Spring 2023

CUB Plastic Shipping Bag Recycling Program

Samuel M. Arkin
Gettysburg College

Ethan J. Bruemmer
Gettysburg College

CUB Plastic Shipping Bag Recycling Program

Abstract

We implemented a plastic shipping bag recycling program at Gettysburg College. Recycling bags contribute towards contamination within the college's single-stream recycling or end up directly in the landfill via traditional trash collection. The production of plastic bags relies on the continued production of fossil fuel extraction. Plastic bag recycling can decrease fossil fuel extraction and waste entering landfills. To curb Gettysburg College's generation of waste, we placed four bins in various locations throughout the Center Union Building (CUB) in order to collect plastic shipping bags over a 4.5-week period. We made three hypotheses: that our bins would collect shipping bags and be used by Gettysburg College students, that different locations of the bins would impact their usage, and that over time contamination would decrease and desired product collected would increase. We collected 215 plastic bags, which represented 9.53% of the total amount of plastic shipping picked-up from the mailroom. Placing bins closer to the mailroom and away from dining areas reduced contamination and increased shipping bag collection. We did not find support that over time contamination would decrease and desired product increase. We hope this project will guide future policies to increase recycling of plastic shipping bags.

Keywords

climate change, plastic bag, recycling, advocacy, policy

Disciplines

Environmental Studies | Policy Design, Analysis, and Evaluation

Comments

Written for ES 400: Seminar.

CUB Plastic Shipping Bag Recycling Program

An Advocacy and Policy Oriented Approach towards Implementing Efficient Recycling Practices

4/28/23

I affirm that I will uphold the highest principles of honesty and integrity in all my endeavors at Gettysburg College and foster an atmosphere of mutual respect within and beyond the classroom.

Sam Arkin: Sam Arkin

Ethan Bruemmer: Ethan Bruemmer

Abstract

We implemented a plastic shipping bag recycling program at Gettysburg College. Recycling bags contribute towards contamination within the college's single-stream recycling or end up directly in the landfill via traditional trash collection. The production of plastic bags relies on the continued production of fossil fuel extraction. Plastic bag recycling can decrease fossil fuel extraction and waste entering landfills. To curb Gettysburg College's generation of waste, we placed four bins in various locations throughout the Center Union Building (CUB) in order to collect plastic shipping bags over a 4.5-week period. We made three hypotheses: that our bins would collect shipping bags and be used by Gettysburg College students, that different locations of the bins would impact their usage, and that over time contamination would decrease and desired product collected would increase. We collected 215 plastic bags, which represented 9.53% of the total amount of plastic shipping picked-up from the mailroom. Placing bins closer to the mailroom and away from dining areas reduced contamination and increased shipping bag collection. We did not find support that over time contamination would decrease and desired product increase. We hope this project will guide future policies to increase recycling of plastic shipping bags.

Introduction (Ethan)

Goals and Objectives

The goal of our project was to reduce waste that Gettysburg College collects by increasing recycling. In order to accomplish this, we planned to collect plastic shipping bags, such as the blue and white amazon shipping bags. Plastic bags are contaminants to the single stream recycling Gettysburg College uses. Single stream recycling requires students and faculty to put all recycling in a singular bin. Once facilities collect and combine the bags of recycling, Waste Management (WM) then acquires it and brings it to a facility in Elk Ridge, Maryland. Through mechanical engineering the product collected from Gettysburg College gets sorted. WM has released to Gettysburg College that they only recycle waste that presents a contamination level of 5% or less. This means that if 5% or more of the recycling is contaminated then it will be brought to the landfill and treated as waste. In reaching out to WM, they chose not to release to us information on the percentage of the Gettysburg College recycling that actually gets recycled and the percentage that is diverted to the landfill. In addition, WM chose not to release how they determine and measure contamination of the recycling. This lack of information is especially significant when you consider that in the most recent Association for the Advancement of Sustainability in Higher Education (AASHE) Sustainability Tracking, Assessment & Rating System (STARS) report Gettysburg College released that WM has collected 172.09 tons of recycling from them (AASHE 2022).

Plastic recycling bags are not eligible to be recycled through WM single stream recycling. However, secondary facilities are available that can recycle this product. Walmart is a primary collector of such products and transfers them to recyclable facilities. They state, “plastic bag and film recycling bins were distributed to all open Walmart U.S. stores, including Puerto Rico, by October 2021” (Walmart). The shadow of data that WM has placed on us furthers the necessity to recycle these plastic bags. Currently, these bags are either thrown directly into the trash, on course to a landfill, or are contamination for the college's single stream recycling. Either way, none of it gets recycled and all of it has negative environmental consequences.

The reason why plastic bags are one of the biggest contaminants is that they result in the machinery getting blocked and the efficiency of the recycling being decreased massively (Freinkel, 2011). Storm waters and winds also carry plastic bags into large bodies of water, resulting in harmful impacts on oceans, rivers, lakes and wildlife (Mclaughlin, 2016). When the particles from photodegraded plastic bags get into the bodies of water, they also cause immense harm to filter feeding marine species (McGlaughlin, 2016). These particles contain Polychlorinated biphenyls or PCBs that travel up the food chain becoming biomagnified and don't only pose a threat to the health of food webs but also pose a threat to human health and safety (McGlaughlin, 2016).

In addition, the lack of recycling around plastic bags leads to a greater need to make more, and thus a greater usage of the fossil fuels needed to create those plastic bags. This cradle to grave system also leads to an increase in the amount of waste created, as they don't make any effort to close the loop and repurpose these bags. This increase in waste then leads to a decrease in the amount of CO2 trapped by zooplankton, (one of the largest carbon sinks in the ocean) since the microplastics released from the decomposing bags lead to shortened lifespans and many other negative side effects that affect their populations (Botterell, 2018). These plastics can last for centuries in marine ecosystems, making these negative side effects extremely long lasting (Botterell, 2018). Plastics also contribute to 6% of the globe's consumption of fossil fuels (World Economic Forum, 2016).

Furthermore, the plastic industry adds to climate change at every stage from oil extraction to plastic incineration or decomposition. It is predicted that the plastic industry will release 1.34 billion tons of greenhouse gas emissions by 2030 annually (Kistler, 2019). This is why learning to recycle these bags or repurpose them is so important, and why a lasting policy to achieve this goal should be implemented at Gettysburg College.

Similar Experiments

While there is no experiment that replicates ours directly, there are at least two other studies of waste on college campuses that informed our study (. Nova Scotia Community College (NSCC) is an institution that has completed waste audits for their thirteen campuses since the 2011-2012 academic school year (AASHE, 2020). NSCC's waste management practices were the highest ranked in the AASHE, or STARS report. This report shows how useful these waste audits are in understanding a recycling plan's effectiveness, and how this strategy puts them atop the list. During waste audits, they learn the recycling patterns of the students in certain spaces, and with this data, are better able to figure out how to change student behavior. Every year NSCC improves the amount that is diverted from the landfill, with 69.82% of materials diverted from the landfill by recycling, composting, donating, or re-selling during the 2018-2019 academic school year (AASHE, 2020). This reduction of waste? is why we have chosen to adopt a similar strategy, to conduct waste audits on our bins, which will help us better understand recycling habits for future policy action. For example, it will help us figure out the best location for the bins and the mechanical procedure responsible for facilitating distinct change.

At Dickinson College, they work alongside GIANT in the "Bags to Benches" initiative, which uses the plastic shopping bags collected to make park benches (Dickinson, 2023). Dickinson uses single-stream recycling like Gettysburg College but has many more initiatives focused around removing contamination from the recycling bins, such as composting on the Dickinson farm, "Bags to Benches," reuse initiatives, and E-waste recycling (Dickinson, 2023). Dickinson, like NSCC, also conducts waste audits that help them understand which policies work and which don't in improving recycling habits (Dickinson, 2023). The "Bags to Benches" initiative and the waste audits completed at Dickinson helped to further define our project.

Our study will examine the move away from the over-inclusive single stream recycling bins that lead to more pollution being released, and lead to larger contamination (Berardocco et al., 2020, Catlin et al. 2020). Therefore, having bins with a designated specific product we theorized would lead to less confusion around what we were collecting. Furthermore, we decided to use colored bags as liners for the bins in our experiment, as studies have demonstrated the efficacy of using colored trash bags (Sörme, et al., 2019). In the case of our experiment, we will look to use blue plastic bags, and white and blue bins that resemble the Amazon plastic shipping bags that we will be mainly collecting.

On a college campus, Cho (2019) found in her study "that self-determined motivation, attitude toward recycling, perceived behavioral control and negative anticipated emotion had direct effects on campus recycling intention, while recycling intention and self-determined motivation influenced students' actual campus recycling behavior." Based on this information we will look to capitalize on students' self-determination and will slowly increase awareness around the presence of the bins and their use. Noh (2021) suggested that social media and campus wide information sharing were positively impacting intention and behavior around recycling norms.

Hypotheses

Hypothesis 1: We hypothesize that over 4.5 weeks, by collecting plastic shipping bags/ amazon bags, we will increase the amount of recyclable material at Gettysburg College.

Hypothesis 2: With four different locations for the bins, we hypothesize that there will be significant spatial variation in the amount of desired product collected and contaminated product collected among four recycling bins when placed in different locations throughout the CUB.

Hypothesis 3: Lastly, we hypothesize that over 4.5 weeks we will see an increase in the collection of plastic shipping bags and a decrease in contaminated products in our bins. This will measure the effects of our advocacy campaign and our attempts to change people's recycling habits.

Methods (Sam)

Pre-Data Collection

Talking with People/Getting Permissions

In line with campus policy and procedure we required initial authorization to utilize facility recycling bins and place them throughout the CUB. We proceeded to, after discussing with Randall Wilson and Sarah Principato, collect primarily Amazon shipping bags and other shipping bags received by the mailroom. Based on assumption we decided to target Amazon directly due to their misleading advertising and overwhelming abundance within the mailroom. Consulting with Nicholas Pogasic in the mailroom we established a baseline of product count that is eligible for us to procure. Within the mailroom, all products stored within the *Grey_Rack*, *Large_Envelopes,* and *Tub_Sideways* are eligible for our recycling program. As all mail to Gettysburg College students comes through the mailroom, our collected amount is in proportion to the total eligible packages Gettysburg College receives. Nicholas provided us with an abundance of information including *Store*, *Carrier, mailroom location, date_recieved,* and *date_pickedup.* We began collecting data from Nick 1.5 weeks prior to the placement of our bins. This allowed us to confirm that there was a significant number of packages within the mailroom eligible for collection. We compared the *date_pickedup* to our collected sample to calculate the percent recycled.

What to Collect and How

To proceed with the collection timeline, we established optimal location placement within the CUB in congruence with strict dates of collection. We placed them at: *Cub_Desk, Mailroom,* *Junction,* and *Hallway.* Based on assumption and experience, we believed these locations have the highest foot traffic post mailroom visits. We placed the bins before the mailroom opened on February 22, 2023, and collected our first sample after the mailroom closed on February 24, 2023. We then proceed to, at the end of each day of both Wednesday and Saturday, collect and count the product within the bins. We chose those dates based on compromising the desire to obtain more data points, the desire to reduce burden on us, and the desire to create equal collection windows. While we acknowledge collection windows are not equal, because the mailroom is only open five days a week and because we wanted weekly intervals, our only option was to collect at three days, and two-day intervals. After the first collection date the following Wednesday and Saturday, we collected and counted the product. To minimize the unequal interval impact we collected Saturday night, and while we acknowledge this does not make the Monday-Wednesday, Thursday-Saturday, equal in terms of collection (because the mailroom is only open Monday-Friday), we attempted to limit difference to the best of our ability. Our collection continued for three more weeks after that for a total of 4.5 weeks of data collection and nine data points.

Comparing our gathered eligible product in comparison to Nicholas' baseline, we calculated the percent collected. We simultaneously accounted for bin contamination by determining abundance and descriptive categories for each individual bin. Collecting data on each bin, for each collection date, we described the collected product as: *Food_Product, Drink_Product, Amazon_Bags, Shipping_Bags, Other,* and *Paper_Product.* This would allow us to compare how bins related to each other on the basis of contamination type.

Advocacy Campaign

To increase usage, we created various modes of outreach that sought to engage the campus community and inform them of our project. We designed a poster that was placed in various locations across the campus (Figure 7). Using social media (Instagram) and the digest we attempted to circulate the information online. By advocating the bins at a table in the CUB while using word of mouth we sought to increase bin usage.

Data Collection and Statistical Analysis

Model 1

Testing for hypothesis one required us to obtain and compare the statistics of how many eligible bags were collected without our bins. We compared the amount of eligible product deposited in our bins to the amount of eligible product picked up from the mailroom (Figure 1) Because we are comparing a percent, the size of the collection window is not relevant. Model 1 further depicts an abundance comparison bar graph (Figure 2). In our analysis, we used the collection period and not date because each collection window is not of equal length (Figure 2). We demarcated the collection period by a, meaning a three-day collection window, and b, a two-day collection window (Figure 2).

Model 2

To model our second hypothesis, we conducted an ANOVA test that compares each individual location with one another while treating each date collected as its own unit of analysis. The values used within the test are the percent of eligible product collected (for each date for each bin) and the percent of contamination collected (for each date for each bin). To help visualize the significance of this comparison, eligible products and contamination across the four bins were calculated as percentages of each other (Figure 3). We compared both eligible products collected, and contamination collected (Figure

Model 3

To test our third hypothesis, we conducted a linear regression of eligible products collected in comparison to contamination collected as percentages of the total. We are testing our regression with a percent comparison of the total rather than an abundance comparison of the total because the third hypothesis seeks primarily to establish the increase/decrease of each variable in relation to each other. Percentage comparisons allow us to test this while an abundance comparison would demonstrate collected ratios in relation to the total which is not what this hypothesis tests (Figure 4). It illustrates the date by percent eligible product and percent contamination. The contamination type across the 6 variables dissected allows us to better understand the patterns in which the bins are utilized (Figure 5). It proves important for policy recommendations and possible future projects of similar study.

Results (Sam)

Model 1

Model 1 depicts hypothesis 1 in that it demonstrates the abundance of eligible products collected throughout the 4.5 weeks (Figure 1). Overall, the total eligible products we could have collected were 2,257 while in total we collected 215. This depicts that our overall percent collected is 9.53%. The abundance of eligible products collected during a collection window by the actual amount of collected eligible product within that window varied throughout the study (Figure 2). We collected 145 Amazon bags compared to the 72 shipping bags (67.4%). Continuously, 65% of what the mailroom collects (out of eligible products) is Amazon shipping bags (Figure 6).

Model 2

When comparing location of the bins, results indicate that only a select number of comparisons between bins are statistically significant. Comparing the abundance of eligible products collected provided three statistically significant results: *Cub_Desk-Doorway* (p = 0.016), *Mailroom-Junction* (p = 0.025), and *Mailroom-Doorway* (p = 0.004). Additionally, when looking at contamination, across the four bins the only comparison of significance was. *Mailroom-Doorway* (p = 0.026) . Figure 3a depicts this comparison of both eligible products and contamination as a percentage while Figure 3b depicts it as a ratio of abundance.

Model 3

We collected a total of 215 pieces of eligible product and a total of 126 pieces of contamination. This translates into 63.05% eligible products and 36.95% of contamination. The linear regression depicts that over time there is no statistical significance between the relationship of contamination and eligible product collected by date as a percentage of one another. The p-value of this regression is 0.1842, the f-value is 2.17, and the r^2-value is 0.23666.

Discussion (Ethan & Sam)

Model 1

We collected a significant number of eligible products through placing our bins throughout the CUB. Throughout the 4.5 weeks that we collected Amazon bags and other shipping bags, we saw no significant increase or decrease in usage of the bins. Traditional campus recycling does not recycle these products through single stream recycling. In fact, they contribute to contamination of recycling where it only takes 5% contamination of each haul to transfer it to the landfill. Therefore, our collection of amazon bags and shipping bags contributes to increasing campus recycling on our end, but also may reduce the amount of contamination in traditional campus single stream recycling. However, we are unable to quantify the reduction in contamination because WM would not provide us with numbers that can allow this calculation to be tested.

Our collection of 9.53% of the number of eligible products we conclude is successful. This project design was new to Gettysburg College, where we collected plastic shipping bags, along with an advocacy campaign to change people's behavior around recycling. We believe that this contributed to the percentage of usage being 9.53%. The percentage figures illustrate that we were able to collect a significant number of eligible products out of the total eligible picked up from the mailroom (Figures 1 & 2). Therefore, because the number of packages that either went to the landfill or contributed to recycling contamination was 2,257, and the amount we collected was 215, we were able to divert 9.53% into recyclable material that otherwise would not. We depict abundance of collected product against mailroom picked up product to show if what we actually collect is of policy significance (Figure 2). We find support for our first hypothesis.

Model 2

We concluded that our second hypothesis was partially supported. Comparing the locations spatially to one another we concluded that some locations did better than others when discussing both eligible product and contamination. *Cub_Desk* and *Mailroom* were the bins closest to the mailroom. While *Cub_Desk* had the highest abundance of eligible products, *Mailroom* had the largest eligible product to contamination ratio. *Doorway* and *Junction* had the 2 lowest ratios of product and highest levels of contamination of the four bins. The ANOVA test indicates that the only significant difference exists between *Cub_Desk-Doorway* and *Mailroom-Junction* and *Mailroom-Doorway*.

What we interpret from this result is that *Doorway* and *Junction* are not in optimal locations and should not continue to exist for future policy. They demonstrate the smallest contamination/eligible product ratio. Due to *Mailroom* (while not collecting the most eligible packages) having the greatest difference between in abundance of contamination/eligible product this is in an optimal location. Additionally, *Cub_Desk*, while only having the second largest difference between eligible product to contamination, collected the greatest abundance of packages 110.

Model 3

Our third hypothesis was not supported by the available data. The linear regression indicates there is no significance between the percent eligible product and percent contamination over time. We have multiple theories as to why it appears the relationship between contamination and eligible products did not change. One explanation is the location. Hypothesis 2 indicates that some locations are significantly different from others in both eligible product and contamination. There may be comparisons within this set that may explain why there is no change in the relationship between the data.

Another explanation could be that there is a select portion of people devoted to recycling and there is a significant portion of people who do not care. We believed that through advocacy we could possibly sway people that fall somewhere in the middle and therefore increase recycling. However, it may be possible that there really is no middle, where there are people who care and people who don't. This however requires further testing among the Gettysburg College population in the form of a behavioral, sociological test, possibly one of survey design . Interestingly, a study performed by Catlin et al. (2021) illustrates how pro-environmental labeling might encourage more usage of the bins, but it also results in more contamination. This might explain how the contamination slowly went up despite our efforts to inform people of them and encourage them to use the bins. Furthermore, a study by Cho (2019) saw that while direct advocacy efforts did change students' immediate behaviors it did not change the general social norms surrounding it in the college. This can explain why students at Gettysburg College seemed to respond to our direct advocacy efforts, but in the end, we were not able to involve most of the school and receive more packages. A study done by Noh (2021) found that they were able to positively impact students' attitude and the college's social norms towards recycling through forms of social media and college education. This study's attempts to impact student's behavior around recycling seemed to have been successful due to the large amount of funding and participation in the study.

Our project centered around increasing campus recycling and pathways to accomplish this, not on changing the norms on campus associated with recycling. A project for future study may be more proficient with their ability to manipulate campus norms. Our results aid in providing support for such a project by demonstrating that with the implementation of a new recycling initiative and minimal advocacy, Gettysburg College students will not increase usage solely based on the bins existing. While our results here are not significant, they may still be useful for future policy implementation. However, while there is a significant lack of knowledge about current recycling patterns due to waste management not releasing information, we do not know how our level of contamination compares towards the general recycling patterns of the campus.

The composition of contamination was primarily paper products, we believe people did not look carefully enough at the bins (Figure 5). They may have had good intent on trying to recycle paper, but they did not care enough to read the signage and understand that was not what we were collecting. Our advocacy grew out of the theory that (out of all eligible products) because the mailroom gets primarily Amazon bags, we should target them individually in addition to shipping bags generally. Continuously, 65% of what the mailroom collects (out of eligible products) is Amazon shipping bags (Figure 6). It is curious how the ratio of Amazon and non-Amazon bags are similar between what we collect and what the mailroom hands out. What we interpret from this is that an advocacy campaign better targeting Amazon bags may be more successful as it can trigger more apparent social cues and be more recognizable. In hopes this would reduce contamination as it would trigger greater attention. A future project could better evaluate how efficacious this theory may be.

Limitations and Future Work

We believe our advocacy campaign lacked significant effect in being able to persuade more people to use the bins for the correct reason and to stop using them for the wrong ones. This could be explained by the people's self-determination to either recycle, or not care. Other studies corroborate the belief that self-determination and self-motivation play crucial roles in increasing student recycling (Cho, 2019). Furthermore, an abundance of the contamination was traditional recyclable material, however, it was not recyclable through the means of our collection process. We believe many individuals thought this to be a general recycling bin where they could place anything. A future test could work on narrower advocacy and target with greater force the desired demographic. Studies indicate that multi-stream recycling shows success when using pictures or symbols of the material able to be recycled due to the assumption many people are not reading the signage (Sukstorf, 2020). While we did attempt to create a poster that was specific enough, future advocacy could target Amazon bags more specifically (making up 65.69% eligible bags able to be collected). These symbols will need to be clear and specific, as research shows that unclear symbols lead to an increase in misunderstanding (Latkin, 2022). A lack of clarity around recycling can also lead to people not recycling due to the confusion on what can and can't be recycled (Roy, 2022).

Our study lacked a significantly desirable time scale that could test at greater lengths our research design. We also are students with other responsibilities and cannot devote more time to creating and collecting more bins across the campus. Greater bureaucratic support could make up for these limitations that we faced. We believe many students open their packages in their residence halls, and if future policies are able to acquire more bins, it would be beneficial to place them in those locations. In addition, using Residence Assistants (RAs) and Community Assistants (CAs) to spread the word during community meetings that students are required to attend, and to encourage the usage of the bins could be extremely beneficial. Most importantly, for the advocacy campaign there are only two of us. If there is a larger campus wide effort made by Facilities Services and the ES Department in tandem with the RAs and CAs, more people may become aware and become compelled to participate. This could lead to a change in the culture around recycling, with more people caring about doing it correctly.

Conclusion (Ethan & Sam)

We collected 9.53% of all the eligible plastic shipping bags that came through the mailroom. This equates to 215 bags over the short 4.5-week period. If our plastic shipping bag recycling efforts were implemented on a large scale, with various factors of policy reform in mind, we theorize that significantly more bags could be collected. Additionally, over time, people would become more aware of these bins and their specific designation. This could lead to a significantly larger decrease in plastic bags diverted to landfills or plastic bags entering recycling as a form of contamination. Additionally, the partial support for spatial variation being significant indicates that future attempts should take into consideration heavily where these bins are placed. It is crucial in ensuring less contamination while advocating for greater usage.

Acknowledgments

Thank you to James Biesecker and Eric Richardson who gave us permission to use the bins in CUB. Thank you to Nicholas Pogasic for providing us with continuous information on the packages in the mailroom. Thank you to Professors Sarah Principato, Randall Wilson and Tasha Gownaris for helping us with the project. And finally a big thank you to Kenny in facilities for providing us with a niche inside look at the way the CUB opporates.

References (Ethan & Sam)

Berardocco, C., Delawter, H., Putzu, T., Wolfe, L. C., & Zhang, H. (2022). Life Cycle Sustainability Assessment of Single Stream and Multi-Stream Waste Recycling Systems. *Sustainability*, *14*(24), Article 24. https://doi.org/10.3390/su142416747

Botterell, Z. L. R., Beaumont, N., Dorrington, T., Steinke, M., Thompson, R. C., & Lindeque, P. K. (2019). Bioavailability and effects of microplastics on marine zooplankton: A review. *Environmental Pollution*, *245*, 98–110. https://doi.org/10.1016/j.envpol.2018.10.065

Catlin, J. R., Leonhardt, J. M., Wang, Y., & Manuel, R. J. (2021). Landfill or Recycle? Pro-Environmental Receptacle Labeling Increases Recycling Contamination. *Journal of Consumer Psychology*, *31*(4), 765–772. https://doi.org/10.1002/jcpy.1216

Cho, M. (2019). Campus sustainability: An integrated model of college students' recycling behavior on campus. *International Journal of Sustainability in Higher Education*, *20*(6), 1042–1060. https://doi.org/10.1108/IJSHE-06-2018-0107

Freinkel, S. (2011). *Plastic: A toxic love story*. Houghton Mifflin Harcourt. http://www.mackin.com/BookPics/Book.aspx?isbn=9780547152400

Latkin, C., Dayton, L., Yi, G., & Balaban, A. (2022). The (Mis)Understanding of the Symbol Associated with Recycling on Plastic Containers in the US: A Brief Report. *Sustainability*, *14*, 9636. https://doi.org/10.3390/su14159636

Lyons, L. (n.d.). *Waste & Materials* (worldwide). Dickinson College. Retrieved April 10, 2023, from https://www.dickinson.edu/info/20052/sustainability/2284/waste_and_materials

McLaughlin, M. (2016). Ban, Fee, Take-Back/Recycle: Which Approach Wins Out in the End? *Master's Theses and Capstones*. https://scholars.unh.edu/thesis/1078

Noh, M. (2021). Understanding the Effect of Information Sources on College Students' Recycling/Reuse Behavior towards Clothing and Textile Products. *Sustainability*, *13*(11), Article 11. https://doi.org/10.3390/su13116298

Plastic and Climate: The Hidden Costs of a Plastic Planet—Center for International Environmental Law. (n.d.). Retrieved April 10, 2023, from https://www.ciel.org/plasticandclimate/

Sukstorf, C. (2020). The Effect Of Pictorial Signs On Recycling Rates. *Environmental Studies Undergraduate Student Theses*. https://digitalcommons.unl.edu/envstudtheses/275

The New Plastics Economy: Rethinking the future of plastics. (n.d.). World Economic Forum. Retrieved April 10, 2023, from https://www.weforum.org/reports/the-new-plastics-economy-rethinking-the-future-of-plastics/

US EPA, O. (2019, April 17). *The U.S. Recycling System* [Overviews and Factsheets]. https://www.epa.gov/recyclingstrategy/us-recycling-system

Waste: Circular Economy. (n.d.). 2022 ESG. Retrieved April 10, 2023, from https://corporate.walmart.com/esgreport/environmental/waste-circular-economy

Waste Minimization and Diversion | Nova Scotia Community College | Scorecard | Institutions | STARS Reports. (n.d.). Retrieved April 10, 2023, from https://reports.aashe.org/institutions/nova-scotia-community-college-ns/report/2020-03-06/OP/waste/OP-18/

Roy D., Berry E. Dempster M. (2022, May 3). "If it is not made easy for me, I will just not bother". A qualitative exploration of the barriers and facilitators to recycling plastics. *PLOS.* Retrieved April 10, 2023, from https://journals.plos.org/plosone/

Appendix:

Tables:

Table 1	
Date	Percent of Eligible Packages Collected
2/24/2023	8.91%
3/1/2023	4.59%
3/3/2023	20.77%
3/15/2023	13.65%
3/17/2023	4.78%
3/22/2023	11.19%
3/24/2023	16.00%
3/29/2023	7.80%
3/31/2023	3.11%

Table 2		
Collection Point	Total Eligible Product Collected	Packages Picked Up From the Mailroom
Collection 1, a	27	303
Collection 2, a	13	283
Collection 3, b	27	130
Collection 4, a	55	403
Collection 5, b	11	236
Collection 6, a	33	295
Collection 7, b	20	125
Collection 8, a	23	295

Collection 9, b	6	193

Table 3a				
Name	*Junction*	*Cub_Desk*	*Doorway*	*Mailroom*
Eligible Bags	44.12%	73.33%	35.19%	81.16%
Contamination	55.88%	26.67%	64.81%	18.84%

Table 3b				
Name	*Junction*	*Cub_Desk*	*Doorway*	*Mailroom*
Eligible Bags	30	109	19	54
Contamination	38	41	35	15

Table 4		
Date	Total Contamination	Total Eligible Product
2/24/2023	18.18%	81.82%
3/1/2023	45.83%	54.17%
3/3/2023	37.21%	62.79%
3/15/2023	36.78%	63.22%
3/18/2023	47.62%	52.38%
3/22/2023	23.26%	76.74%
3/25/2023	31.03%	68.97%
3/29/2023	48.89%	51.11%
4/1/2023	62.50%	37.50%

Table 5	
Material	Abundance
Amazon Bags	145
Shipping Bags	72
Paper Product	58
Food Product	36
Drink Product	20
Other	11

Table 6		
Store	Count	Percent
Amazon	1941	65.69%
USPS	194	6.57%
N/A	114	3.86%
Other	706	23.89%

Figures

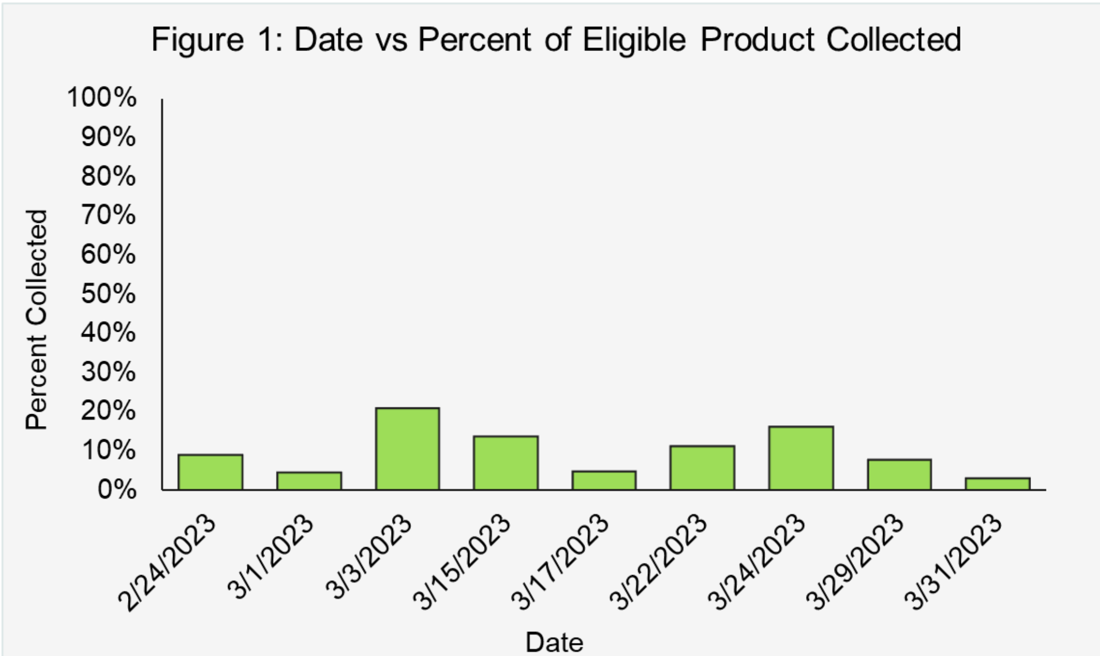

Figure 1: Depicts the date by Percent Collected. Each date represents the day we collected our product from the bins. The collected eligible product is displayed as a percentage of the available product for us to be able to collect.

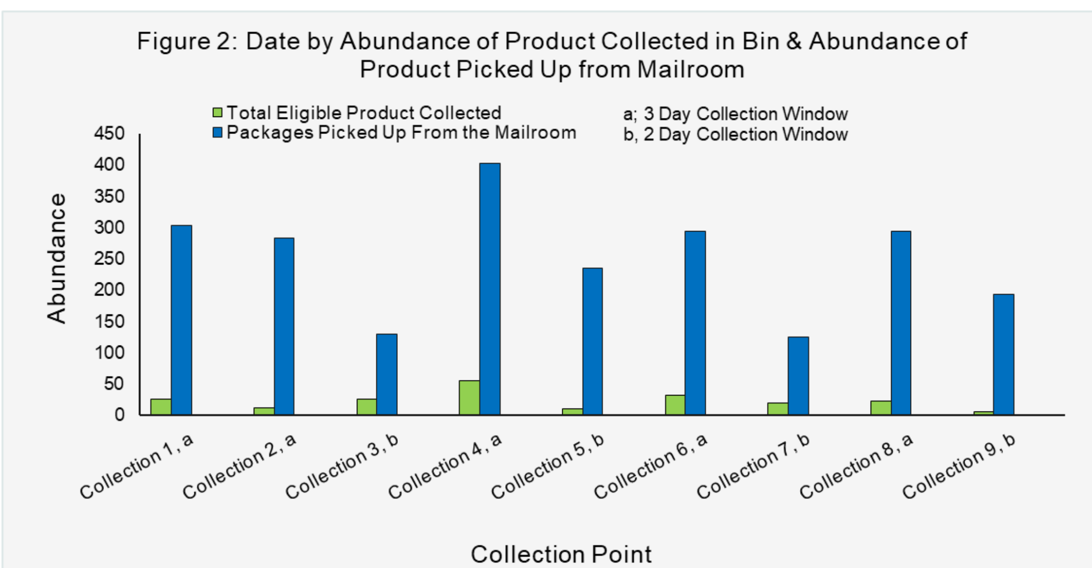

Figure 2: Depicts each collection period by abundance. Due to the collection period intervals being unequal, either 2 or 3 days, we depicted through a or b denoting the amount of days each period was. The abundance display demonstrates the actual collected amount which is important in understanding the ways in which we attempted to reduce the college's recycling.

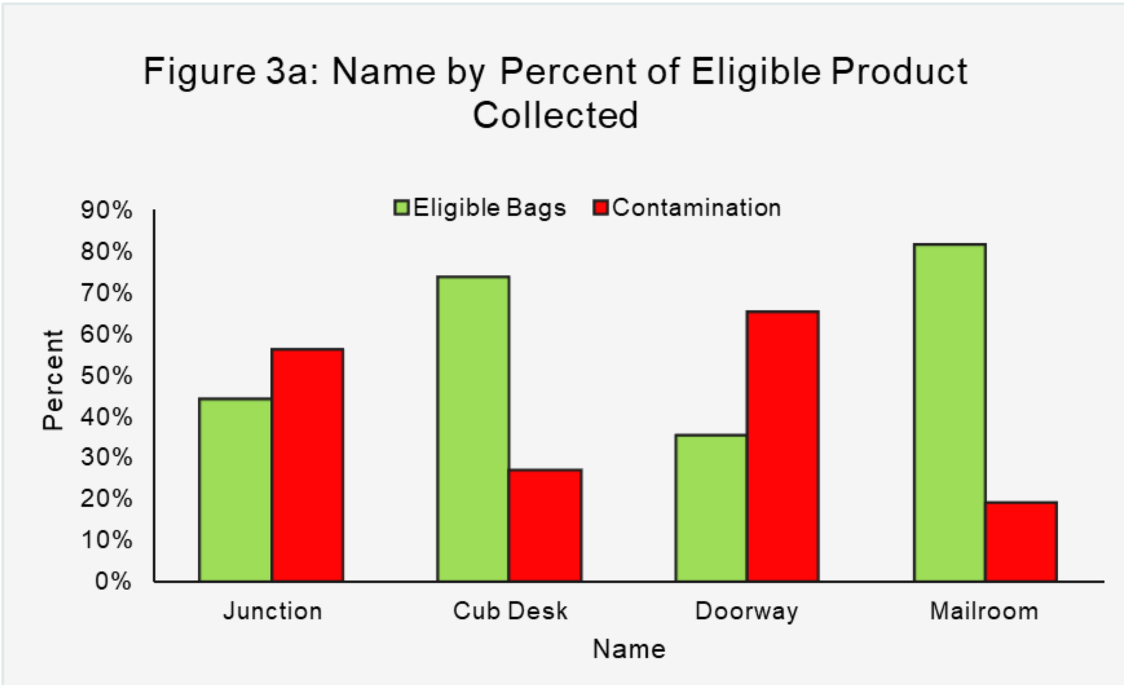

Figure 3a: This depicts the name of each bin by the percent of eligible product collected and percent contamination collected. This is to help us determine which comparisons are significant. The significance is depicted in the results.

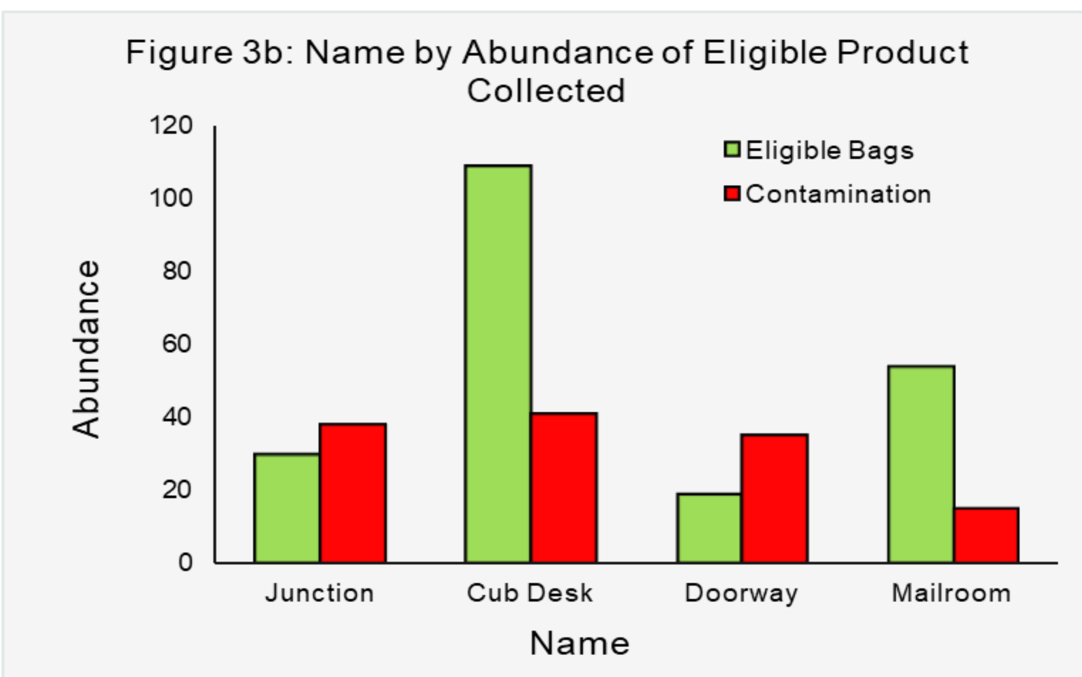

Figure 3b: This demonstrates the same thing as 3a but as an abundance. Again, the abundance display helps visualize the actual amount of recycled product, and in this case contamination as well. It displays significantly different information than Figure 3a.

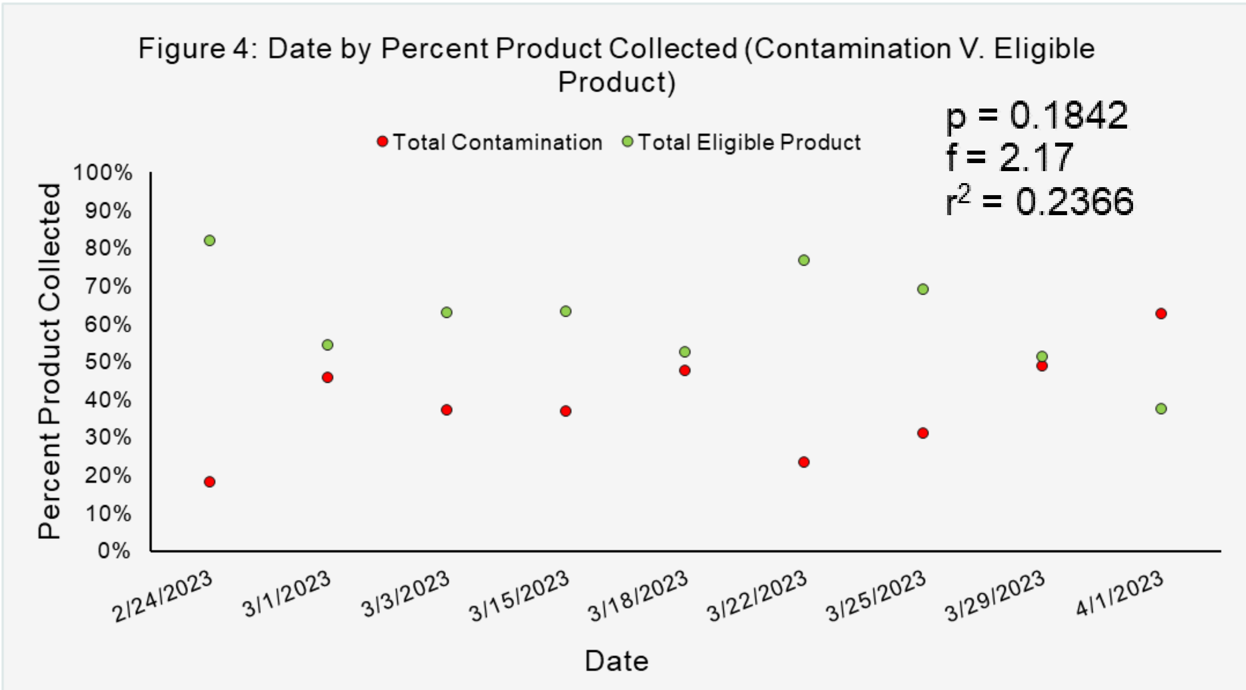

Figure 4: This figure displays the linear regression of each date by Percent Product collected, whether it was eligible product or contamination. Included are the p, f, and r^2 values.

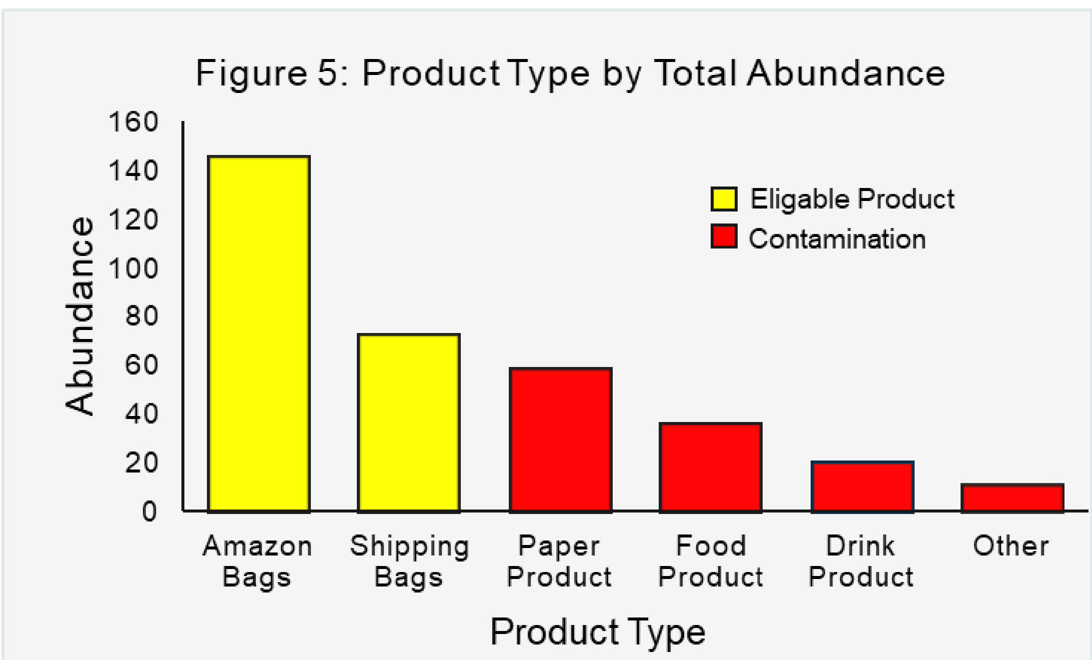

Figure 5: This demonstrates broken down by type the abundance of contamination we received. Giving a visual representation of the amount of product collected for each type by whether it was eligible product or contamination. Important for policy.

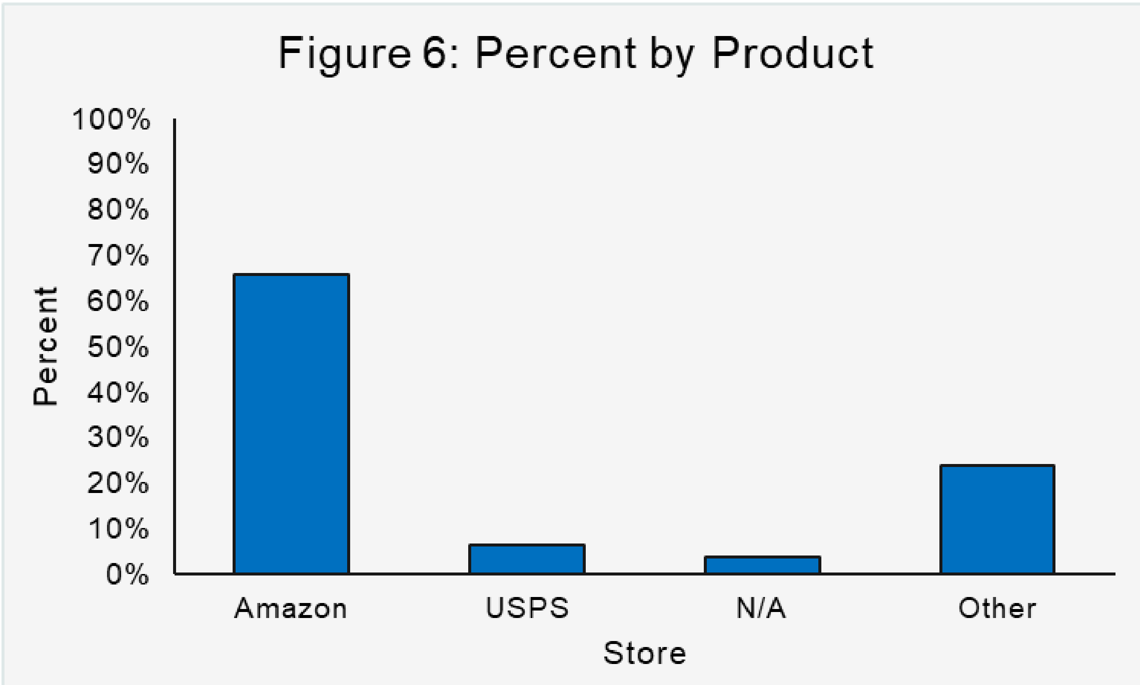

Figure 6: This figure depicts the Percent by Product received from the mailroom. The distribution of packages picked-up from the mailroom. Important for policy.

Figure 7: This figure is the poster we used throughout the CUB and various academic buildings.