Going Green – With Envy or Education?

1. **Executive Summary**
2. **Introduction**

We are living in a world where life expectancy of humans has increased steadily over the years at 1.09% per year and currently is around 7.6 billion. Addition of every single human being to the planet adds significant waste over his or her lifetime and in New York alone, an entire Empire Sate building can be filled with just one day of trash collection. With the steady increase in population and the prevalence of certain societal factors like increase in wealth leading to more buying, development of new packaging and technical products that are not biodegradable and life style changes over reliance of fast food consumption all leading to more and more waste being created in the world.

By 2100[[1]](#footnote-1), the increasing global urban population will be producing three times as much waste at it does today. If the world keeps up with the current urbanization and population growth rate, the global waste generation is estimated to rise to 2.2 billion tones by 2025[[2]](#footnote-2). All this waste being produced has been having a grave and negative impact on the environment.

* Generation of harmful chemicals and green house gases from landfill sites.
* Effects of deforestation to habitat destruction and global warming.
* Larger amounts of energy required to build new products from raw materials

1. **Why Recycling**

According to United States Environmental Protecting Agency (EPA), “*Recycle is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products*”. According to 2016 Recycling Information Report[[3]](#footnote-3), it was estimated that in 2007, activities related to recycling in US contributed to 757,000 jobs (.52% of all jobs in US economy), $36.6 billion in wages (.62% of total wages paid) and $6.7 billion in tax revenue (.90 % of total tax revenue). Along with the economy benefits of recycling its positive impact on the natural environment is even far greater including

* Waste reduction that is being sent to landfills.
* Conservation of natural resources like wood, water and minerals.
* Pollution reduction by reducing the need for the creation of new raw materials.
* Savings in energy consumption by reusing existing products to building new products.

1. **Social Comparison Theory**

Annually, Americans generate 258 M tons of municipal solid waste (MSW)[[4]](#footnote-4) and 35% of MSW is recycled while 13% is combusted for energy production. Compare to other part of the world, Germany ranks #1 on the list of countries with the highest recycling rate with 65% of its waste being recycled.

Our research is predicated on evaluating social comparison[[5]](#footnote-5) theory to drive positive change for the environment. Social comparison theory is predicated on the belief that there is an intrinsic drive with in each individual to gain accurate self-evaluations.

1. **Experiment Design**

In this field experiment study, we intend to estimate the effect of social comparison on recycling. Many municipalities spend a lot of resources educating their residents on the benefits of recycling. In Montgomery County, MD (our test geography), there is an annual flyer that is mailed to every resident of the county informing them of the benefits of recycling and providing information on how and what to recycle.

According to Alan Pultyniewicz the recycling coordinator for Montgomery County (MoCo), MD – current recycling rate[[6]](#footnote-6) in MoCo is 61% with a goal of getting to 70% by 2020. While the county has engaged in a lot of education efforts to increase recycling (print ads, bill-boards, social media) , they don’t really have a good handle on the impact of these individual efforts. Participation rates vary by neighborhoods and in general there seem to be an economic divide here with neighborhoods with higher participation (rate at which recycling material is put-out for pick up) than low-income neighborhoods.

The field experiment in this study is an attempt to measure the impact of direct-communication (mail-in flyer) on recycling participation when the mailer includes a social comparison tactic.

**5.1 Outcome measure**

Ideally, the outcome measure for the experiment would be consistent with what the county measures as recycling rate. However, there are some issues with the way the data is collected, stored and is made available that required us to take a different approach. The county collects recycling data on a daily basis by route (600-1000 homes typically) – and not by individual residential units. This data could potentially be made available (pending technical resources) for research purposes. Given the timing and resources available for the project, we could not depend on this data to design our experiment.

In order to fit the experiment to the resources available for this project, we decided to focus on a different outcome measure – the “put-out” rate – essentially an indicator (1 or 0) for whether a household made recycling materials available for pick-up on the scheduled collection day for the neighborhood.

**5.2 Target Population**

Given that the recycling rate is already very high (61%) in MoCo, in order use resources more efficiently, it makes sense to target future efforts at increasing recycling rates to residents that are not currently participating in the recycling effort. So our target population is MoCo residents that are not currently participating in the recycle program.

Given the limitations of time and resources available for this field experiment project, we decided to collect a small sample of single family residents in MoCo that are non-participants in the recycling program. We did this by studying recycling patterns near one of the researcher’s home (a rather convenient sample), for several days and decided on a subset of two routes (RE13W02 and RE13H02) that had enough non-participating residents based on one set of observations. There were 186 houses in these two routes (out of a total of 485 houses observed) that did not participate in the recycling program in the pre-treatment period.

**5.3 Experiment Duration**

We took one pre-treatment measurement of the outcome to help identify the sample of the target population we will be conducting our experiment on. Once we randomly assigned our treatment (details below), we administered our treatment – which was a direct-mailed post-card (details below) with information about the extent of participation in the neighborhood compared to overall county statistics, along with other useful information on how and what to recycle. We measured the outcomes one week after treatment. The timing of the measurements in shown in the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 03/08/2014 | 03/14/2018 | 03/25/2018 | 04/04/2018 | 04/05/2018 |
| Pre-treatment | Pre-Treatment | Treatment | Post-Treatment | Post-Treatment |

**5.4 Treatment Details**

The flyer includes benefits of recycling to the environment, and how you can recycle in Montgomery County through pictures on the front page. It has social comparison data on the back, encouraging the treated neighborhood to recycle more to achieve the average recycling rate of the county and meet the county’s goal. Please see the flyer [here](https://github.com/CynthiaHu/w241experiment/blob/master/flyer/Mailed/IMG_20180321_165607.jpg).

As recycling rules vary by county or state, we used the information from the county’s website[[7]](#footnote-7) and integrate all the information into the flyer with one style.

While we designed the treatment to be as effective as possible (catchy colors, large font, post-card vs. envelop), to increase compliance (i.e. read the flyer), we realize that not all the houses assigned to treatment might have actually complied with our treatment. Ideally, we would have done a follow-up survey to identify the households that were assigned to treatment – to get a measure of whether they were actually “treated” i.e. read the post-card we sent them. Since we did not pursue the follow-up approach, our estimated treatment effect is essentially “intent to treat” effect and not the actual treatment effect.

**5.5 Randomization engineering**

Since neighbors may talk to each other (and observe each others’ actions) - it is possible that there might be some spill-over if we assign houses in a neighborhood to different

treatment conditions. Therefore, we conducted random assignment at street level - an entire street gets the same treatment condition. There are 25 streets in our sample, and we randomly assigned 13 of them to treatment group – (out of the 186 households selected for this experiment, there were102 households assigned to treatment and 84 assigned to control).

d <- read.csv("Recycling\_Subjects.csv", header = T)

# clustering randomization at street level

set.seed(1234)

cluster.id <- unique(d$Street)

treat.street.ids <- factor(sample(cluster.id,13))

d$Assigned <- d$Street %in% treat.street.ids

describe(d$Assigned)

# save the assignment to csv file

write.csv(d, "Recycling\_Assigned.csv")

**5.6 Covariates**

There are several factors that could influence someone’s recycling behavior – belief that it matters, environmental awareness, social mores/peer-pressure, income, education level etc. Because of our experimental design (randomized control trial), these covariates are independent from the treatment assignment – therefore our treatment-estimates are unbiased. However, we might be able to get better precision on our treatment-estimate by using some of these covariates if they help explain some of the variance in the outcome measure. In reality, getting household level information for the metrics listed above is likely difficult.

**5.7 Power Calculation**

1. **Results**
2. **Challenge and Limitations**
   1. **Generalizability (External-Validity)**
   2. **Repeated treatment**
   3. **Measure long-term effect**

1. http://www.worldbank.org/en/news/feature/2013/10/30/global-waste-on-pace-to-triple [↑](#footnote-ref-1)
2. http://www.globalwastemanagementconference.com/ [↑](#footnote-ref-2)
3. https://www.epa.gov/sites/production/files/2017-05/documents/final\_2016\_rei\_report.pdf [↑](#footnote-ref-3)
4. https://www.infrastructurereportcard.org/cat-item/solid-waste/ [↑](#footnote-ref-4)
5. https://www.psychologytoday.com/us/basics/social-comparison-theory [↑](#footnote-ref-5)
6. [↑](#footnote-ref-6)
7. https://www.montgomerycountymd.gov/sws/ [↑](#footnote-ref-7)