, on waste sorting behaviour, should first consider taking steps to determine whether or not their participants possess fundamental awareness and knowledge of what is being investigated.

Furthermore, previous research by Eklund et al. (2010) suggests that time constraints may be a potential influencing factor regarding the observed tendency for people to group items together upon disposal. Further research into this particular behaviour may prove especially useful in formulating effective methods to improve waste sorting behaviour. Researchers may also wish to investigate waste-sorting techniques that aim to work *around* this behaviour, should it prove particularly difficult to change.

Previous studies have also demonstrated that people's sorting behaviours suffer from categorical confusion (Eklund et al., 2010). Thus, it would be beneficial for UBC to emphasize sorting of certain items. The label above the organics bin clearly says "No Plastics" with an image of a plastic bag struck through. The same label could be used above the recycling bins to ensure accurate sorting. Even with Emily present, recycling consistently showed higher contamination on most days.

Finally, according to Visschers et al (2016), knowledge of proper recycling behaviour alone does not provide sufficient motivation to improve sorting behaviour. Barr (2007) suggests targeting individuals at a deeper level by encouraging the implementation of value systems in early life that highlight the necessity of caring for the environment.

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Appendix

Appendix A:

Figure 1: Emily Poster

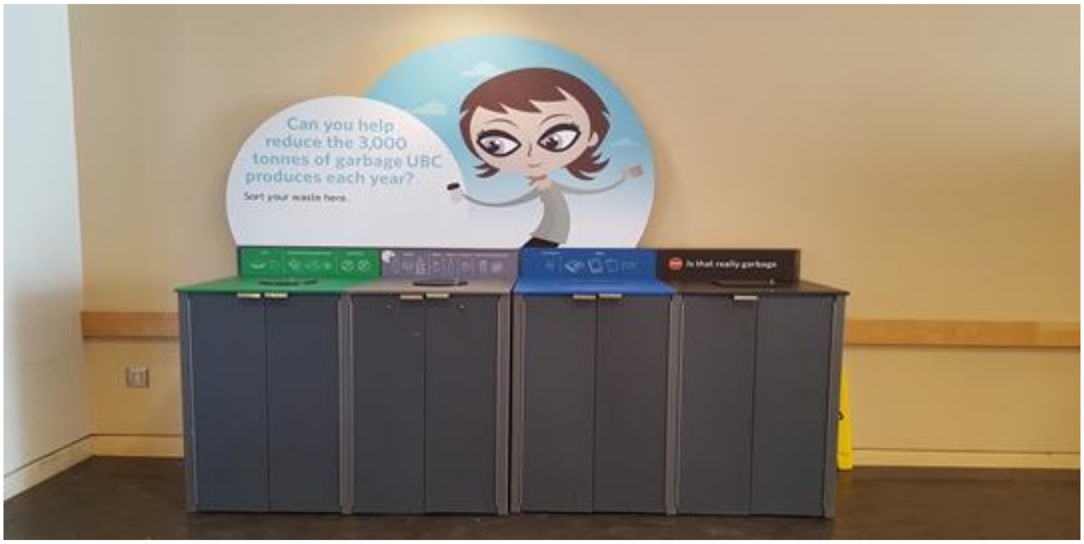


Figure 2: Sorting Guide

Appendix B:

Figure 3: Comparing the mean kg/contamination between conditions, for each stream

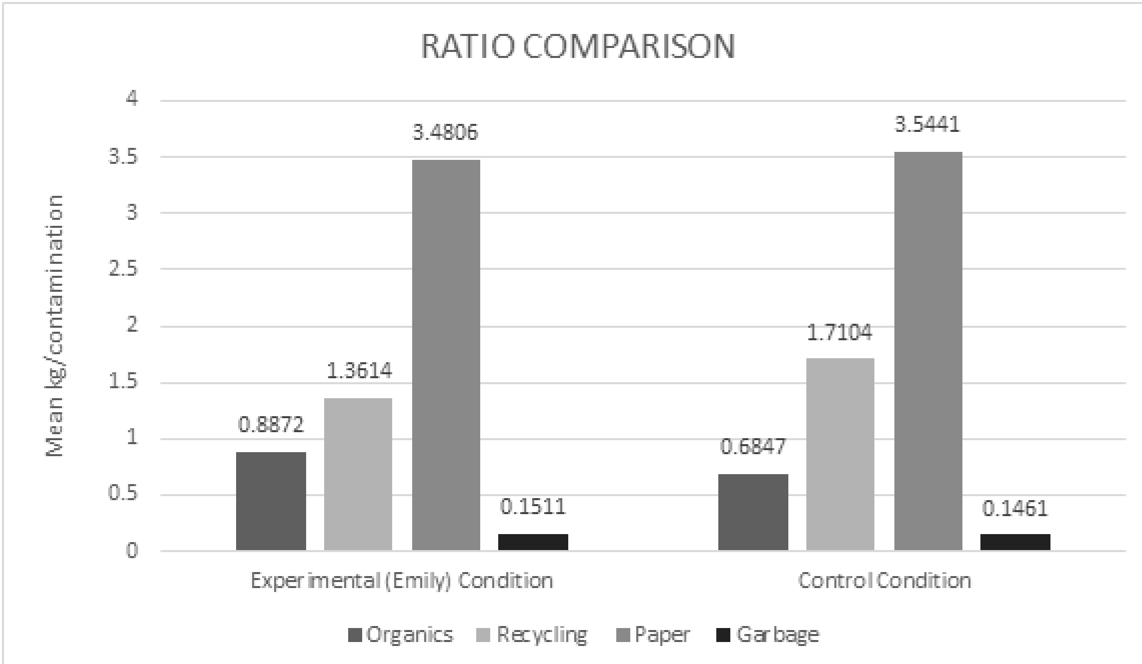


Figure 4: Comparing the mean weight (kg) between conditions, for each stream

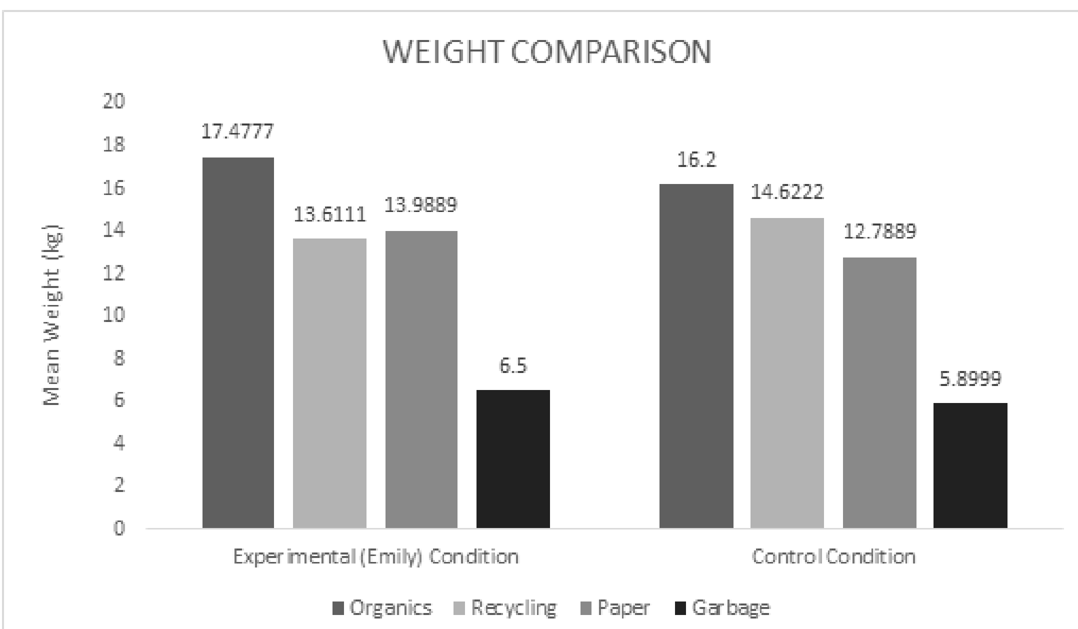


Figure 5: Comparing the mean contamination count between conditions, for all streams

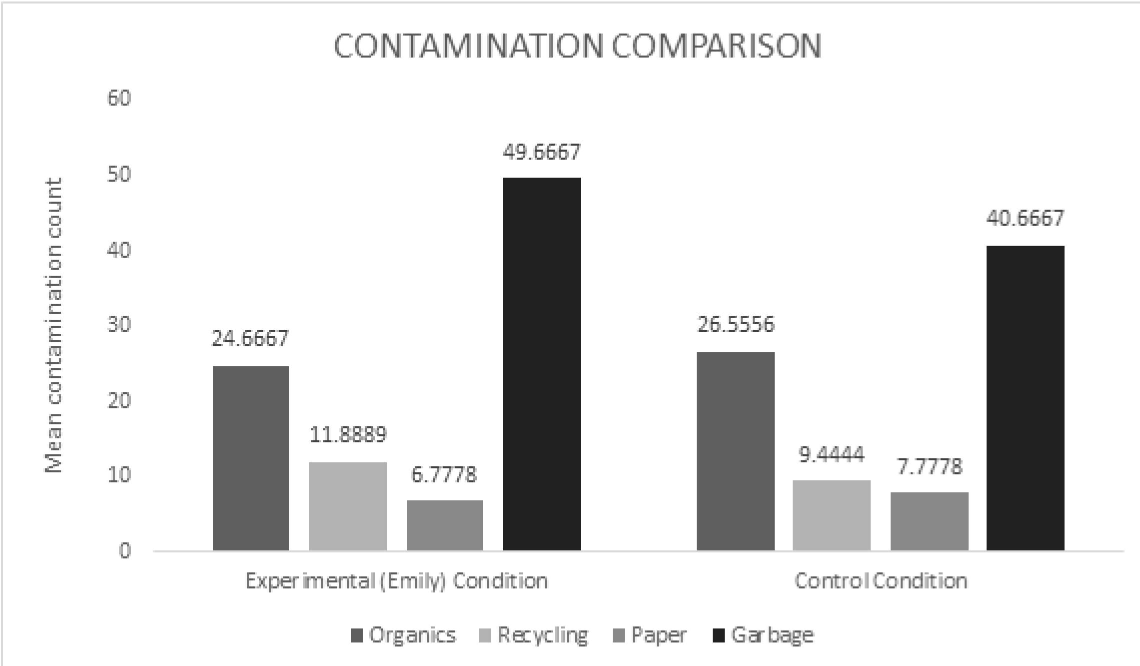


Figure 6: Analyzing the 'overall effect' of Emily on the experimental condition

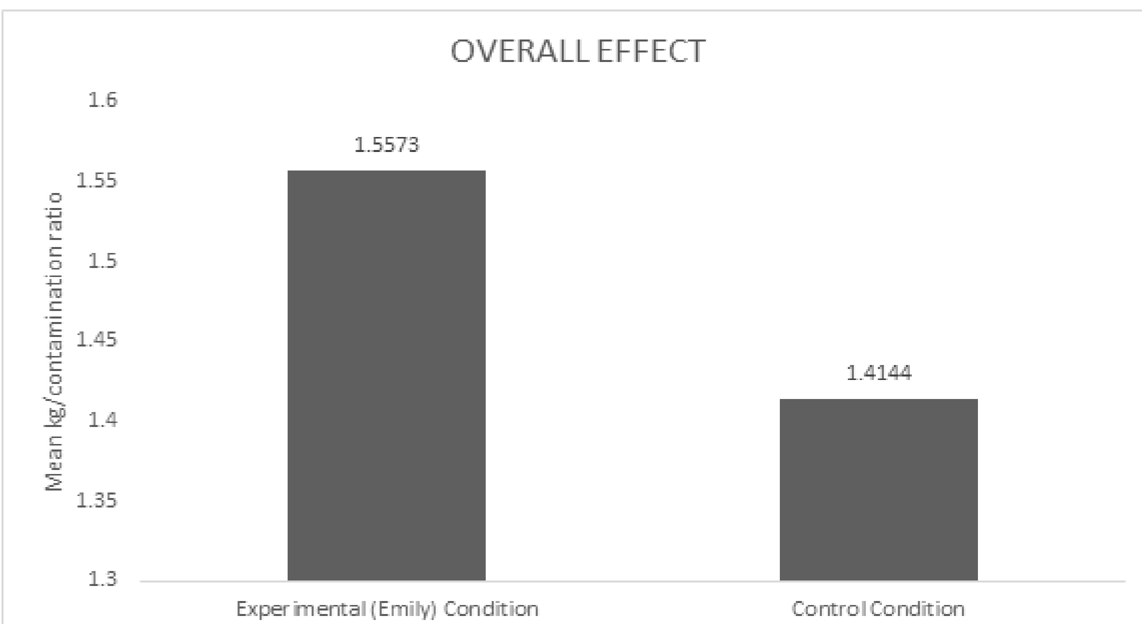
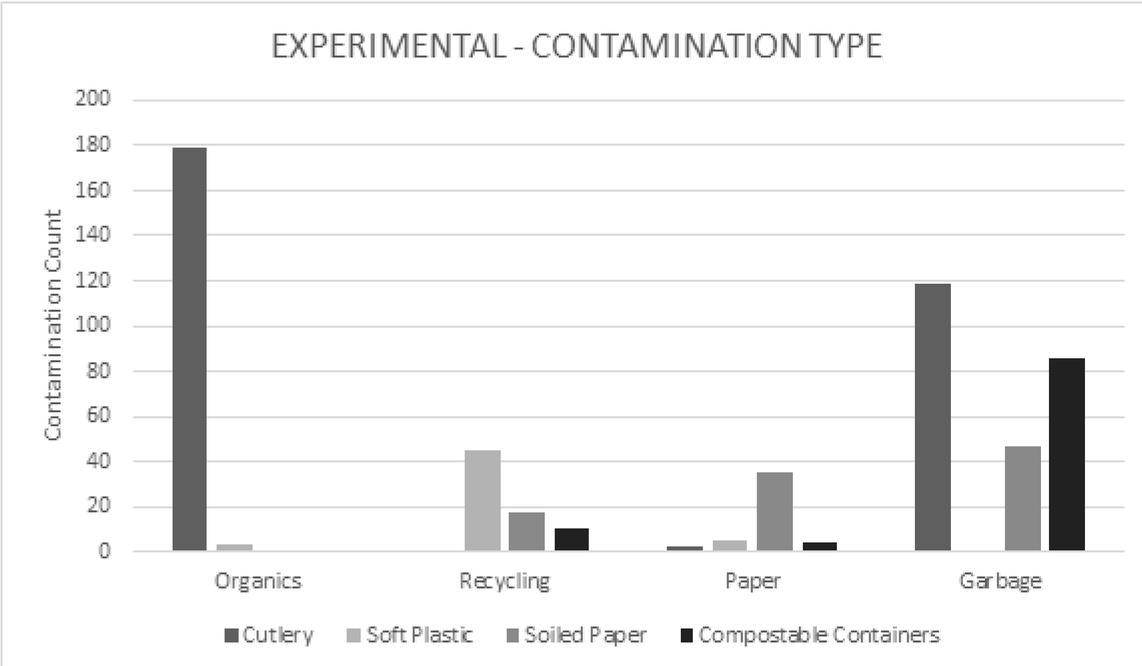


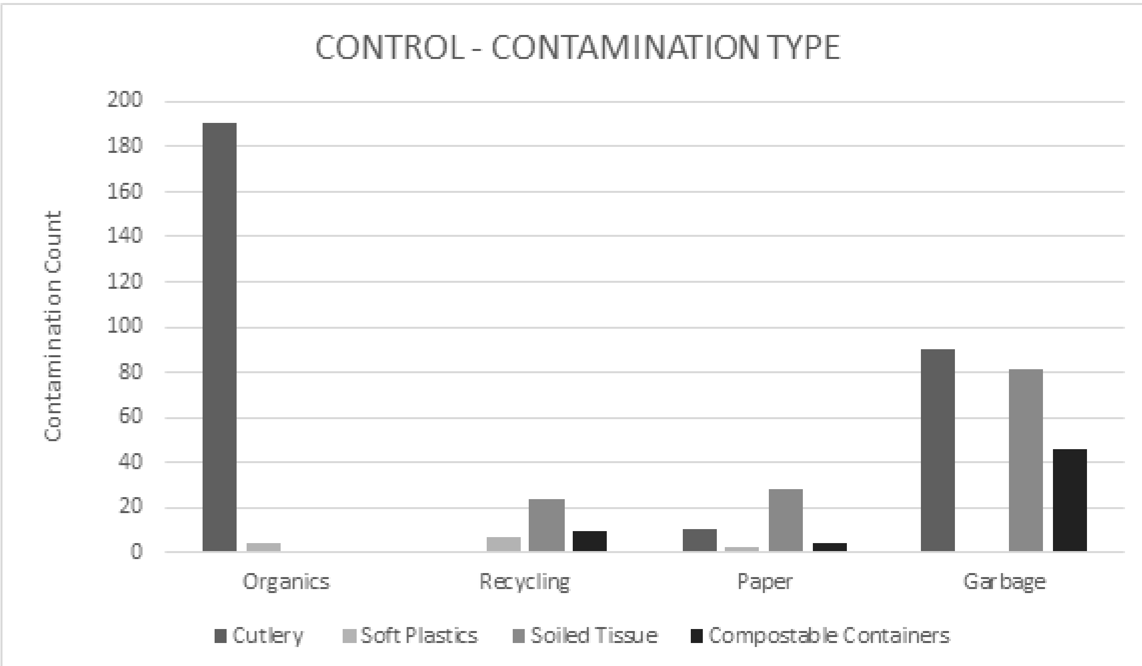
Figure 7: Qualitative analysis of the most incorrectly sorted contaminant found in each stream, in experimental condition



Experimental	Organics	Recycling	Paper	Garbage
Cutlery	179	N/A	2	119
Soft Plastic	3	45	5	N/A
Soiled Paper	N/A	17	35	47
Compostable Containers	N/A	10	4	86

** Organics: Soiled Paper and Compostable Containers are not contamination
** Recycling: Cutlery is not contamination
** Garbage: Soft Plastic is not contamination

Figure 8: Qualitative analysis of the most incorrectly sorted contaminant found in each stream, in control condition



Control	Organics	Recycling	Paper	Garbage
Cutlery	194	N/A	10	90
Soft Plastics	4	7	2	N/A
Soiled Tissue	N/A	24	28	81
Compostable Containers	N/A	9	4	46

** Organics: Soiled Paper and Compostable Containers are not contamination
** Recycling: Cutlery is not contamination
** Garbage: Soft Plastic is not contamination

Figure 9: Qualitative analysis of the change in kg/contamination ratio over time