UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Taking an Environmental Step into the 3rd Dimension

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Executive Summary

The purpose of this study was to see the how current Sort-It-Out 3D display bins, with existing waste signage(2D3D), and 3D display bins, with existing waste signage removed, influenced waste sorting behaviour. The research question investigated was; Does having just 3D display cases on the Sort-it-out Station across from the Soup Market make a significant difference on sorting habits compared to 3D signs accompanied with 2D instructions? The bin that was used for this study was the “Emily” bin across from the Soup Market in the UBC AMS Nest. Quantitative research was done to observe the various types of trash thrown into bins (compost, recycling, paper, and trash) whether correct or incorrect. Qualitative research was done to observe whether individuals stopped and looked or tossed their trash, as well as peer influences. We found that there was only a marginally significant difference in the conditions of recycling and compost, favoring 2D3D sorting. The trash and paper bins showed more incorrect sorting in both conditions and there was no significant difference between the two conditions.

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Research Question

Does having just 3D display cases on the Sort-it-out Station across from the Soup Market make a significant difference on sorting habits compared to 3D signs accompanied with 2D instructions?

Hypothesis

We predict that 3D display cases on the Sort-it-out station, across from the Soup Market, without 2D signs will improve waste sorting accuracy. This can be justified through two studies done at different universities. A study done at Carnegie Mellon University in New York found that 2D signs were not helpful when sorting trash, as many students looked inside the trash cans in order to see where to sort the trash and therefore CMU implemented 3D signs in order for students to visualize what belonged in each bin, which improved waste sorting (Chung, Gaw, Guarino, and Parnes, 2011). Secondly, a similar study conducted at the University of Washington discovered that bins with 3D signs had a higher accumulation of compostables and recyclables relative to trash (Johnson, 2013; “Easing the Disposal Dilemma in the Husky Den”)

Methods

Participants

The participants of our study include all the users of the Sort-it-out station across from the Soup Market in the AMS Nest, which includes students, faculty, staff, and visitors. We collected data for 520 individuals during rush hours (12-2pm) for a period of two school days, for two weeks. The AMS nest was chosen due to high traffic and the presence of both 2D displays and 3D boxes.

Conditions

There were two conditions present in our study; the control condition was the Sort-it-Out station accompanied by 2D signs and 3D display boxes (2D3D), the manipulation was removing the 2D signs and only measuring on the 3D display boxes (3D only).

Measures

An observational study was conducted on the “Emily” bin across from the Soup Market in the UBC AMS Nest during rush hours (12-2pm). A table on Excel was created that contained the 4 bins: compost, recycling, paper, and trash. This table was created very simply with the 4 bins represented at the top of the spreadsheet, and the type of waste written under each bin as it was disposed of by each participant. We recorded every type of trash that we encountered. We chose to measure it this way because we knew that the Nest and sorting bins would be very busy during this time, and trying to determine whether waste was correct or incorrect in the moment would make things more confusing and possibly cause inaccurate results. The type of trash was recorded in the spreadsheet under the bin it was thrown into, whether the waste was sorted correctly or incorrectly. We also tallied the number of users that approached the bin and noted whether they stopped to look or tossed their waste. This was measured qualitatively by observing whether individuals were hesitant, and stopped to look at the bins, display bins, and signs or if they just walked by and tossed their waste in the most convenient bin. These observations were noted separately from their specific trash thrown away.

Procedure

The researchers observed participants by sitting at a nearby table where they had a clear view of the type of waste being thrown into what bin. The independent variable of the study was the manipulation of signs, more specifically whether 2D display and 3D boxes were present or just 3D boxes alone. The dependent variable was the accuracy of sorting the waste into the correct bins. In order to record the most accurate results the data was collected through observation. More specifically, looking at what bin the waste was sorted into, and what type of trash was being disposed of, as this would provide more in depth results when looking at which waste yields to the most incorrect sorting. We also collected data on whether the participants "stopped and looked" or "tossed" their waste, though this was not recorded collectively with their trash sorting behavior. "Stop and looked" was defined as participants who paused before throwing away trash to observe signage, while "tossed" was defined as participants who did not show any hesitation and just threw the trash away without glancing at the displays for more than a second. A blank observation table can be found in the Appendix, Figure 5.

Results

Quantitative

Tables 1 through 8, in the Appendix show a tabulation of the data collection. The tables are split into correct and incorrect sorting of waste, each table showing both conditions (2D3D and 3D only), as well as the waste item that was sorted. Hence, we computed the accuracy of sorting, by dividing the number of correct items by the total number of items in each bin. In general, the accuracy in 2D3D bins were higher compared to 3D only bins. More specifically, compost showed a 93.62% accuracy for 2D3D and 88.20% for 3D only. Recycling showed a 90.07% accuracy in the 2D3D condition and a 82.02% accuracy in the 3D only condition. On the other hand, paper showed a 35.13% accuracy in the 2D3D condition and a 29.03% accuracy in 3D only condition. As well, garbage showed a 17.28% accuracy for the 2D3D condition and 14.70% in the 3D only condition.

Furthermore, four chi-square tests were administered to examine the relationship between sorting accuracy for each compost, recycling, paper, and trash bins in their 2D3D or 3D only conditions. The relationship between these variables in compost were found to be marginally significant, chi-square = 3.73, $p=.053$. Participants were marginally more likely to correctly sort into the 2D3D condition. Similarly, recycling also yielded marginally significant results, chi-square = 3.22, p=.073, again only marginally more likely to correctly sort into the 2D3D condition. The chi-square test on the paper bin showed no significant result, chi-square = 0.29, p=.59, and neither did the chi-square test on the trash bin, chi-square = 0.31, p=.58. There was no significant result found.

Qualitative

Along with tallying how many people approached the bin, we also made note of whether individuals stopped to look or toss. In the 2D3D condition 167 individuals tossed their waste, compared to 138 individuals stopping to look and sort their trash. In the 3D only condition, 111 individuals tossed while 110 individuals stopped to look. As our dependent variable was the accuracy of the actual waste sorted, observing individuals and their behaviour was a separate variable and did not correlate to sorting behaviours.

Discussion

Overall, our results do not support our hypothesis that 3D only boxes will contribute to more sorting accuracy. We found no significant results in terms of differences between the 2D3D and 3D only conditions, but there was a marginal effect opposing our hypothesis when looking at the compost and paper bins individually. In these bins participants sorted slightly more accurately in the 2D3D condition. Compost seems to have the highest accuracy in sorting, both in 2D3D condition and the 3D only condition. On the other hand, the trash bins have the most incorrect sorting in both conditions. This can be explained by individuals using the trash bin as a default when being unsure of where to put the waste.

The qualitative data observed was measured as a separate variable so we could not make any direct correlations, but through observation found that stopping and looking did not necessarily result in correct sorting behaviours, and vice versa. We made note of one lady who tried to sort her waste but got frustrated and ended throwing the rest of her waste into the garbage bin. We also found that individuals seemed to be influenced by their peers. If an individual did not know how to sort their waste and their friend just threw everything into one bin, we observed that often the first individual would follow. On the other hand, we also observed that tossing didn’t necessarily mean wrong sorting habits. This can be explained by individuals who already know where the waste belongs and don’t need time to stop and look.

Largely, students know what waste to throw into the compost and recycling bin, which is supported through our results. However, participants were having the most trouble deciphering where specific items such as a paper plate, napkins or items where food waste is on (i.e paper plate, tray) goes into, this can be seen in Table 8 in the Appendix. This can lead to the broad assumption that while the Sort it Out bins are beneficial the difference between each bin is not made clear enough in the 2D displays or 3D. A plastic bag with food scraps in it, does it need to go into the trash? Or does each item need to be sorted separately? These are challenges that were presented while observing the study and due to time constraint, (sorting while rushing to class) the default option of throwing everything in the trash was utilized. With the help of an observation study, we were able to see and hear the thought process that many students go through when sorting trash, most students recognized the bins but found the diagrams or items in the 3D boxes to be unhelpful because it was not showcasing their waste item.

In relation to a larger population, these results show that both 2D signs and 3D boxes yield to a higher accuracy. Although, the signs need to be more specific to the environment that the waste bins are located in and what type of trash is most common, as this would lead to the most accuracy. In terms of environmental sustainability, the sorting bins and the results showing that the most accurate sorting is done through 2D signs and 3D boxes, all help UBC Zero Waste Action Plan and their mission to have a waste free community. In the future, the Zero Waste Action Plan could be mimicked on a larger scale. If UBC could become a model Zero Waste community, perhaps the City of Vancouver for example would be able to take recommendations, to help implement a broader and widespread zero waste community initiative.

Limitations

Our limitations include the period of time we spent observing, as we only measured during 12-2pm on the Thursday and Friday of 2 weeks in March. During the days we observed the 3D only condition, it was “clubs day”, so there was less space for people to eat lunch, which means the Sort-it-out bin was less busy. Because less people were using the Sort-it-out bin on these two days, there were 90 less participants in this condition. Our statistics take into account the unequal participants, but it is difficult to know for sure how having a smaller sample size in one condition truly affected the results, had there been a larger sample in the second week. This challenge can be addressed through conducting another study on weeks that will have no interruption. This will allow for equal amounts of participants in both weeks and more accurate data. Because we did an observational study, it often became difficult to see what people were tossing in each bin, which could have caused us to make errors in our observations. Additionally, because some cutlery was biodegradable (belonging in the compost bin) and other utensils were plastic (belonging in the recyclable plastics bin), it was difficult to observe whether the utensil being thrown away was plastic or compostable. On three occasions individuals threw away plastic bags filled with containers and other content. Since we did not know exactly what was inside, we excluded these items from our data. These challenges could be addressed by choosing a different method of determining sorting accuracy (such as manually checking waste), or choosing to focus on a specific type of common trash to simplify the observation process.

Recommendations

The vision stated in the UBC Zero Waste Action is to be a campus “transformed into a zero-waste community by advancing innovative solutions to conserve, reuse, recycle, and redesign materials and resources” (University of British Columbia 12). One of the ways the Zero Waste UBC Community plans to do this is through “empower[ing] individual and collective action through education, engagement, and the development of integrated systems and enhanced infrastructure (12).”

To help meet the goal of becoming a zero waste community, we have a few recommendations specifically for the AMS Nest. We found that the 3D boxes were not as helpful in encouraging correct waste sorting behaviour, compared to the 3D boxes accompanied by 2D signage. To optimize the effectiveness of the 3D boxes, we suggest that more specific trash pieces be added to these boxes. We believe this will help sorters more easily identify which bin their trash belongs to. When people stop to look at the bins, making it easier for sorters to match their waste with items in the 3D boxes will help lessen the amount of incorrect sorting. Building off of this, not every container in the AMS Nest can fit in the 3D boxes. We observed that people get confused when the item they were disposing of was not in the box. Additionally, to address this issue, we recommend that the AMS Nest food outlets use the same containers and cutlery to make it easier for users of the AMS Nest Sort-it-out bins to sort their waste. Currently, some cutlery is biodegradable, which means they can be sorted into compost bins, but others are plastic and belong in the recyclable plastics bin. Deciding on one type of cutlery for the entire Nest could be a step towards ensuring accurate sorting. Furthermore It would be beneficial to design further research that links whether or not a participant stopped to look at signage, along with their sorting accuracy to determine if there is any correlation. This would be especially helpful in determining which waste products are often inaccurately sorted and thus must be better represented in the signage or 3D boxes.

References

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University of British Columbia. (3. October 2014). UB Vancouver Campus Zero Waste Action Plan. Retrieved from https://sustain.ubc.ca/sites/sustain.ubc.ca/files/uploads/CampusSustainability/CS_PDFs/RecyclingWaste/Zero_Waste_Action_Plan%202014%2010%2003%20final.pdf

Appendix

Figure 1: Chi Squared Test on Compost Bin

	2D3D	3D Only	*Marginal Row Totals*
Correct	220 (214.52) [0.14]	157 (162.48) [0.19]	377
Incorrect	15 (20.48) [1.47]	21 (15.52) [1.94]	36
Marginal Column Totals	235	178	413 (Grand Total)

Chi-square Statistic: 3.732
p-value: .05

Figure 2: Chi Squared Test on Plastic Recyclables Bin

	2D3D	3D Only	*Marginal Row Totals*
Correct	136 (131.5) [0.15]	73 (77.5) [0.26]	209
Incorrect	15 (19.5) [1.04]	16 (11.5) [1.76]	31
Marginal Column Totals	151	89	240 (Grand Total)

Chi-square statistic: 3.22
p-value: .07

Figure 3: Chi Squared Test on Paper Bin

	2D3D	3D Only	*Marginal Row Totals*
Correct	13 (11.97) [0.09]	9 (10.03) [0.11]	22
Incorrect	24 (25.03) [0.04]	22 (20.97) [0.05]	46
Marginal Column Totals	37	31	68 (Grand Total)

Chi-square Statistic: 0.29
p-value: .59

Figure 4: Chi Squared Test on Garbage Bin

	2D3D	3D Only	*Marginal Row Totals*
Correct	28 (26.39) [0.1]	15 (16.61) [0.16]	43
Incorrect	134 (135.61) [0.02]	87 (85.39) [0.03]	221
Marginal Column Totals	162	102	264 (Grand Total)

Chi-square Statistic: 0.31
p-value: .58

Figure 1: A Blank Observation Table Used to Collect Data

	A	B	C	D	E	F	G	H
1								
2	2D3D CONDITION							
3	At the end label if it was right or wrong					Hesitiation		
4		Compost	Recycle	Paper	Trash		Stop to Look	Toss
5	Types of Trash-->							
6								
7								
8	3D ONLY CONDITION							
9		COMPOST	RECYCLE	PAPER	GARBAGE	Hesitation		
10	Types of Trash-->						Stop to look	Toss
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								

Table 1: List of Correct Items Sorted in Compost for both Conditions

Waste Item	2D3D Condition	3D Condition
Curry bowl	17	7
Napkin	36	26
Paper Plate	6	-
Food Container	31	35
Soup bowl	24	18
Chopsticks	20	15
Food Scraps	17	21
Tray	17	17
Snack Bag	15	2
Checkered Wrapper	9	16

Table 2: List of Incorrect Items Sorted in Compost for Both Conditions

Waste Item	2D3D Condition	3D Condition
Plastic noodle bowl	1	2
Lid	10	9
Coffee cup	3	2
Juice box	1	-
Utensil	-	5
Gum	-	1
Ziplock	-	1
Soy Sauce Packet	-	1

Table 3: List of Correct Items Sorted in Recycling for Both Conditions

Waste Item	2D3D Condition	3D Condition
Coffee Cup and Lid	4	7
Utensils	36	33
Plastic Cup	-	3
Plastic Bowl	2	2
Glass Bottle	9	5
Milk Container	1	2
Can	23	7
Lid	53	5
Juice Box	1	14
Tray	1	-
Glass Container	1	-
Soup/Black Container	5	-

Table 4: list of Incorrect Items Sorted in Recycling for Both Conditions

Waste Item	2D3D Condition	3D Condition
Curry /Soup Bowl	7	3
Napkins	3	-
Food Scrap	1	-
Sleeve	1	2
Chopstick	1	-
Sauce	1	-
Saran Wrap	1	-
Food Container	-	4
Straw	-	1
Paper Cup	-	5
Wrapper	-	1

Table 5: List of Correct Items Sorted in Paper for Both Conditions

Waste Item	2D3D Condition	3D Condition
Sleeves	4	1
Chopsticks	2	-
Paper	6	7
Chopstick Wrapper	1	-
Brown Paper Bag	-	1

Table 6: List of Incorrect Items Sorted in Paper For Both Conditions

Waste Item	2D3D Condition	3D Condition
napkins	12	10
Snack Bag	1	1
Milk Container	1	2
Cake Box	1	-
Pizza Box	2	-
Brown Food Tray	1	-
Container	5	1
Can	1	1
Paper plate	-	2
Curry bowl	-	1
Water bottle	-	1
Wrapper	-	1
Chopsticks	-	1

Table 7: List of Correct Items Sorted in Garbage for Both Conditions

Waste Item	2D3D Condition	3D Condition
Soy sauce	8	3
Straws	1	4
Plastic Bags	1	7
Saran Wrap	2	-
Styrofoam	1	1
Gum	2	-
Tinfoil	1	-
Headphones	1	-
Chip Bag	1	-
Wrapper	10	-

Table 8: List of Incorrect Items Sorted in Garbage for Both Conditions

Waste Item	2D3D Condition	3D Condition
Food scrap	6	1
Chopstick	13	5
Napkin	25	19
Plastic/food container	5	8
Utensil	8	10
Snack Bag	11	5
Plastic lid	14	14
Soup/Curry Bowl	17	11
Drink Cup	1	1
Coffee cup w/sleeve and lid	4	1
Paper/milk container	5	-
Paper wrappers	6	1
Paper	6	4
Paper plate	1	-
Tea bag	1	-
Sushi tray	8	1
Sushi lid	2	-
Can	1	1
Plastic bag w/food container	-	1
Bubble Tea	1	-

Photo 1: 2D3D Condition

Photo 2: 3D Only Condition