Sort-it-with Waldo and its Effects on Pro-Environmental Behaviour

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Final Report:

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Executive Summary

This paper investigates the research question: *Can a redesign of the current 3D display bins at UBC improve the waste-sorting behaviour in the UBC student body, faculty, and visitors in the AMS Nest?* by implementing a new intervention--*Sort-it-with Waldo* 3D display bins. This study aims to increase the accuracy of waste-sorting behaviour by drawing patrons' attention to the cut-outs of a well-known cartoon figure (i.e. *Waldo*) in the transparent 3D display boxes mounted on a set of *Sort-it-out* bins at the AMS Nest. Also, the redesigned 3D display boxes were filled with samples of waste typically generated at the AMS Nest and of their respective disposal category. Our study established a baseline of no intervention through counting the number of contaminants in each bin and weighing the total waste in each bin. This baseline was then compared with the experimental condition that used *Sort-it-with Waldo* 3D display. We hypothesized that the implementation of *Sort-it-with Waldo* will influence the waste-sorting behaviour as evident in a change in the number of contaminants and in weight. The research findings indicated that there was no significant difference between the control and experimental condition. A replication of the study is suggested along with recommendations for eye-catching visual displays for future interventions.

Project Title:

Sort-it-with Waldo and its Effects on Pro-Environmental Behaviour

Research Question

Can the current Sort-it 3D display bins be improved to make them more effective by redesigning the inside of 3D bins (i.e. including more waste examples and a Waldo Character) to increase accuracy of waste sorting behaviour of UBC student body, faculty and visitors located at AMS Nest?

Hypothesis

The implementation of the *Sort it with Waldo 3D* display will increase waste-sorting accuracy among UBC student body, faculty and visitors at AMS Nest

Methods:

Participants: Our participant population included the UBC student body, faculty and visitors who used the *Sort-it-out* 3D bins located in the Lower Level of AMS during weekdays. In the experiment, every individual passing by the waste sorting station had an equal chance of participating in the study, since the experiment was not conducted in a controlled environment. After the study, 20 people who were approximately within the 5 meter range of *Sort-it with Waldo* 3D display were randomly selected to participate in a short survey regarding the experimental 3D displays. (See Appendix Table 2.1)

Conditions: The study consists of two conditions: control condition (i.e. baseline) with *Sort-it-out* bins with the current 3D display and experimental condition with *Sort-it-with Waldo 3D* display. *A Sort-it-with Waldo 3D bin contains* 2D cardboard cut out of cartoon character *Waldo* holding a bin according to the type of disposal (See Appendix 4.2). The box was also filled with more 3D waste models in respect to their disposal category (See Appendix 4.1, 4.3). The Independent variable in our study is the *Sort-it-with Waldo* 3D bins; the dependent variable in our study is the participant's waste sorting accuracy.

The control condition ran for five weekdays at the 3D display bins located under the staircase in the AMS Nest Lower Level in front of the *Emily* intervention. Then, the experimental condition ran the consecutive week for another five weekdays at the same location, but with *Sort-it-with Waldo* 3D display bins. The independent variable in our study was the implementation of the *Sort-it-with Waldo* 3D display bins, whereas the dependent variable was the accuracy of participants' waste-sorting behaviour as reflected in the total weight of each disposal bag and the number of contaminants in each bag.

Measures: The designated *Sort-it-with Waldo* 3D display bins included four types of disposal: food scraps, recyclable containers, paper and garbage. To assess participants' sorting accuracy, the number of contaminated wastes in each category were visually identified and counted according to the *Sort-it-out Guide* on the UBC website. Then we compared the number of contaminated wastes in the control condition and experimental condition. If the results supported our hypothesis, the decreased number of contaminants would indicate that the intervention successfully improved the sorting behaviours in participants. Furthermore, a digital luggage scale was used to measure the total weight of each disposal bag in kilograms (See Appendix Figure 5). This was to identify if there was a change in weight between the kilograms of weight in the control and experimental condition. The change may denote an influence of the *Sort-it-with Waldo* intervention on the participants' sorting behaviour.

After the experimental condition had ended, we conducted a qualitative survey to further examine the effectiveness of the *Sort-it with Waldo* intervention on a random selection of 20 participants within approximately a five-meter radius of the sorting station (Appendix Table 2.1). For example, the participants were asked if the intervention aided them in their waste sorting and if they noticed its presence.

Procedure: The goal of our study was to determine if the addition of a character (i.e. Waldo) and altering the waste contents inside the 3D display boxes would increase accuracy of sorting behaviour in the four Sort-it-out bins; paper, recyclables, garbage and compost. Our first step was contacting the janitorial staff that manages the waste bins in the AMS Nest. We arranged to have the bags from the bins on the lower-level located underneath the *Emily* sign to be placed outside at 15:00 PST during the test weeks. We weighed the bags with a portable luggage scale in kilograms (See Appendix Figure 5) during the 5 weekdays between March 15th through March 21st for the control condition. This was preceded by the experimental condition between the dates of March 22nd to March 28th. After the bag was weighed, it would be analyzed for the number of contaminants by manually counting waste pieces that did not correspond to the category. Since the bags were clear, we could easily manually count out the number of missorted pieces. These factors were measured and recorded on our table (See Appendix Table 1). To ensure the consistency in-between trials, the results were later calculated according ratio value. The ratios were total contaminants divided by the weight in kilograms for each bin. The data was analyzed using Microsoft Excel to conduct the one-tailed t-tests and calculate the p-values for each category.

After acquiring the result in both of the conditions, a subsequent day was contributed exclusively for conducting the survey. Twenty participants within a 5-metre radius were randomly selected at 15:00 PST to fill out a brief anonymous survey to on the effectiveness and design of the *Sort-it-with Waldo* 3D Display (See Appendix Table 2.1).

Results:

The effects of the *Sort-it-with Waldo* 3D bin designs in the AMS Nest were shown by the ratio of contaminants per kilogram to demonstrate how heavily contaminated each bin was. Four one-tailed t-tests were directed to identify whether a moderate note of the results were consistent with our hypothesis that contaminants would decrease with the implementation of the Sort it with Waldo 3D bin design. For each situation, the t-score was generated to determine the impact of the Sort it with Waldo bins and the control condition, which was the current 3D display bins. The Standard Deviation and Ratios were also calculated along with p values.

The results in Figure 1 show the average contaminants per kilogram for each bin of waste. The ratio for the contaminants of the recycle bin was 6.102 for condition 1 and 3.136 for condition 2, for the paper bins the ratio for contaminants for condition 1 was 16.298 and 6.024 for condition 2. The garbage bin had a ratio of 13.412 for condition 1 and 7.136 for condition 2. The compost bin had a ratio of contaminants per kilogram of 3.404 for condition 1 and 16.408 for condition 2. A one tailed t-test was conducted to identify if there was any significance in the implementation of our Sort it with Waldo 3D bins within the four waste containers. The t-test value, for recycling was 0.05080 ($p<0.05$) paper 0.040128 ($p<0.05$), garbage 0.457775 ($p<0.05$) and compost 0.02282 ($p<0.05$), which suggests that the *Sort-it with Waldo* 3D bins had no effect on sorting behaviours. This is shown through Figure 1 and Table 1. Figure 1 shows the average contaminants per kilogram and Table 1 shows the raw data collected from the waste bins. (See Appendix) The standard deviation for the waste bins were; recycling (1.9159) for condition 1 and (3.30594) for condition 2, paper (0.43445) for condition 1 and (0.040128) for condition 2, garbage (5.76925) for condition 1 and (6.40913) for condition 2 and compost (6.81097) for condition 1 and (13.3246) for condition 2. (Appendix Figure 3)

Since it was impossible to monitor who exactly was using the sorting waste stations the study was a between-groups study. The p values were calculated with a statistical p value of <0.05 to determine the significance. With the analysis there is evidence that our *Sort it with Waldo* 3D bins had no effect on UBC Student, faculty and visitors sorting behaviour. The p value for the recycle bin was 0.4838, paper 0.4872, garbage 0.4854 and compost 0.4927. The critical t -value to determine if there was any significance was 3.841($p<0.05$) Day 1 t – values for recycling, paper, garbage and compost were, 0.23485, 0.5, 0.24223, and 0.24223 which are all insignificant at $p<0.05$. The critical t-values for Day 2 were 0.07989, 0.29516, 0.02237, and 0.03934. This also shows that there is no significance with a p value of <0.05. Day 3 critical t-values were 0.19743, 0.43716, 0.33994, and 0,20293. Additional it shows insignificant results with a p value of <0.05. Day 4 critical t-values were 0.32797, 0.29516, 0.22782 and 0.19743. There is no significance with a p value of <0.05. Day 5 critical t-values were 0.06345, 0.24223, 0.06163 and 0.01913. These numbers also show no significance with a p value of <0.05. This data displays that there was no change in UBC student, staff, faculty or visitors sorting behaviours in regards to the experimental condition of *Sort-it-with Waldo* 3D bins.

After the data was collected, a qualitative survey was completed (Appendix Table 2.1) 20 patrons who were near the Sort it with Waldo 3D bins were asked to answer a few questions. The survey consisted of a few yes-no questions and also a rating scale of how they rated the *Sort-it-with Waldo* 3D bins. The results from this survey had a ratio of 7.2 in regards to the question on rating the display bins for sorting behaviour (Appendix 2.2) This however was conflicted with the question, if they had even noticed a change. Some participants answered that it was helpful, however noted that they did not notice there was a change. 13 of the 20 participants recorded to not seeing a change.

Discussion:

As our results indicate, there was no significant difference between the control and experimental conditions in terms of the weight of waste in kilograms and the numbers of contaminants in waste. Therefore, we concluded that our implementation (i.e., *Sort-it-with Waldo 3D* display) did not have any effect on participants' sorting behaviours. However, since we ran into many unforeseen confounding variables while running the experiment, the lack of our implementation might not explain the insignificant results. Rather, we suggest that the lack of an effect was possibly due to the confounding variables in the experiment. First, we were unable to make a concrete agreement with the janitorial staff in regards to the removal of the waste. This introduced the problem of inconsistent data collection during our baseline period. Secondly, all of the bags were left in a pile and it was difficult to determine which bag belonged to which disposal category: garbage, compost or recyclable containers. Moreover, there were possible environmental factors that may have introduced challenges in the data collection. Since the experiment was conducted during the end of the semester, both of our control and experimental bins experienced low traffic. According to the results of the survey, only seven survey participants out of twenty noticed that the bin was redesigned. Therefore, participants may be less engaged with the *Sort-it-with Waldo* since they were busy, and thus "time poor" (Zhao, 2017). A study on UBC students' recycling behaviour in 2013 result demonstrated that the recycle frequency, accuracy, as well as garbage accuracy significantly decrease two weeks before the final exam compared to first two weeks of the semester (Zhao, 2017). In addition, due to the time constraints, the overall length of the data collection period was only ten days. Therefore, it could be said that not enough data was collected to note any significant effect. Lastly, since the intervention was installed on only one set of Sort-it-out 3D bins, the data may not be the representative of the overall sorting behaviour at the AMS Nest. Considering the unexpected confounding variables and other factors that might have affected the results, we argued that our data was not truly representative of the *Sort-it-with Waldo 3D* display's effects on waste sorting behaviour. Future directions for replicating our experiments will be proposed in recommendations section.

Recommendations:

Due to the numerous unforeseen confounds over the duration of this study, a replication is highly recommended to ensure any effect could be observed. *Sort-it-with Waldo* and similar future waste-sorting interventions can also be implemented with additional visual changes. First, 3D boxes can be mounted higher at eye-level so that they naturally fall within the UBC student body, staff, and visitors' eyesight. According to the marketing strategy of "eye level is buy level", customers tend to purchase what is immediately within their field of vision so stores often organize products they wish to sell at eye-level (Lihua, 2016). Similarly, all waste-sorting interventions work best if they are strategically placed to stand out rather than blend into the background. A large sign that invokes both injunctive and descriptive norms behind the Sort-it-out bins may also be useful. In the study on social norms by Goldstein, Cialdini and Griskevivius (2008), their study results illustrate that people tend to conform most to the norms of groups in their immediate environment and if these norms are clearly laid out. An example of such a sign can be: "1 in 10 UBC students can consistently sort waste correctly. How would *you* sort your waste?" or "1 in 10 UBC students enjoy outdoor activities in the beautiful British Columbia. How would you protect the environment by correctly sorting?"

Finally, a bigger display is recommended so that patrons' eyes are automatically drawn to the intervention. Since the *Sort-it-with Waldo* 3D display bins could be difficult to see from a

distance, an addition of a small character likely did not affect potential users' ability to process how they would sort their waste correctly before they arrived at the sorting station. Making waste sorting an automatic process is a key component in creating behaviour change as numerous UBC students, faculty, and visitors live a fast-paced lifestyle. As a result, they do not always possess the time to make deliberate decisions on daily tasks such as waste sorting. Also, the *Sort-it-with Waldo* 3D display bins are small and cluttered with sample waste—a likely cause as to why many of the patrons did not even notice it. This was reflected in one of the survey comments since the participant claimed that they only looked at the sorting guide at the sorting station for guidance but not the display due to how packed with items they were. A larger, less cluttered display could counteract this issue by making clear how the consumer should sort their waste before they even arrive.

Appendix

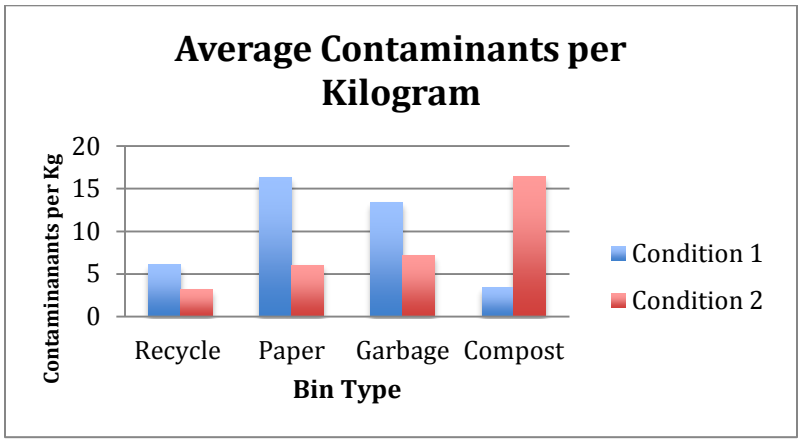

Figure 1. Average Contaminants per kilogram in both conditions

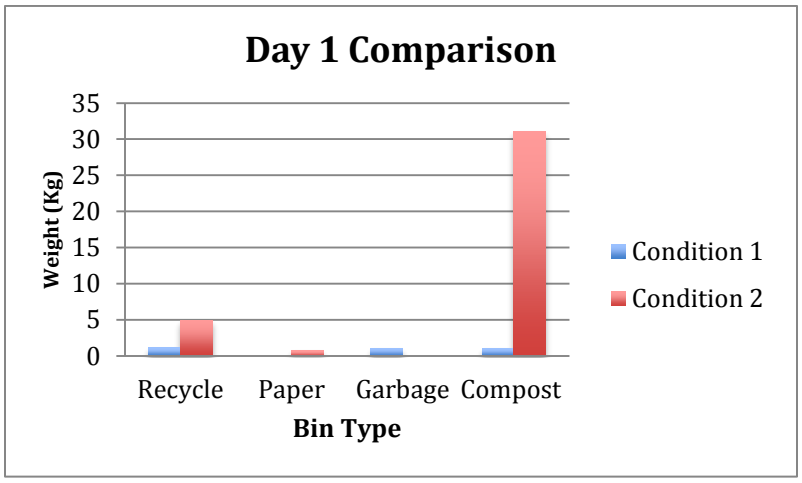

Figure 2.1.1. Day 1 weight of disposal comparison between condition 1 and 2

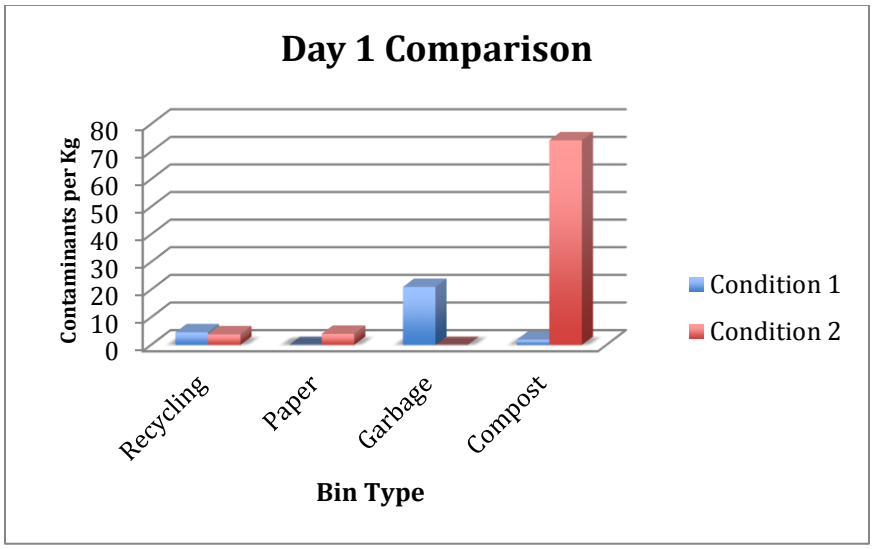

Figure 2.1.2. Day 1 Contaminants comparison

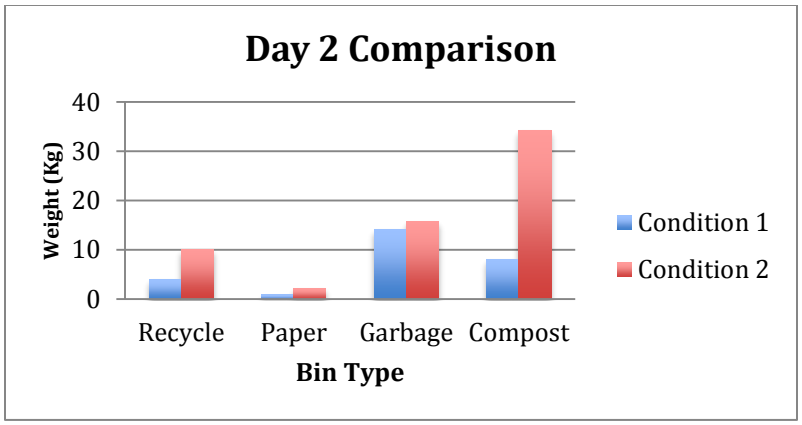

Figure 2.2.1. Day 2 weight of disposal comparison

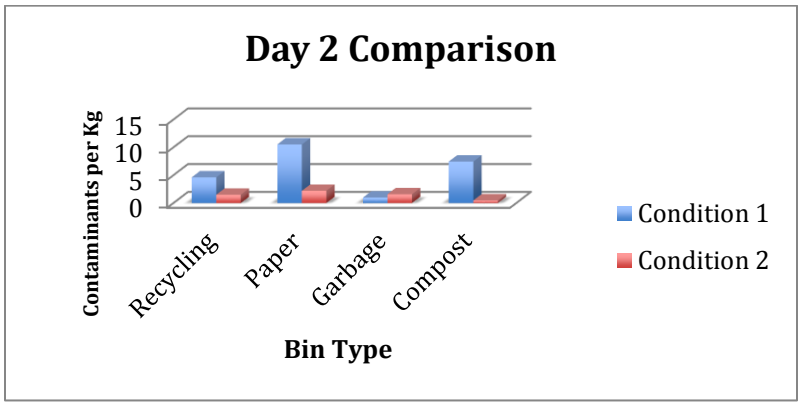

Figure 2.2.2. Day 2 Contaminants comparison

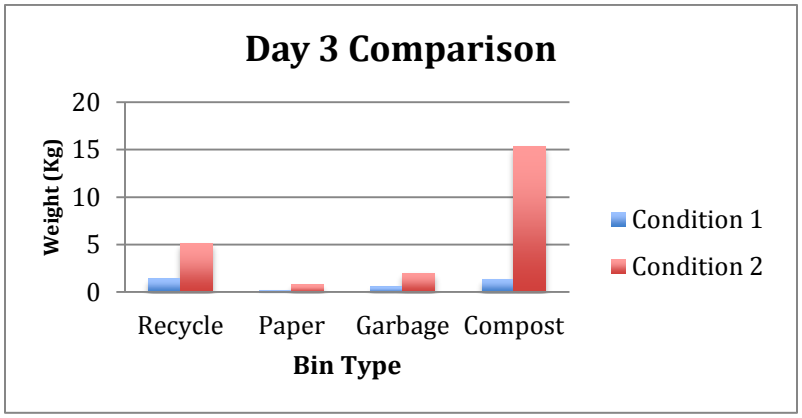

Figure 2.3.1. Day 3 weight of disposal comparison

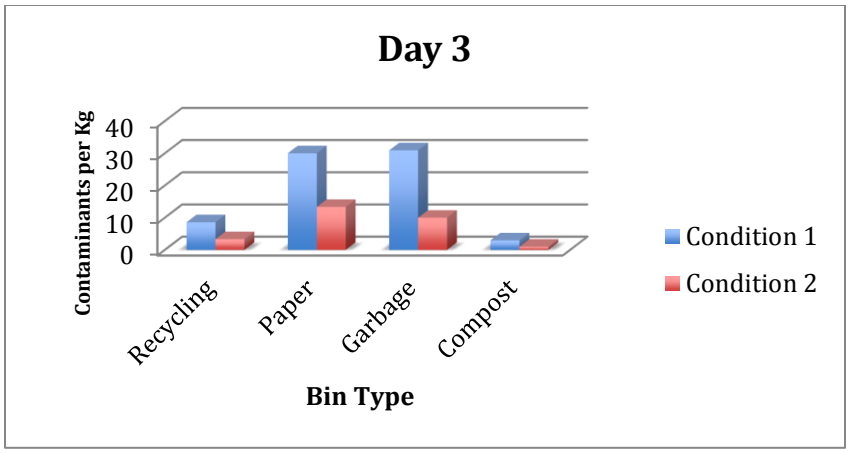

Figure 2.3.2. Day 3 Contaminants comparison

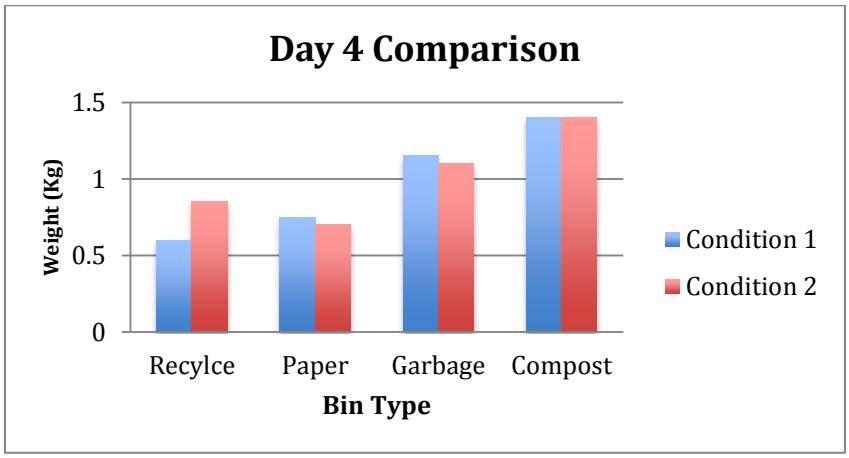

Figure 2.4.1. Day 4 weight comparison

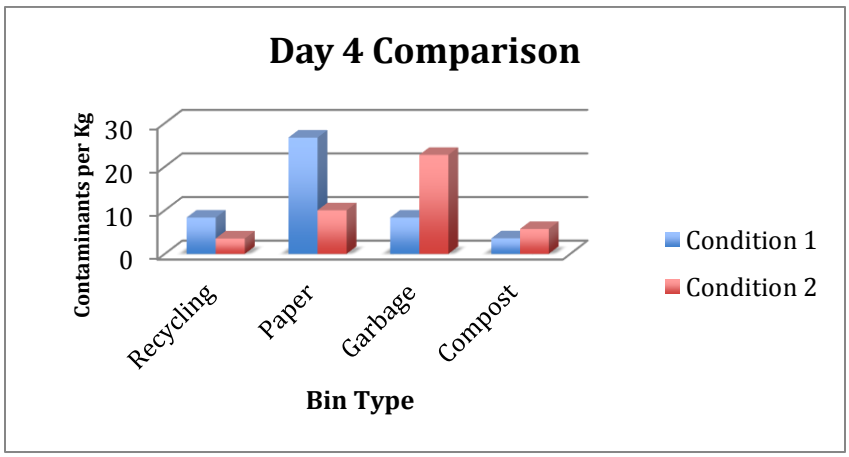

Figure 2.4.2. Day 4 Contaminants comparison

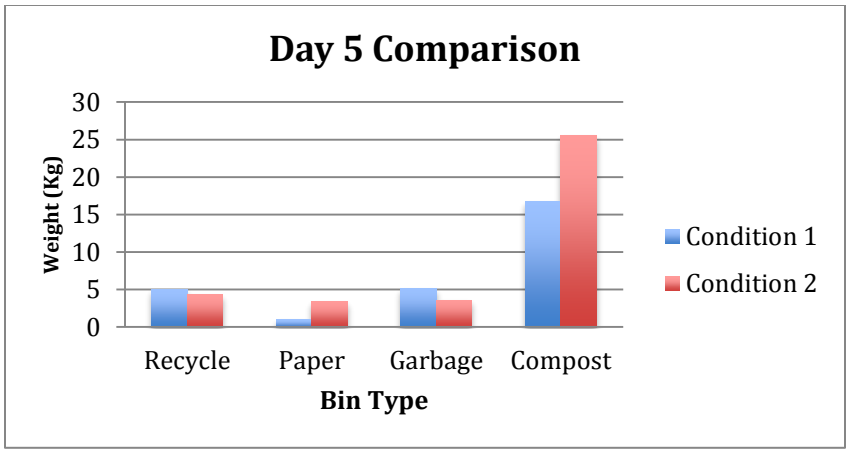

Figure 2.5.1. Day 5 weight comparison

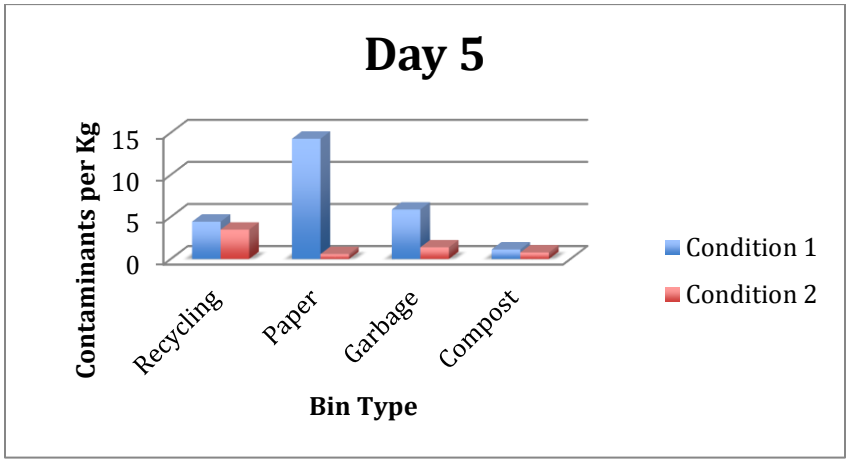

Figure 2.5.2. Day 5 Contaminants comparison

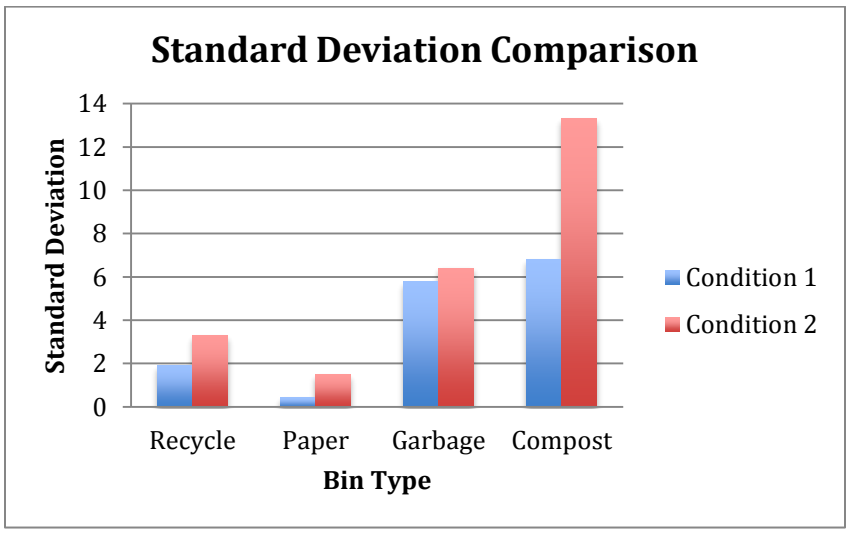

Figure 3. Standard deviation comparison

Figure 4.1. An overview picture of the intervention

Figure 4.2.

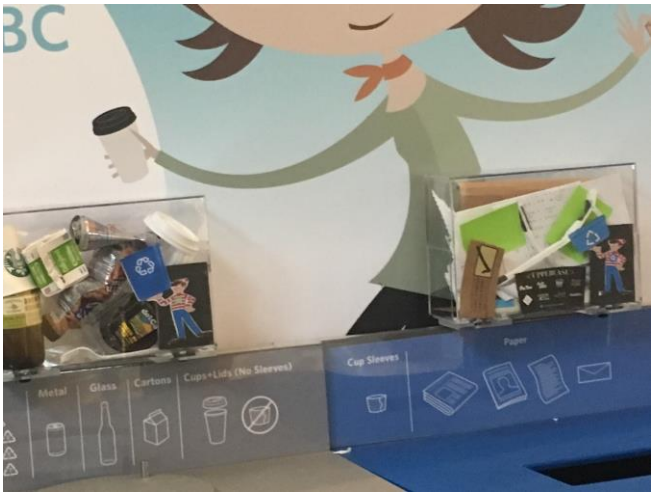

Figure 4.3.

Figure 5. Picture of the luggage scale

Table 1

Date	Bin Location & Condition	Bin Type	Weight (Kg)	# Of contaminants
March 15/17	Nest/Cond.1	Recycling	1.10	5
		Paper	0	0
		Garbage	1.05	22
		Compost	1.05	2
March 16/17	Nest/Cond.1	Recycling	3.9	18
		Paper	0.95	10
		Garbage	14.2	14
		Compost	8.05	60
March 17/17	Nest/Cond.1	Recycling	1.4	12
		Paper	0.2	6
		Garbage	0.55	17
		Compost	1.35	4
March 20/17	Nest/Cond.1	Recycling	0.6	5
		Paper	0.75	20
		Garbage	1.15	40

		Compost	1.4	5
March 21/17	Nest/Cond.1	Recycling	4.95	22
		Paper	1.05	15
		Garbage	5.1	30
		Compost	16.7	19
March 22/17	Nest/Cond.2	Recycling	4.95	19
		Paper	0.75	3
		Garbage	0	0
		Compost	31	23
March 23/17	Nest/Cond.2	Recycling	10.1	15
		Paper	2.2	0
		Garbage	15.7	25
		Compost	34.2	16
March 24/17	Nest/Cond.2	Recycling	5.1	17
		Paper	0.75	10
		Garbage	2	20
		Compost	15.35	15
March 27/17	Nest/Cond.2	Recycling	0.85	3
		Paper	0.7	7
		Garbage	1.1	25
		Compost	1.4	8
March 28/17	Nest/Cond.2	Recycling	4.3	15
		Paper	3.4	2
		Garbage	3.6	5
		Compost	25.6	20

Table 2.1

Sort it with Waldo Survey

On a scale of 1 to 10, how would you rate the Sort it with Waldo 3D display bins in influencing your waste-sorting behaviour?

1 2 3 4 5 6 7 8 9 10

Do the Inside-out bins help you sort better?		
Helpful	Neutral	Unhelpful

Do you notice that the design of 3D bin has changed? **YES** **NO**

Any comments?

Table 2.2:

Sort it With Waldo Survey Results

	Helpful	Neutral	Unhelpful
Do the Bins Help you Sort Better	14	3	3

	YES	NO
Do you notice that the design of the 3D bin has changed	7	13

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