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Relative Location of Bins and Its Effects on Recycling in Campus

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Abstract

The amount of non-recyclable material in recycle-bins creates extra cost because of the extra labor required for sorting and transportation. This study aims to investigate if the problem is caused by the placement of the recycle-bins. We analyzed whether basic placement changes in proximity would reduce the amount of wastes in recycle-bins and also whether these changes will maximize the recyclable materials in the recycle bins, thus, helping the recycling process to be more profitable. There was a significant decrease of externally derived contamination when recycle-bins were placed further, relative to waste-bins. However, that reduced the recyclable materials also. The conclusion was placing a bin nearer to foot traffic increases its litter load. It is recommended that in places with higher amount of recyclable material, recycle-bins to be placed nearer, regardless of externally derived contamination, in order to obtain as much recyclable material as possible.

Keywords: Recycling behavior; Recycling; Recycling barriers; Recyclable material; Externally derived contamination; Littering; Waste management

Introduction

In our throw-away era in which we are depleting our resources, many countries, municipalities and local governments conduct programs for recycling and sustainable waste management. Their success is important to ensure humanity's welfare. Most waste is produced by the public, therefore public participation is important [1-3]. Public campaigns for social awareness and responsibility, technology and environmental education are the main provisions to encourage people to participate in recycling [4].

Higher education institutions are primary centers to foster the next generation's environmental consciousness and to devise and sustain proper waste management methods and practices [5-9]. Because universities generate a range of wastes different than households [10], they deserve special parameters of recycling convenience claimed that recycling is altruistic. This altruism must be encouraged by reducing its inconvenience or by compensating its cost with rewards [11-14].

The research found that situational factors are important in recycling behavior. Decreasing expended energy and time to execute a proper recycling process encourages participation in recycling [1,15]. Davies et al. [16] examine how control elements either facilitate or discourage recycling, and suggest better strategies for encouraging voluntary compliance with recycling procedures. Accordingly, this study is concerned to understand how placement of bins relates to recycling convenience, because removing external barriers can significantly influence the adoption and maintenance of behavior. In order to optimize placement, recycling bins must be easily accessible; they should be dispersed across a region rather than centralized in one location within that region; and they should provide for distinct kinds of refuse – at least to distinguish recyclables from rubbish [17].

Over the past few years, research has shown that use of recycling bins depends also upon waste bins, as recycling rates dramatically decrease when recycling bins are located away from waste bins. This dependency raises our main issue: externally derived contamination, i.e., placing improper wastes into recycling bins [18]. Some reasons for this error are: not knowing which materials are to be recycled, or not understanding the signs on bins or their specific meaning [19]. This research examines low-recyclers, those who think they don't have time or energy to distinguish between waste and recycling bins [20]. Perhaps such people do not think about whether their refuse is recyclable, and to just get rid of the garbage they prefer to throw it into the nearest bin regardless of its designation because it is easier. People have a significant tendency to choose the nearest location, just as they tend to select supermarkets or hospitals by their convenient location [21,22]. Now distance to the nearest receptacle is positively predictive of littering [23], our aim is to investigate whether placement of recycling bins, relative to foot traffic patterns and to the placement of waste bins, affects the quantity of externally derived contamination and whether these changes in placements are also predictive of littering.

Method

Research site

Observations were carried out on four different days at a health sciences university in Istanbul, with different bin placement on each day. The heterogeneity of those visiting or using the university is due to its facilities. A second division professional basketball team and their youth teams provide an athletic and non-academic population. Conference rooms used by various companies provide non-health-sector population. Also, the university's high technology devices and simulators attract companies to set up seminars for doctors; this provides a population from the health-sector outside the university. As universities don't consist only of students, naturalistic observation method was used, including all guests to the university. The campus has two main buildings; the observed bins were located in a passage

between the buildings and the cafeteria. This is the most heavily used walkway of the campus.

Project design

Given the corridor of the walkway, foot traffic was on the x axis. On day one, waste bins were placed in front of recycle bins on the y axis (Figure 1); on day two, their relative placement was reversed (Figure 2).

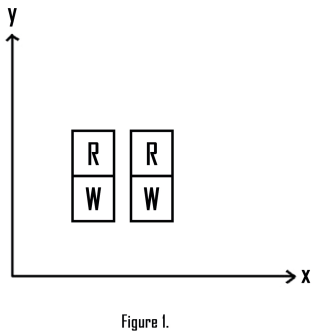

Figure 1.

Figure 1: Experiment 1.

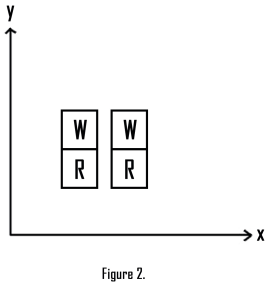

Figure 2.

Figure 2: Experiment 2.

Though 71% of people don't change their recycling attitude by social pressure [19], because participants desire to present themselves in a positive way [24] and because participants' choices change by the status, age, race or gender of the interviewers [25-28], the authors posed as coffee shop customers, observing from 10 m distance to avoid creating social pressure.

Administrators, staff, students and visitors were observed unawares at the university, in Istanbul, between 9 A.M. and 4 P.M. Experiments were conducted on Fridays between 13 November and 11 December 2015. Bins were emptied at 12:30 p.m. by staff as usual, to avoid fullness as a confounding factor so that people wouldn't change their bin preference when they saw one bin much more full than the other. Bins which were regularly used in the observed area were identical except for the recycle sign on top of recycle bins and non-recycle sign on top of waste bins.

On day three, recycling bins were placed on the x axis and waste bins were placed between them (Figure 3).

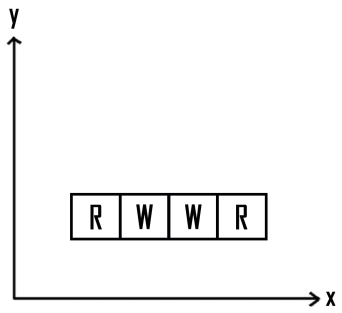

Figure 3.

Figure 3: Experiment 3.

On day four, their respective locations were reversed, placing recycling bins between waste bins on the x axis (Figure 4).

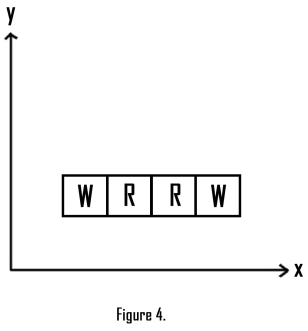

Figure 4.

Figure 4: Experiment 4.

Data recording and analysis

At least one of the authors was always observing the bins during the process to record data at the moment someone threw material into the bins. Placement of bins was manipulated only on days of observation; after observation, bins were returned to their original positions. The system - developed by the Society of the Plastics Industry to aid sorting for recycling – was used to classify types of litter. It was calculated that 12 observations would be needed in each group to give the study a power of 80 percent to detect a difference in primary outcome of 75 versus 25 percent $p < 0.05$ was accepted as a significant level.

Results and Discussion

Approval was obtained from the first author's university's Human Research Ethics Committee on 20 August 2015 and from the second

author's university's Human Research Ethics Committee on 17 August 2015. The fullness of bins never exceeded 2/3. Day two's experimental design significantly increased the amount of recyclable material obtained and slightly increased the externally derived contamination (Tables 1 and 2). The difference between the third day and the fourth day is significant, though not as significant as the difference between the first day and the second day. The composition ratio of litters was compatible with bins. It has been found that misusers of bins either didn't look at bins or looked only a moment, whereas responsible users looked bins more than one second.

	Ideal Recycle	Real Recycle	Ideal Waste	Real Waste	E.D.C.	Sample Size
First Day	64.70%	14.70%	35.29%	35.29%	None	34
Second Day	78.94%	63.15%	21.05%	10.53%	14.28 %	19
Third Day	72.72%	54.54%	27.27%	4.54%	29.41 %	22
Fourth Day	58.82%	26.47%	41.17%	23.52%	40%	34

Table 1: Percentages of Different Experiments.

	Recycle Bins		
	Recyclable Material	Non-recyclable Material	Unidentified Material
First Day	5	None	None
Second Day	11	2	1
Third Day	10	5	2
Fourth Day	8	6	1
Waste Bins			
	Recyclable Material	Non-recyclable Material	Unidentified Material
First Day	17	6	6
Second Day	3	2	None
Third Day	4	1	None
Fourth Day	11	7	1

Table 2: Numbers and Classifications of Usages.

Our study is compatible with previous findings that the closest bins were preferred more by their participants. Although the population of the university is predominately female, and girls and women have higher tendency to recycle [29-31] and recycling behavior is closely associated to higher education [31-34], the significant difference of misplaced litters on the first and on the third day indicates a robust finding of the present research beside that younger people tend to recycle less [30,35,36] weakens the research. Similar to [19], which found that separating recyclable materials into so many categories discourages 20% of respondents to recycle, our study observed that people throw their litter into the nearest bin whether recyclable or not, even if all unidentified litters were thrown into the correct bin (Table 2). In view of this finding, we may optimize the process of recycling due to people's tendency to use the nearest bin, without creating new costs. This regulation might eliminate or at least reduce the problem that we cannot obtain all recyclable materials even in most developed regions [37]. The first choice is placing bins on the y axis, though our findings show that placement on the x axis also works, if less effectively.

Conclusion

Placing bins on the y axis when the foot traffic is on x axis is the most efficacious method. In this method, bins' relative proximity to foot traffic is the same wherever a pedestrian comes from. However, it may not sometimes be possible, to place bins on the y axis, because of the architectural inconvenience of the building or the lack of usable space. In this case, the second most effective method can be used: placing bins on the x axis, when the foot traffic is on the x axis. It is suggested that in places with higher amounts of recyclable material, recycling bins to be placed nearer, regardless of externally derived contamination, in order to obtain as much recyclable material possible. Obtained amount of recyclable material can offset the amount of externally derived contamination. Placing bins on the y axis should be the primary choice. Limitations of this study may be: universities provide mostly educated population that may differ in recycling behaviors outside the campus, this possible difference may provide different results. Also, the bins in this study were nearly identical, all bins had grey color. The results may be improved further with colored recycling bins. Different shapes and colors might affect the results [38]. Future studies can investigate the parameters a bin possess that can influence recycling behavior and also can replicate the study. We also suggest more emphasis on the importance of recycling in education for the future of our planet.

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