

Relationship Between Lid Presence and Sorting Behaviour at Sorting Stations

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University of British Columbia
Environmental Psychology 321
Professor Jiaying Zhao
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My Little Lambda
Camilla De Cesare, Jason Chen, Sarah MacDonald

Executive Summary

The University of British Columbia is committed to sustainability projects and implementing infrastructure that can improve sorting behaviour (Sustainability Plans, n.d.). The research question for this study is: does adding a lid to a garbage bin that is part of a larger sorting station - in which lids are already present - increase sorting behaviour? Through a covert naturalistic observation, 181 participants were observed and coded as they used the sorting stations present in the Irving K. Barber library. The results indicate that there is a positive correlation of 0.21, suggesting that lid presence on garbage bins is correlated to increases in effective sorting behaviour. Based on this study, UBC is recommended to add lids to the garbage bins at sorting stations in which other lids are present to increase sorting behaviour.

Research Question and Hypothesis

Through UBC's sustainability project, place and promise, UBC has committed as an institution to the idea of sustainability and advancing sustainability on campus (Sustainability Plans, n.d.). Sorting refuse appropriately is important for protecting the environment, and in 2012 UBC was able to divert 48% of solid waste from landfills using their refuse sorting program (Sustainability Plans, n.d.). Given UBC's commitment to sustainability projects (Sustainability Plans, n.d.), they are interested in implementing infrastructure that could support and improve sorting behaviour. The stakeholder explained that they added lids on the bins for food scraps and plastic to avoid fruit flies. However, they then noticed that more people were using the trashcan, which did not have a lid (see Appendix E for stakeholder conversation). In a recent study, Duffy (2009) found that covering receptacle holes with lids increased sorting behaviour by 34%. Does adding a lid to a garbage bin that is part of a larger sorting station - in which lids are already present - increase sorting behaviour?

Our general hypothesis is that lid presence on a garbage bin is positively correlated with effective sorting behaviour, as operationalized by an 85% accuracy threshold in sorting refuse. We also hypothesized that people who are coded as non-sustainability geared or very sustainability geared on the new ecological paradigm (NEP) scale will show no significant difference in sorting behaviour stations regardless of lid presence on the garbage bin. People who are coded as indifferent will show significantly more sorting behaviour at a station where a lid is present on the garbage bin.

Method

In order to study the relationship between lid presence on garbage cans and sorting behaviour at sorting stations where other lids are also present on the other sorting bins (Appendix A), we conducted a covert naturalistic observation in the Irving K. Barber Library at UBC (Appendix A), and asked participants to fill out a survey about their environmental attitudes.

Participants

The population for this study are the people on the UBC campus. Since the study took place in Irving, our specific sample are people who passed by Irving and used the sorting bins during our observation times. This includes but is not limited to students (part or full time), staff, faculty, visitors, etc. We did not measure any information about the participants, but based on observation, the majority were students.

Conditions

There were two conditions in this study. In the first condition, the three sorting stations had lids covering the food scraps bin, the bin for plastic, and the garbage can (Appendix A). In the second condition, the three sorting stations only had lids covering the bin for food scraps and the bin for plastic. We manually removed the garbage bin lid using a screwdriver so that it was not visible to participants in this condition (Appendix A).

We chose three sets of sorting bins (Appendix A), all located on the ground floor of Irving. The sorting stations in the three bins are in the same order, and are all the same colours and dimensions (Appendix A). We selected these bins to control for potential confounding variables. However, two of the three bins also contained stickers on the containers while one bin did not (Appendix A). Furthermore, one set of bins was located in a cafe in Irving, another was located close to the stairs at the centre of the ground floor, and the other set of bins was located in the hallway close to the bathrooms and some classrooms. The location of the bins could also be a confound for this study. We tried to control for the confounds by measuring all of the sets of bins with and without lids on the garbage can, as well as observing them in different orders.

We ran a pilot study and believe that traffic was optimized at sorting stations between 11.30AM – 1.00PM. Therefore, the observations were conducted during this time frame on Monday, Wednesday, and Friday for two consecutive weeks. This allowed us to obtain a large enough sample for reasonable statistical analysis.

Measures

We used a Boolean coding system to record the participants' sorting behaviour. If the participant ineffectively used the bins (less than 85% accuracy), they were coded as '0'. If the participant sorted 85% of what they were sorting away correctly, they were coded as '1'. We chose a cut-off of 85% to allow for a margin of error. We chose this because we believe that this is high enough to represent effortful sorting, yet this accounts for human error both on the sorting knowledge of the participant and on the observation skills of the experimenters in a public space. As an observer we cannot guarantee knowledge of all of the items a participant has and the material each of those items are made out of. For example, we cannot tell if cutlery being sorted is plastic or biodegradable in material composition. We decided to use a Boolean system to allow for speed in coding so that we would not miss coding any participants. For the purpose of our study it was very important to make sure that every person using the sorting bins during the observation times was coded. Otherwise, our data could be skewed.

We used the new ecological paradigm (NEP) measure which is widely used in the United States as a cross sectional assessment of environmental worldviews, namely endorsement of environmentally conscious attitudes. It was chosen due to its widespread use as an ecological paradigm (Anderson 2012). We included a 5-point Likert scale to record participant response (Rothman 2000). The labels non-sustainability geared, indifferent, and sustainability geared were selected to convey understanding for this particular experiment, they are not labels used explicitly by the NEP measure. The NEP survey was adjusted to use a 1-5 Likert scale where an average score of 1-2 on this scale results in a label of non-sustainability geared, a score of 4-5 results in a label of very sustainability geared, and a score of 3 is coded as indifferent.

Procedure

The study took place over 6 non-consecutive days between 11.30AM and 1.00PM (Appendix C). The three sorting stations were observed in 30-minute increments, in varying

order (Appendix B). During 3 of those days, lids were present on the food scraps bin, the bin for plastic, and the garbage can. On the other 3 days, the garbage bin lid was removed from all three stations using a screwdriver (Appendix A). On any given day, two observers were present to assign participant ID (Appendix C), code participant sorting behaviour by hand using a Boolean system (Appendix C), and administer a print version of the NEP survey (Appendix C). The hard copies were then entered into a comma separated value sheet for later analysis. The same two observers were simultaneously present at each station to distribute the work of observing participants and distributing surveys. Consent is not required for observation in a public space, but we did request consent orally, as well as provide a written consent form provided by Professor Zhao for participants completing the survey (Appendix C).

Results

Of the 15 questions in the NEP survey, 7 of them (even numbered questions) were reversed scored to align with the rest of the questions (odd numbered questions) (Appendix C). This was done so that low scores represented a weak endorsement of environmental attitudes and high scores representing a strong endorsement of environmental attitudes; while middle range scores represented an indifference of endorsement (neither denial nor active endorsement).

Our analysis consisted of two stages. The first stage included a linear regression analysis between sorting behaviour and lid presence on garbage bins. The second stage consisted of two linear regressions between sorting behaviour, lid presence on garbage bins, and NEP average score. NEP scores were separated into two tiers, adjusted from our original hypothesis to accommodate the data. Scores below 3.5 represented a weak endorsement of positive environmental attitudes. Scores above 3.5 represented a strong endorsement of positive environmental attitudes. This division completely eliminated the indifferent tier. For all regression analysis we used a dummy data method whereby a Boolean is interpreted as an integer for the purposes of analysis (Introduction to SAS, n.d.).

For the first stage, we calculated the percentages of people who sorted effectively in both conditions. In the lid presence condition 72% of participants observed sorted effectively compared to 51% in the lid absence condition (Appendix B). To further the analysis, we performed a linear regression between sorting behaviour and lid presence on the garbage bin which yielded a significant relationship where $n = 181$, $t(179) = 2.98$, $p = 0.0033$, $SD = 0.5$, and a positive correlation of 0.21. This suggests that lid presence on garbage bins is positively correlated to sorting behaviour. Therefore adding a lid to the garbage bin at a sorting station is correlated with people sorting more effectively compared to sorting stations where the garbage bin has no lid.

The second stage of our analysis consisted of two linear regression analysis between sorting behaviour, lid presence on garbage bins, and NEP average scores in order to test our hypothesis regarding NEP score representation of environmental attitudes and sorting behaviour. We chose not to perform a multiple linear regression between sorting behaviour, lid presence on garbage bins, and NEP score average (not tiered) because of the lack of score diversity (lowest score was 2.7, highest score 3.6) (Appendix D)

Our analysis of NEP average score tiers shows that NEP score tiers are not significantly related to lid presence affecting sorting behaviour. We suspect the lack of significance is due to our small sample size of survey completing participants ($n = 25$ compared to the 181 total participants observed), as well as the disproportionate number of participants collected who scored between these two tiers ($n = 9$ for NEP score average < 3.5 , $n = 16$ for NEP score average $>$

3.5).

We do still observe differing directionality between these two tiers; for those who score an average below 3.5 (representing weak environmental attitude endorsement), lid presence is positively correlated with sorting behaviour, while for those in the above 3.5 tier (representing strong environmental attitude endorsement, lid presence is negatively correlated. We believe that for those who score in the lower tier, lids are encouraging to sorting behaviour, while for those in the upper tier, lids are may be unfavourable towards sorting efforts. With a larger sample size, we suspect the negative correlation between sorting behaviour and the upper NEP survey average tier would not be present.

Discussion

We believe that lid presence on the garbage bin reduces the visual salience of said bin compared to the other sorting bins with lids at the same station (Best Practices Review 2009). This is important because if it does not look cohesive, people will gravitate towards the garbage bin to sort all of their refuse even if it is incorrect as the garbage bin is more salient than the other bins. Moreover, not having a lid on the garbage bin encourages ineffective sorting due to the fact that there is no transactional cost as there is no lid to manipulate. Therefore, once a lid is added to the garbage bin, people must commit to opening a lid, and thus makes the manipulation of the other bin lids seem negligible since they have already made the initial investment of effort (Shultz 1996).

Despite our significant results pertaining to the relationship between lid presence and sorting behaviour, we encountered some challenges that need to be considered when reviewing this experiment. We could not control for the lack of text present at one of the sorting stations (Appendix A). While we were concerned that this could be a potential confound an analysis comparing the average sorting behaviour across stations of the same lid condition (lid presence or lid absence) revealed no significant differences in said sorting behaviour. On average station's sorting behaviour showed little variance (station 1 = 0.5614035, station 2 = 0.5952381, station 3 = 0.6463415). Therefore, we do not believe that the text discrepancy acted as a confound. However, for future studies, we recommend completely controlling for the appearance of all the bins and all the station (Best Practices Review 2009).

Furthermore the location of these bins was conscripted by our stakeholder partner, because said stakeholder communicated to us that they were already planning on adding lids to the garbage bins at Irving library location, and would like some additional information in the form of our research to either inform whether they solidify this decision or reconsider. Ideally, we would like to test multiple building across campus to ensure that the building location itself is not a confounding variable, considering that different buildings may attract different audiences. This experiment also faced considerable participant collection challenges. The fact that only 25 of 181 total participants consented to completing the survey is indicative that the survey was too long or that participants require more incentive to complete it. We suggest for future studies to either use a shorter measure, or pay participants for completion as this has been shown an effective incentivization method (Boutis & Wilson 2008).

Furthermore, we remain concerned by possible observer effects, despite trying to control for this by breaking up observation times into 30 minutes intervals, participants could have noticed the observers and this could change their behaviour. Moreover, we used a Boolean system for convenience, however, this cost us qualitative data and the possibility of a wide range of quantitative data; for example, we could have gauged accuracy for each individual bin.

To improve upon the previous concerns listed, we recommend videotaping observations rather than field coding them. This would eliminate observer effects and also determine participant sorting behaviour and accuracy more effectively. Taped observations could also be replayed as part of inter-rater reliability testing.

Additionally, we would like to ensure that standalone garbage bins (ie: garbage bins not attached to a sorting station) are in no way more accessible than the sorting stations being observed for fear that this may be a third variable.

Recommendations for UBC

We recommend that UBC include lids on all sorting stations across campus as our results support that lidded garbage bins at sorting stations with lids on the other bins are positively correlated to sorting behaviour. Adding lids to these garbage bins will increase sorting behaviour and thus support sustainability efforts by UBC to reduce waste produced by ineffective sorting. In particular, lids should be added to buildings on campus that report low sorting accuracy observations. We believe that our findings can in the very least be generalized to UBC students as statistically they make up a majority of the UBC population on campus (UBC Facts and Figures 2015). Especially if UBC is committed to sustainability efforts by installing additional sorting stations over the next two years (Station Locations, n.d.), and has a 2.1 billion dollar annual operating budget (UBC Facts and Figures 2015), the budget allocated for sorting bin acquirement should be used wisely in selecting the sorting stations that foster the most effective sorting behaviour by choosing stations that have lids on all of the bins, including garbage.

Works Cited:

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Appendix A:

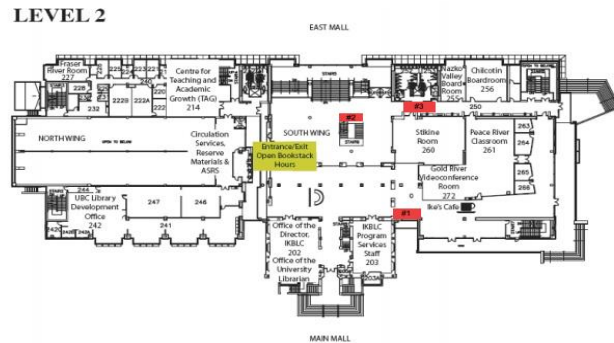


Figure 1.1 The red arrow indicates the location of the Irving K. Barber Library relative to other buildings on campus. Irving houses the eatery known as Ike’s Cafe. On the map to the right is a map of the main floor of the Irving K. Barber Library, red boxes indicate the locations of sorting bins 1 through 3 used in this experiment.

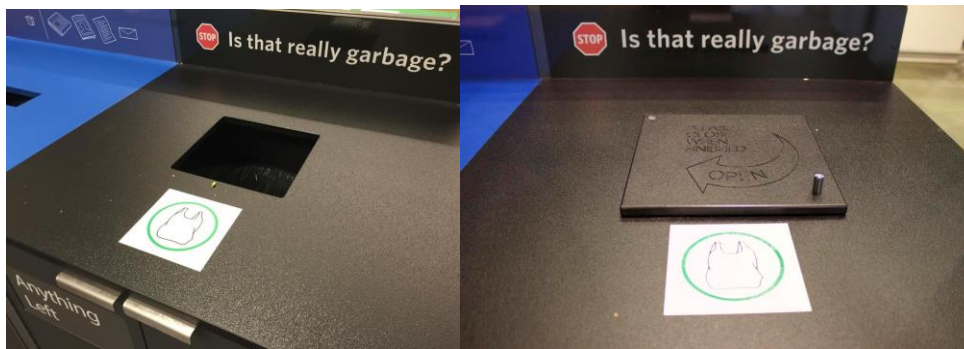


Figure 1.2 On the left, an example of what the garbage bin of a sorting station looks like in the lid absence condition. There is a screw hole located in the upper left hand corner that allows for a lid attachment. On the right, an example of the garbage bin lid covered by the lid.



Figure 1.3 Shown left to right, station 1 located at Ike’s Cafe, station 2 located by the stairs of the ground floor, and station 3 found in the hallway between the ground floor classroom and bathrooms. Take note that station 1 is missing the “Sort it Out” text station 2 and station 3 have on the bottom left hand corner of the station bin set.

Appendix B:

Lid condition on garbage bin	Sorted “effectively” (>85% accuracy)	Sorted “ineffectively” (<85% accuracy)	Total participants coded	% of participants who sorted effectively
Lid absent	50	48	98	51%
Lid present	60	23	83	72%

Table 1.1 Shown above is a table representing sub sample sizes for each condition and corresponding sorting accuracy illustrating that more participants sorting effectively in the lid present condition.

NEP tier	Regression Statistics for effects by lids on sorting station controlling for NEP tier						
	Correlation coefficient	T value	SD	DF	F statistic	Std. Error	P value
Score average < 3.5	0.3750	1.528	0.2123829	14	2.333	0.2455	0.1489
Score average > 3.5	-0.2500	1.139	0.05773503	7	1.296	0.2196	0.2924

Table 1.2 Above is the statistical output of the regression analysis between lid presence and sorting behaviour after pre-selecting for each NEP score average tier. It shows evidence that while neither tier shows a significant p value, lid presence for NEP score averages below 3.5 are positively correlated to sorting behaviour while negative for scores above 3.5.

Day of the week	Lid Presence	11:30AM - 12:00PM	12:00PM - 12:30PM	12:30PM - 1:00PM
Monday	Present	Station 1	Station 2	Station 3
Wednesday	Absent	Station 3	Station 1	Station 2
Friday	Present	Station 2	Station 3	Station 1
Monday	Absent	Station 1	Station 2	Station 3
Wednesday	Present	Station 3	Station 1	Station 2
Friday	Abstent	Station 2	Station 3	Station 1

Table 1.3 Shown above, is the observation schedule used by the experimenters to keep record of which station, condition, time and day to collect participants.

Appendix C:

LVM		
NAI		
KAW		
LXQ		
JGK		
WVH		
FSX		
LHJ		
TKC		
CJE		
YDV		
LNH		
XBH		
FDQ		
UDM		
BMR		
RHP		
SQH		
LRG		
VYX		
BKL		
QMS		
QOB		
CIL		
FYZ		
LIM		
OBE		
SEY		
RHL		
ADL		
YZB		
ZTV		
CQT		
GNO		
PRV		
CYZ		
EGE		
YKL		
WXB		
CMR		
DMU		
ZHY		
GNE		
CXV		
GKB		
UEB		
AVC		

Sorting Behaviour Sorting Sheet

Researcher (Initials)	Lid presence (1) or lid absence (0)	Station #	Date/Time (every half hour)	PID	Sorting Behaviour (effective- 1, ineffective-0)	Sustainability Attitude (fill in later)

Example 1.1 An example of the participant identification code sheets that were used to provide an anonymous identification to participants completing surveys. Researchers used this sheet to code and record participant behaviour while observing at sorting stations

Consent to Participation - Sorting Bin Survey Irving K Barber Library

Welcome to our study. We are running a survey on sorting behaviour at Irving library's sorting stations as our group project for the PSYC 321-Environmental Psychology course. The survey will take about 5 minutes to complete. You will answer a series of questions on your environmental beliefs in the survey.

Your participation in this survey is entirely voluntary and anonymous. You can refuse to participate or withdraw from the survey at any time. Your identity will be kept strictly confidential. All documents will be identified only by code number and stored securely. You will not be identified by name in any reports of this study. Data in this survey will only be accessed by the students, the course instructor, and the teaching assistant. Results of this study will be used to write a research report. There are no risks associated with participating in this survey.

If you have any questions about the study, please contact us below.

Camilla De Cesare (camilladecesare@gmail.com) or 604-368-1727

Jason Chen (j.chen529993@gmail.com) or 778-322-9689

Sarah MacDonald (s.em.macdonald@gmail.com) or 604-790-5242

You can also contact the course instructor, Dr. Jiaying Zhao, assistant professor in the Department of Psychology and the Institute for Resources, Environment and Sustainability at UBC. Dr. Zhao can be reached at at [604-827-2203](tel:604-827-2203), or environmentalpsychology321@.

If you consent to participate in this study, please proceed to the next page.

Sorting Bin Survey Irving K Barber Library

PID: _____
 STATION #: _____

Please indicated on a scale of 1 to 5 how strongly you agree with the following statements, where 1 indicates strongly disagree and 5 indicates strongly agree.

1. We are approaching the limit of the number of people the Earth can support.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

2. Humans have the right to modify the natural environment to suit their needs.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

3. When humans interfere with nature it often produces disastrous consequences.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

4. Human ingenuity will insure that we do not make the Earth unlivable.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

5. Humans are seriously abusing the environment.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

6. The Earth has plenty of natural resources if we just learn how to develop them.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

7. Plants and animals have as much right as humans to exist.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

9. Despite our special abilities, humans are still subject to the laws of nature.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

11. The Earth is like a spaceship with very limited room and resources.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

12. Humans were meant to rule over the rest of nature.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

13. The balance of nature is very delicate and easily upset.

Strongly Disagree					Strongly Agree
1	2	3	4	5	

14. Humans will eventually learn enough about how nature works to be able to control it.

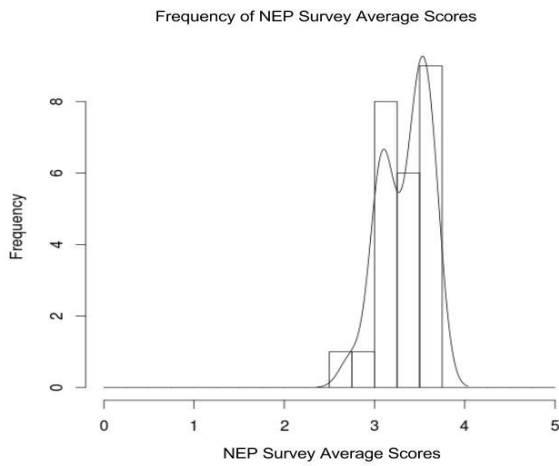
Strongly Disagree					Strongly Agree
1	2	3	4	5	

15. If things continue on their present course, we will soon experience a major ecological catastrophe.

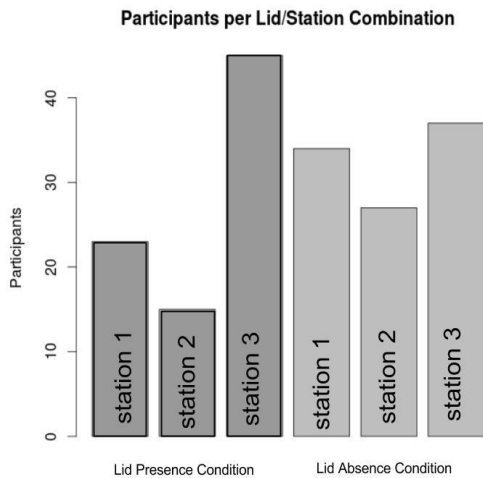
Strongly Disagree					Strongly Agree
1	2	3	4	5	

Example 1.2 Shown above are pages 1 (left side) and page 2 (right side) of the NEP survey using a 5 point Likert scale. The image furthest to the left is the consent form that prefaced the NEP survey. Participants were asked to initial in the corner to verify consent.

Appendix D:



Graph 1.1 The above distribution illustrates our limited response scores from the NEP survey. while we expected a wide distribution, our range actually was 2.7 to 3.6.



Graph 1.2 Shown from left to right, the first three bars represent participant collections for stations 1 through 3 respectively in the lid presence condition while the following three represent stations 1 through 3 in the lid absence condition.

Appendix E:*Stakeholder Notes:*

Our stakeholder explained to us that they added lids to the recycling and food composting bins due to fruit flies. They then observed that less people were using those bins, and were instead using the trash can which was left uncovered. Therefore, they began adding lids to the trash bins at the sorting stations in Irving to see if it would impact sorting behaviour. We were told to conduct this study in Irving because this is where they began adding lids to the trash cans. This is why our question focuses on whether or not the presence of a lid on the trash at sorting station influences sorting behaviour at Irving.

Procedure Notes:

The days on which these conditions took place alternated. For example, on the first Monday when the study took place, all lids were present. On Wednesday, we removed the lids on the trashcan. The order kept alternating for two weeks until each condition was observed three times. Furthermore, we varied the order in which the bins were observed. For the first observation bin 1 was observed from 11.30AM to 12.00PM, bin 2 was observed from 12.00PM to 12.30PM, and bin 3 was observed from 12.30PM and 01:00PM. We altered the time for various reasons. Firstly, this counterbalanced any effects that time could have. For example, perhaps from 12.30PM to 1.00PM was the busiest time and we did not want that one bin to have the most participants. By only observing a set of sorting stations for half an hour, we reduced the chance of participants noticing the presence of the researchers and therefore altering their behaviour as a consequence.