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The Effect of Recycling versus Trashing on Consumption: Theory and Experimental Evidence*

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Abstract

This article proposes a utilitarian model in which recycling could reduce consumers' negative emotions from wasting resources (i.e., taking more resources than what is being consumed) and increase consumers' positive emotions from the disposal of consumed resources. We provide evidence for each component of the utility function using a series of choice problems, and formulate hypotheses based on a parsimonious utilitarian model. We follow up at various stages in the development of our model and introduce experiments with real disposal behavior to verify these hypotheses. Our findings suggest that the positive emotions associated with recycling can overpower the negative emotions associated with wasting. As a result, consumers could use a larger amount of resource when recycling is an option and more strikingly, this amount could go beyond the point at which their marginal consumption utility becomes zero. We extend the theoretical model and introduce acquisition utility and the moderating effect of cost of recycling (financial, physical, and mental). From a policy perspective, our research argues for a better understanding of consumers' disposal behavior to increase the effectiveness of environmental policies and campaigns.

"Just as the third graders believed that their litter run was helping the planet, Americans have embraced recycling as a transcendental experience, an act of moral redemption."

— John Tierney (1996)

1 Introduction

The United States Environmental Protection Agency keeps close tabs on how much we recycle and trash. While we recycle more than ever, we also generate much more waste. EPA statistics show that from 1960 to 2012, the amount of waste generated in America increased from 2.68 to 4.38 pounds per person per day, an increase of more than 60 percent. In 2012, Americans recycled 34.5 percent of this waste or 1.51 pounds of the 4.38 pounds generated by each person daily (EPA 2012). Given the significant amount of waste being generated, the Environmental Protection Agency has followed a hierarchal approach to waste management — Reduce, Reuse, Recycle — to identify program priorities for sustainability. As a result, the government continues to spend a significant portion of taxpayers' money in advertising and promoting this approach to the general public. For example, recycling contests are being organized and prizes are given out to communities and organizations that recycle the most. Given the substantive effort to promote waste management as an actionable means to save our planet, a better understanding of the psychology behind consumer decisions to trash versus recycle is an important endeavor.

Consequently, scholars have started to investigate factors that influence waste reducing, re-usage, and recycling with the objective of developing actionable insights for policymakers (Lord 1994; McCarty and Shrum 2001; Goldstein, Cialdini, and Griskevicius 2008; White, MacDonnell, and Dahl 2011; Trudel and Argo 2013; Trudel, Argo, and Meng 2015; 2016). For example, Fullerton and Kinnaman (1996) investigate municipal recycling and trashing rates and find that municipalities are able to reduce the number of trash bags collected and increase

recycling rates when they charge consumers for each bag of trash collected, although the fee for disposal may also have contributed to illegal dumping and increased recycling sorting fees. Schultz et al. (2007) show that using descriptive normative messages that allow for consumers to compare their energy consumption rates to those of their neighbors effectively reduces energy consumption. Building on Shultz et al. (2007), Goldstein et al. (2008) find that hotel guests are most likely to reuse their towels when signage describes behavior that occurs in a setting that most closely matches their situational circumstances. Mazar and Zhong (2010) find that while exposure to green products promotes altruistic behavior, the purchase of such products may reduce altruism. As a final example, Trudel and Argo (2013) find that the extent to which a product is distorted during consumption determines whether a product is trashed or recycled. Consumers are far more likely to trash paper that has been cut into pieces or aluminum cans that have been dented in comparison to paper and cans that remain whole and undistorted.

The insights gained from this literature can go a long way in helping policy makers and marketing managers educate and persuade consumers and design products and packaging to increase recycling rates. The underlying assumption motivating these research studies is that recycling is good for the society, and the more people recycle, the better. However, recycling is only good if it does not lead consumers to use significantly more resources (Caitlin and Wang 2005) and therefore, it is important to understand the psychology behind how disposal behavior may affect consumption.

While there exist several descriptive models of decision-making that inform how consumers make consumption choices (e .g. Bettman, Luce, and Payne 1998; Hoch and Loewenstein 1991;Kahneman and Tversky 1979), little is known about how consumers make disposal choices and in particular, why they trash versus recycle a product. Motivated by an effort to improve environmental regulations, macro-level theoretical models of waste control (Keeler, Spence and Zeckhauser 1971; Plourde 1972) and recycling have been put forward. Smith

(1972), for example, investigates how taxes and fees are used to motivate firms to reduce waste and increase recycling. In their model, recycling enters household utility functions simply as a negative cost term, reflecting the additional effort that the household has to incur in order to recycle used resources. In a similar spirit, Lusky (1976) develops a social planning model in which the goal is to optimally allocate a given amount of labor between recycling, disposal, and production. Similar to what we will propose in this paper, Lusky (1976) allows recycling to have a positive effect on consumers' utility. The tradeoff between recycling and disposal in his study, however, comes from the difference in the labor productivity in performing these two tasks. In summary, prior theories of recycling have largely focused on macro-level resource allocation and not on consumers' psychological processes in making recycling decisions.

In our baseline model we abstract away from the costs of disposal and highlight the tradeoff between positive and negative emotions associated with disposing of material in the trash versus recycling. More specifically, we focus on positive and negative self-conscious emotions (e.g., pride, guilt) to provide support for our model and illustrate our point throughout the paper. While we acknowledge that more basic emotions (e.g., sadness, happiness) may also influence disposal behavior and consumption, the model is not intended to provide an exhaustive list of the many emotions that could be associated with recycling and disposal behavior and their differential effects. Rather, our goal is to build a parsimonious and tractable model that uses a small number of parameters to yield useful predictions for a variety of real-world scenarios involving recycling. In our theorizing, we focus on self-conscious emotions because they have been found to have a profound influence in regulating people's moral, prosocial, and pro-environmental thoughts and behavior (Baumeister, Stillwell and Heatherton 1994; Tracy and Robins 2004; Tracy, Robbins, and Tangney 2007). As common examples of self-conscious emotions, pride and guilt are anticipated or evoked through self-evaluations of one's moral conduct or one's behavior relative to personal or social standards (Lewis 1997,

Tracy and Robins 2004).

In most consumer research, the decision to trash versus recycle is investigated as an isolated, one-shot decision (e.g., Kidwell, Farmer, and Hardesty 2013; Trudel and Argo 2013; White et al. 2011). However, in our model we approach the decision to trash versus recycle a product as the result of a series of decisions in which one choice follows another. For instance, we consider the possibility that the decision of how much of a resource to use is the result of whether or not a consumer believes he would trash versus recycle the resource after he is finished with it.

There are similarities with the work investigating licensing effects to that which we are proposing (Effron, Miller and Monin 2012; Kahn and Dhar 2006; Mazar and Zhong 2010; Merritt, Effron and Monin 2010). In the domain of consumer behavior, the licensing effect has been shown to act similarly to other guilt reducing mechanisms such that prior virtuous acts can boost people's self-concepts and therefore license them to choose an option that would normally have negative self-attributions (Kahn and Dhar 2006). The initial boost in self-concept decreases the guilt associated with the negative choice. Our model makes a variety of predictions of consumption patterns based on whether or not consumers believe they would trash or recycle the resource afterwards, with the opportunity to recycle predicting that consumers may consume more of a resource. Importantly, we do not model consumption and disposal as isolated decisions but rather propose that people use anticipated emotions to guide their disposal decisions in much the same way that we see in the licensing literature. Our predictions are based on anticipated emotions associated with disposal, and in particular, the effects of recycling to moderate negative emotions associated with wasting and to induce positive emotions associated with disposing used resources. In the section that follows, we construct our theoretical model of recycling and develop testable hypotheses which we later explore.

Standard economic models have typically ignored or trivialized the role of emotions on

people's behavior and make the standard assumption of rationality (Arrow 1987). Behavioral economists and decision making researchers have challenged this assumption and identified different emotional influences on behavior (Camerer, Loewenstein, and Rabin 2011; Loewenstein and Lerner 2003; Sanfey et al. 2003). Sanfey et al. (2003), for example, show that people use both cognitive and emotional processes to evaluate the fairness of proposals from ultimatum game partners. In other work, incidental mood has been shown to influence risk perceptions. Johnson and Tversky (1993), assign induced positive or negative moods in research participants by getting them to read newspaper stores and then have them estimate fatality frequencies for a variety of events. Those who are induced with a negative mood have more pessimistic estimates of fatalities. Other research has shown that integral emotions can lead to biased decision making, even in the presence of cognitive information suggesting alternative courses of action (Gigerenzer 2004, Loewenstein 1996; Loewenstein et al. 2001). Undeniably, emotions are drivers in many of the decisions that people make (Lerner, Li, Valdesolo, and Kassam 2015), including the decision to trash versus recycle a product.

2 A Theoretical Model of Recycling

The effect of recycling on consumption in our model is two-fold. Based on prior literature we know that people are strongly averse to creating waste (e.g., Arkes 1996; Bolton and Alba 2012). Therefore, there are reasons to believe that consumers avoid waste whenever they can. Conceptually, we propose that consumers are waste averse in general, and experience negative emotions when taking more resources than what they actually use. We build a utility-reducing component in our model to capture the array of negative self-conscious emotions that are associated with wasting resources. When waste occurs, recycling could help reduce the extent of negative emotions that a consumer would experience. On the other

hand, when the consumer disposes used resources, we posit that the usage of a resource could, to some degree, justify trashing. As the negative emotions are mitigated, recycling in this case induces an array of positive emotions that we capture with a utility-enhancing component in our theoretical model. As demonstrated below, we use a series of experiments to establish these different effects of recycling. Our focus is on the existence and tradeoff between the negative and positive emotions associated with the consumer's disposal behavior, which generates meaningful predictions for various recycling scenarios.

2.1 Formulation of the Model

We now offer a utilitarian framework to highlight a consumer's tradeoffs in deciding how much of a resource to consume when they have the option to recycle versus trash. To begin, consider a conscientious consumer who thinks carefully about his disposal choices. There are several important quantities in the decision process. For example, when out for dinner, he might take 5 napkins for a meal, use 2 of them, and then put all the 5 napkins, used and unused, into the trash can. In this case, the amount of resource taken is $q^t = 5$, the total amount of resource used is $q^c = 2$, the amount of wasted resource is $q^t - q^c = 3$, and the proportion of recycled resource is 1.

To build the foundations of our model, we first construct choice problems that reveal the general preference not to waste. Consider the following choice problems:

Choice Problem 1

Imagine that you are at a party and the host has plastic cups available for beverages. You have six of the same drinks that night (i.e. 6 servings of Coca-Cola). There are plenty of cups and you can either choose a new cup for each drink or reuse the same cup throughout the evening.

Which would you prefer to do?

A. Use 1 cup

B. Use 6 cups

Indeed, when we asked 68 participants on Mechanical Turk to choose between using 1 cup vs. 6 cups, 96%[1] of respondents chose to use 1 cup.

Choice Problem 2

Imagine that you are at your favorite take-out restaurant. You take 5 napkins but you only use 3. You have no other use for the other 2 napkins, i.e., you will not use them. Now imagine the same scenario but you take 3 napkins and use all 3.

Which would you prefer to do?

A. I would prefer to take 5 napkins and only use 3

B. I would prefer to take 3 napkins and use all 3

Eighty-six Mechanical Turk participants were asked to make this choice, 77% chose not to waste and selected to take 3 napkins and use all 3.

Choice Problem 3

Imagine that you need to mail a gift. The gift measures 4 inches high x 4 inches long x 3 inches wide. You have the following two boxes at home which you can use to put to the gift in and mail it.

A. 5 inches $\times$ 5 inches $\times$ 5 inches

B. 10 inches $\times$ 10inches $\times$ 10inches

The package is not fragile and you don't need extra packing to keep it safe. It will cost the same to mail the package, regardless of the size of the box.

Which box would you choose to mail your package in?

Consumers once again demonstrate waste aversion, with 97% of Mechanical Turk partic-

[1] All of the choice problems (problems 1-8) are statistically significant with $p < .01$, unless otherwise noted.

ipants (N = 59) choosing the smaller box.

The findings from the choice problems presented above clearly show that people are averse to wasting resources in a variety of different consumption contexts. The results are consistent with prior work demonstrating waste aversion (e.g., Arkes 1996). More importantly, our results suggest that people are aware of waste and that they feel negative self-conscious emotions (e.g. guilt, shame, embarrassment; Lewis 1997, Tracy and Robins 2004). Negative self-conscious emotions like guilt are evoked or anticipated as a result of a self-evaluative reflection of behavior, and are the result of failing to adhere to personal or social standards (Lewis 1997). Being wasteful is in conflict with personal and social standards but it is sometimes unavoidable.

When waste occurs, people may try to recycle the wasted material in order to alleviate the negative emotions that comes with being wasteful. Since recycling is consistent with personal and social standards (Cialdini, Reno and Kallgren 1990; Abbott, Nandeibam, and O'Shea 2013), we believe that recycling may attenuate the negative emotions from wasting resources. Again, a standard choice problem and a between-subjects experiment serves to confirm our intuition by measuring self-conscious emotions from trashing versus recycling. In the problems that follow, to measure emotions we had participants respond to randomized items capturing both positive (proud, good, happy, and pleased with myself) and negative emotions (guilty, bad, ashamed, and embarrassed) on seven-point scales (1= not at all, 7 = very much)[2].

Choice Problem 4a

Imagine the that you are at your favorite take-out restaurant. You order your food and on the way out you take 5 napkins. You go home and eat but only use 3 of the napkins.

[2]Proud, pleased with self, guilty, ashamed, and embarrassed are self-conscious emotions (Tracey and Robins 2004).

Your recycling and trash are side by side. Which would you prefer to do?

A. Recycle the 2 napkins you did not use

B. Trash the 2 napkins you did not use

Indeed, when asked to choose between recycling and trashing unused napkins, 78% (N = 74) of consumers prefer to recycle. To examine the role of emotions and building on choice problem 4a, we ask 114 Mechanical Turk participants to imagine the same scenario as above. Participants are assigned to a between-subjects disposal condition (recycle or trash) and randomly assigned to answer one of two possible dependent variable questions. (1) How would you feel about *taking* the 5 napkins if you trash (recycle) the 2 unused napkins? (2) How would you feel about the *act* of trashing (recycling) the 2 unused napkins?

Overall, the results suggest that creating waste indeed activates negative emotions in consumers, while recycling the wasted resource can significantly mitigate these emotions. When examining how participants (N = 60) feel about taking the 5 napkins in the first place, the results reveal a significant main effect of disposal condition ($F(1, 58) = 9.52$, $p < .01$) such that participants' negative emotions are significantly stronger as a result of taking the 5 napkins when the 2 unused napkins are trashed (M = 2.68) versus recycled (M = 1.53). Next we analyze how people (N = 54) feel about the act of disposal (dependent variable 2) and also find significant differences in the negative emotions elicited by trashing (M = 3.56) versus recycling (M =1.30; F(1, 52) = 42.87, $p < .001$).

To demonstrate the robustness of these effects to other product domains, we present 118 Mechanical Turk participants with another scenario.

Choice Problem 4b

Imagine that you are at the public library working on your taxes. You need some scrap paper so you take 10 pieces of paper from a stack on the counter. You do your calculations and in the end you only use 6 pieces of paper. Four pieces of paper are not needed and go

unused. The recycle and trash bins are side by side.

Participants are randomly assigned to a between-subjects disposal condition (recycle or trash) and consistent with choice problem 4a, respond to one of the two dependent variable questions. (1) How would you feel about taking the 10 pieces of paper if you trash (recycle) the 4 unused pieces of paper? (2) How would you feel about the act of trashing (recycling) the 4 unused pieces of paper? Consistent with the analyses above, we first analyze how participants (N = 60) feel about taking the 10 pieces of paper. The results again reveal a significant main effect of disposal condition ($F(1, 58) = 12.73$, $p < .001$) such that participants' negative emotions are significantly stronger as a result of taking the 10 pieces of paper when the 4 unused pieces of paper are trashed (M = 4.10) versus recycled (M = 2.36). Analysis of dependent variable 2 also reveals significant differences in the negative emotions elicited by the act of trashing (M = 3.91) versus recycling (M =1.54; $F(1, 56) = 38.56$, $p < .001$).

Based on these observations, we build a component in the consumer's utility function to capture the variety of negative self-conscious emotions experienced, $G(q^t - q^c)$, which measures the reduction in utility as a result of wasting resources of the amount $q^t - q^c$.[3] To capture the notion that consumers' negative emotions become more intense as the amount of wasted resources increases, we assume $G(0) = 0$ and $G' > 0$. Furthermore, we assume that these negative emotions are moderated by recycling so that the consumer actually experiences utility reduction of $f(\alpha) \cdot G(q^t - q^c)$, where $\alpha \in [0, 1]$ is the proportion of waste that is being recycled, $f \geq 0$ so that waste is always perceived negatively, and $f' < 0$ so that the negative emotions are alleviated as a larger proportion of the waste gets recycled. Without loss of generality, we assume that $f(0) = 1$ so that the consumer experiences the negative emotions

[3]It is important to acknowledge that consumers may not always be able to eliminate the negative emotions by using up all the resources they acquire. That is, they could still feel negatively when the amount of resources they consume is higher than a benchmark quantity such as what is typical among other consumers or what maximizes their consumption utility. In such situations, we expect over-consumption to be less severe.

in full intensity when none of the wasted resource is recycled. On the other hand, we allow $f(1)$ to be strictly positive, so that the consumer could still feel negative emotions even when all wasted resources get recycled.

Next, we consider consumers' emotions associated with disposing used resources. As mentioned earlier, consumers may experience positive emotions when recycling used resources. To test this possibility, consider the following choice problem.

Choice Problem 5

Imagine that you are at your favorite take-out restaurant. You order your food and on the way out you take 3 napkins. You go home and eat. You use all 3 of the napkins. You take 3 napkins and use 3 napkins. Your recycling and trash are side by side. Which would you prefer to do?

A. Recycle the 3 napkins you used

B. Trash the 3 napkins you used

Eighty-six Mechanical Turk participants choose between recycling and trashing the napkins that they have used, the majority choose the option to recycle (60%, Chi-Square (1) = 3.77, $p = .052$). To further investigate the emotions associated with disposal, we conduct a second single factorial between-subjects experiment with 196 Mechanical Turk participants. Participants are given the same scenario as in choice problem 5 and then randomly assigned to either trash or recycle condition. We then measure their emotional reactions using the same 8 emotion items and similar dependent variable questions to the ones employed previously: How would you feel about *taking* the 3 napkins if you trash (recycle) the 3 used napkins? How would you feel about the *act* of trashing (recycling) the 3 used napkins? Participants are randomly assigned to answer one of the dependent variable questions. The analysis reveals that there is no difference in negative emotions from taking the 3 used napkins if they are trashed (M = 2.03) or recycled (M = 1.75; $F(1, 96) = .92$, $p = .34$). There

is, however, a significant difference in positive emotions. Participants feel stronger positive emotions from taking the 3 napkins when they are recycled (M = 3.94) than they do if the napkins are trashed (M = 1.75; $F(1, 96) = 58.12$, p $< .001$). When examining the act of disposal dependent variable, we again find no difference in negative emotions from disposing of the 3 used napkins in the trash (M = 2.20) versus the recycle bin (M = 2.01; $F(1, 96) = .42$, $p = .52$), and significant differences in positive emotions. That is, participants feel stronger positive emotions from the act of recycling the 3 napkins (M = 3.53) than they from trashing the 3 napkins (M = 1.90; $F(1, 96) = 34.14$, p $< .001$).

Based on these observations, we build a utility-enhancing component into the utility function to capture the array of positive emotions that the consumer derives from recycling used resources, $R(q^c) \geq 0$. This component captures the utility that a consumer derives from recycling a total amount, q^c, of used resources and is a key force that drives overconsumption in the presence of recycling. We assume $R' > 0$ so that the consumers' positive emotions become stronger as the amount of recycled resources increases. To provide supporting evidence for this assumptions, we conduct the following 2 (disposal type: recycle versus trash) $\times$ 2 (used resources: 4 versus 10) between-subjects experiment with 160 Mechanical Turk participants.

Choice Problem 6

Imagine that you are at the public library working on your taxes. You need some scrap paper so you take (4)10 pieces of paper from a stack on the counter. You do your calculations and in the end you use all (4)10 piece of paper. You take 4(10) and use 4(10). The recycle and trash bins are side by side.

Participants are randomly assigned to a between-subjects disposal condition (recycle or trash) and respond to the 4 positive emotion items: proud, good, happy, and pleased with myself. The 2 $\times$ 2 ANOVA on positive emotions reveals a significant main effect of

disposal type ($F(1, 156) = 223.36$, $p < .001$) and a significant disposal type by used resources interaction ($F(1, 156) = 5.57$, $p < .05$). The results are summarized in Table 1 and as our model suggests, planned comparisons confirm that people feel stronger positive emotions from recycling 10 pieces of scrap paper (M = 4.66) than they feel when recycling 4 pieces of scrap paper (M = 4.01; $F(1, 156) = 6.20$, $p < .05$).

Table 1: Positive Emotions Toward Disposing Used Scrap Paper

	Resources Used	
	4 piece of paper	10 pieces of paper
Recycle	4.01(1.56)	4.66(1.48)
Trash	1.68(.67)	1.46(.61)

Note: Standard deviations are in parentheses.

Putting the different emotions together, we propose that a consumer derives the following utility when consuming and disposing a particular resource:

$$U(q^c) - f(\alpha) \cdot G(q^t - q^c) + \gamma \cdot R(q^c),$$

where $U(q^c)$ is the consumption utility that the consumer derives from consuming q^c amount of resources, α is the proportion of the wasted resources that gets recycled, and γ is the proportion of used resources that gets recycled.[4] Throughout the paper, we assume that the consumption utility is continuous and concave ($U'' < 0$) and the consumer's utility is always maximized at an interior consumption quantity that is defined by the first order conditions. The major difference between our utility function and the typical one from the economics literature is that we consider the consumer's disposal choice explicitly. The utility function reflects our general belief that consumers experience negative emotion form wasting resources, and prefer recycling resources over trashing them.

[4]For simplicity, we assume that this utility-enhancing term increases linearly with the proportion of used resources recycled. The linearity assumption does not qualitatively change main predictions of the model.

2.2 Predictions of the Model

The consumer chooses the two quantities above, q^c and q^t, as well as how to dispose the resources in order to maximize his total utility. To minimize the negative emotions, he would always choose $q^t = q^c$ when possible, rendering the disposal of wasted resources irrelevant.[5] If recycling is costless, the consumer in our model would always prefer recycling to trashing. Needless to say, recycling often does come at significant cost to both the consumer (e.g., sorting trash and using multiple bins, having to walk some distance to recycle) and the society (e.g., facility and energy costs of recycling) but we abstract away from these considerations for now in order to focus on the key psychological impact of recycling on consumption.[6]

To confirm the intuition that recycling may lead to wasteful consumption given the positive emotions, we construct several scenarios to test the model predictions. First, consider scenarios in which the consumer is provided with no option to recycle or when the resource is not recyclable in nature (e.g., ceramics). In this case, $\alpha = \gamma = 0$, and the consumer maximizes $U(q^c) - G(q^t - q^c)$, subject to $q^c \leq q^t$. Given that $G' > 0$, the consumer takes only what he consumes to avoid creating waste: $q^{tT} = q^{cT}$, where t denotes "total," c denotes "consumed," and T denotes "trash." The optimal amount of consumption in this case simply maximizes the consumer's consumption utility and is determined by:

$$U'(q^{cT}) = 0. \tag{1}$$

Consider now the other type of scenarios in which the consumer does have the option to either trash or recycle resources. In this case, his utility becomes

$$U(q^c) - f(\alpha) \cdot G(q^t - q^c) + \gamma \cdot R(q^c),$$

[5] Consumers may acquire more resources than needed for practical reasons, and we discuss this possibility explicitly in Section 3.1.

[6] We revisit the cost of recycling and incorporate it into the model in Section 3.2.

subject to $q^c \leq q^t$. To minimize the negative emotions, as before, he would set the total amount of resources taken to be the same as the amount that he consumes. Therefore, he simply needs to maximize $U(q^c) + \gamma \cdot R(q^c)$. If the resource cannot be recycled once used (e.g., medical waste such as tubing), $\alpha > 0$ but $\gamma = 0$. The consumer in this case cannot derive positive emotions from recycling used resources and always chooses to consume the amount that maximizes his consumption utility.

If used resources can be recycled, given the positive emotions associated with recycling, the consumer would recycle all used resources. In this case, he maximizes $U(q^c) + R(q^c)$, and the optimal amount of consumption is determined by

$$U'(q^{cR}) = -R'(q^{cR}), \tag{2}$$

where R denotes for "recycle." Since $R' > 0$ and $U'' < 0$, equations (1) and (2) above suggest that $q^{cT} < q^{cR}$, which leads to our first hypothesis.

H1: *A consumer uses more resource when the option of recycling is present.*

Hypothesis 1 suggests that the option to recycle may lead to an increase in the total amount of resources consumed. Intuitively, as the consumer feels positive emotions when recycling used resources, he consumes more than when he cannot recycle the resources he uses. Support for H1 would hence confirm the positive emotions associated with recycling. If a consumer does not feel positive emotions when recycling used resources, he would be maximizing his consumption utility regardless of how the used resources get disposed. As a result, he would consume the same quantity of resources with and without the recycling option, which contradicts H1.

From a policy perspective, as the number of new recycling bins popping up around our communities increases with the governments' continual efforts to promote recycling, H1 suggests that the unexpected end result may be more waste. There is some existing evidence

that this may be true: while EPA data suggest that greater access to recycling has been successful in increasing recycling, they also show that we produce more waste.

In what follows, we present experiments with real disposal behavior to investigate if consumers actually use more resources when the option to recycle is available.

2.2.1 Juice Sampling with Plastic Cups

In this experiment, we ask consumers to sample four different juices using recyclable cups. We manipulate the type of disposal bins between-subjects. Based on H1, we predict that when a recycling bin is present, consumers will use more cups than when a trash bin is present.

Design and Procedure. We recruit 49 undergraduate participants (53% female) from a private North-Eastern US university in exchange for course credit. Participants enter the lab and complete a battery of individual difference measures. Embedded in the measurement tool is a green behavior scale (Haws, Winterich, and Naylor 2014) consisting of six items used to measure consumers' attitudes toward green/sustainable behaviors. Participants are then randomly assigned to one of two between-subjects disposal conditions, trash only or recycle only.

In each condition and under the guise of a juice evaluation study, participants are asked to sample 4 different fruit juices at an unmanned sampling station. One by one, participants are instructed to go ahead and sample the juices on their own. Two hundred small plastic cups (5 oz.) are stacked behind four unlabeled juice containers. No other instructions are given to the participants. In the trash only condition (N = 24), a trash bin is placed next to the sampling station. In the recycle only condition (N = 25), a recycling bin is placed next to the sampling station. Unknown to participants, a research assistant notes how many cups they use to sample the juices. The number of cups a participant uses is our dependent variable.

Results and Discussion. Since there is no other option, all participants assigned to the recycle only disposal condition toss their used cups in the recycling bin. All participants in the trash only disposal condition toss their used cups in the trash bin. No participant leaves the lab with cups. The 49 participants on average use 3.10 plastic cups in the sampling task (Median = 4, SD = 1.311). The minimum number of cups used is 1 (12 participants, 24.5% of the sample) and the maximum number used is 4 (32 participants, 65.3% of the sample).

Regression analyses do not reveal any main effects of gender or the green scale on the number of cups used. Gender and the green scale also do not interact with disposal condition to reveal any significant interaction effects (all $Fs < 2.07$) and are therefore not discussed further. Analysis of Variance reveals a main effect of disposal condition on the number of cups consumed in the juice-sampling task (Table 2). Consistent with H1, participants assigned to the trash-only disposal condition ($M = 2.71, SD = 1.46$) use significantly fewer cups in the sampling task than participants in the recycle-only condition ($M = 3.48, SD = 1.05; F(1, 47) = 4.56, p < .05$).

2.2.2 Gift Wrapping with Paper

To find further support for H1, and to generalize the results to another product category (paper), we ask consumers to gift wrap $6'' \times 6''$ square boxes. Based on our theory, we predict that when a recycling bin is present (in comparison to when the option to recycle is not available), consumers would use more paper to wrap the same box.

Design and Procedure. We recruit 60 undergraduate participants (38% female) from a private North-Eastern US university in exchange for course credit. One at a time, participants are taken into a room. In this room there is a large roll of paper ($30'' \times 765'$), a table, adhesive tape, scissors, and a tape measure. Our experimental design has two between-subjects disposal conditions to which participants are randomly assigned: a trash only condition or a recycle/trash condition. In the trash only condition (N = 30), next to

the roll of paper is a large trash bin. In the recycle/trash condition (N = 30), next to the roll of paper is a large trash bin and a large recycling bin.

Participants are given a $6'' \times 6''$ box and a study booklet with the following instructions:

For this study, you have to wrap a gift. Tasks such as this are informative in terms of evaluating students' creativity, involvement, and attention to detail. Do the BEST job that you can wrapping this gift. Please take as much wrapping paper as you feel will be necessary to do a great job wrapping this gift box. Measure the amount of paper you cut to start.

Length: _____

Width: _____

Since we do not mention the presence of trash/recycling bins in the instructions, the participants' knowledge of the disposal methods come entirely from their own observation of the environment. After measuring the amount of paper that they cut to wrap the gift box, participants wrap the gift. After they finish wrapping the gift, participants answer three gift-wrapping questions to measure involvement: (1) I took my time wrapping the gift box, (2) I was careful wrapping the gift box, and (3) I am satisfied with my effort wrapping the gift box [strongly disagree = 1; strongly agree = 7]. The dependent variable is real consumption behavior: the amount of paper taken as calculated by the measured length $\times$ width.

Results and Discussion. The 60 participants on average use 677.02 inches^2 of paper in the wrapping task (Median = 677.50, SD = 222.36). The minimum amount used is 288 inches^2 (1 participant, 1.7% of the sample) and the maximum amount used is 1404 inches^2 (1 participant, 1.7% of the sample). Participants in the trash only disposal condition dispose of all their scraps from wrapping in the trash. Consistent with our prediction that people would recycle, rather than trash, used resources when given the option, it is observed that participants in the recycle/trash condition dispose all their scraps of paper from wrapping

the box in the recycle bin.

Table 2: The Amount of Material Used by Disposal Option

	Recycle Option	Trash Only Option
Experiment 1: Juice Sampling (Number of cups used)	3.48 cups	2.71 cups
Experiment 2: Gift Wrapping (Amount of Paper Used)	735.86 inches^2	618.17 inches^2

Analysis of Variance does not reveal any significant differences on the three gift-wrapping involvement questions ($Fs < 2.15$). Involvement is not different across conditions and is not discussed further. The analysis does reveal a significant effect of disposal condition on the amount of paper used (Table 1): Participants assigned to the trash only disposal condition ($M = 618.17, SD = 195.37$) use significantly less paper in the gift-wrapping task than participants in the recycle/trash disposal condition ($M = 735.86, SD = 235.08; F(1, 58) = 4.45, p < .05$).

In summary, these two experiments support our first hypothesis and the tenets of our theoretical model. As a result of the different emotions associated with recycling, consumers use more resources when the option to recycle is present and less resources when they only have the option to trash.

2.2.3 Recycling Packaging Materials

In many situations the wasted resources do not only consist of consumable products. Recycling often occurs, for example, to packing materials such as boxes and other types of containers that do not have consumption utility in themselves. Given its practical relevance, it is important to understand how the consumer feels about disposing of the packaging materials, and whether the disposal method may turn out to have a significant effect on consumption.

If we conceptually think of these packaging materials as "waste" to begin with, due to their lack of consumption utility, our framework would then suggest that the consumer feels negatively about using these packaging materials and would choose to recycle them whenever possible to reduce the negative emotions evoked by wasting. We confirm this intuition using Mechanical Turk participants and two choice problems.

Choice Problem 7

Imagine that you need to mail a gift. The gift measures 4 inches high $\times$ 4 inches long $\times$ 3 inches wide. You have the following two boxes at home which you can use to put to the gift in and mail it.

A. 5 inches $\times$ 5 inches $\times$ 5 inches

B. 10 inches $\times$ 10 inches $\times$ 10inches

The package is not fragile and you do not need extra packing to keep it safe. It will cost the same to mail the package, regardless of the size of the box. Which box would you choose to mail your package in?

Choice Problem 8

Imagine the following: You purchase an item from Amazon to be mailed to your home. The item measures 4 inches $\times$ 4 inches $\times$ 3 inches. Amazon ships the item in a small box measuring 5 inches $\times$ 5 inches $\times$ 5 inches. Which would you prefer to do?

A. Recycle the box

B. Trash the box

Consistent with our prior waste aversion results, 57 of 59 participants (97%) choose the smaller box in choice problem 7. As expected, in the choice problem 8, when asked to choose between recycling and trashing a shipping box, the 86% of consumers (82 of 95) choose the recycle the box. Overall, our findings from the juice-sampling and gift-wrapping studies support H1.

From a modelling perspective, suppose the quantity of consumption is proportional to the amount of recyclable packaging. The consumer's utility function becomes $U(q^c) - f(\alpha) \cdot G(\beta \cdot q^c)$, where β is the ratio of the amount of packaging material to the amount of consumption. The optimal consumption quantity in this case is then determined by

$$U'(q^*) = \beta \cdot f(\alpha) \cdot G'(\beta \cdot q^*). \tag{3}$$

One can obtain by the envelope theorem that the optimal consumption quantity increases with α. Intuitively, when a larger fraction of the packaging materials can be recycled, the consumer's negative emotions from throwing away the packaging material become less severe and he increases consumption of the focal product.

H2: *When the amount of consumption is proportional to the amount of packaging materials, the consumer increases consumption when packaging is recycled than when it is trashed.*

In the following study we investigate the disposal of packaging materials. The design employs a between-subjects design where participants have only one option, either to recycle or to trash the packaging. We focus on how many free pens a subject would take when each pen is wrapped in a substantial amount of packaging.

Design and Procedure. Eighty undergraduate students (41.3% female) from a private North-Eastern US university participate in this study in exchange for course credit. Participants enter the lab and complete a series of behavioral experiments unrelated to this experiment. After completing the lab studies the participants are permitted to leave. The studies are staggered such that participants were dismissed one at a time. Upon leaving the lab, participants are approached by a research assistant and offered some free pens. Prior research has shown that research participants typically take only one when the item is free (Ariely, Gneezy, and Haruvy 2006; Shampanier, Mazar, and Ariely 2007), making this a

Figure 1: Pens and Their Packaging

conservative test of our theory. Pens are packaged in a plastic box inside a cardboard sleeve (see Figure 1). The research assistant instructs the participants to "take as many pens as you like as long as you dispose of the packaging here."

Participants in the recycle condition have two recycle bins (one for plastic and one for paper) placed next to a bag of pens. The bag of pens holds 50 pens and the research assistant ensures that the bag is full at all times. Participants in the trash condition have a garbage bin placed next to the bag of pens. This manipulation is between-subjects and participants have only one possible disposal option, either to recycle or to trash the pens' packaging. Unknown to participants, the research assistant notes their gender and how many pens they take. Real consumption behavior serves as our dependent variable.

Results and Discussion. All participants assigned to the recycle-only disposal condition toss the packaging materials in the recycling bins provided, and all participants in the trash-only disposal condition toss their packaging in the trash bin. No participant takes the packaging materials with them. Regression analyses do not reveal any main effects of gender ($F < 1$). Additionally gender does not interact with disposal condition to reveal any significant interaction effects ($F < 1$). A look at the descriptive statistics shows that across

conditions, the majority of participants take 1 pen (56/80 or 70%). Ten participants (12.5%) choose not to take any pens, twelve participants take 2 pens (15%) and two participants take 3 pens (2.5%). Analysis of variance is used to investigate differences in the mean number of pens taken across disposal conditions. The results reveal a main effect of disposal condition on the number of pens taken. Despite the additional effort in unpackaging the pens, sorting and recycling, participants in the recycle only disposal condition ($M = 1.23$, $SD = .57$) take significantly more pens than participants assigned to the trash only disposal condition ($M = .93$, $SD = .62; F(1, 79) = 5.06$, $p < .05$). This finding supports H2 and suggests that, as long as the consumer feels negatively about creating packaging waste that is associated with his consumption, he consumes less than what optimizes his consumption utility.

2.2.4 Recycling Wasted Resources

Sometimes resources can be wasted for unforeseeable and exogenous reasons. For example, students are sometimes given a certain number of pages of scrap paper when taking an exam, and may not use all of them. When a person is faced with a "quota" of resources that is allocated to him for a given task, how would disposal of the remaining resource affect his consumption?

To answer this question and further separate the two effects of recycling, we consider two scenarios in this section where we fix the total amount of a resource taken to be a large fixed number, $q^t = Q$, referred to as the "quota." In the first scenario, suppose that after the consumer uses a certain portion of the quota, the remainder gets trashed. In the second scenario, the remainder gets recycled. We use the model to predict how disposal of the remaining resources in the presence of a quota affects consumption, and use a real-behavior based experiment to validate the predictions.

As it turns out, implementing the quota and making it clear that the remainder is recycled rather than trashed, among all possible scenarios, leads to the lowest amount of consumption.

This scenario not only exists in the real world but also can be simulated when there is no explicit "quota" in place. We can prime the concept of a quota, for example, by emphasizing the fixed total amount of a particular resource on earth. If we also emphasize the recyclable or reusable nature of resources that are left over from consumption, then we would be simulating an environment that is similar to the second scenario.

Consider now the consumer's utility maximization problem. In the first scenario, his utility becomes $U(q^c) - f(\alpha) \cdot G(Q - q^c) + \gamma \cdot R(q^c)$. Since the remainder of the quota gets trashed, $\alpha = 0$ and $f(\alpha) = 1$. As the consumer is unaware of how the used materials gets disposed in our experiment, his utility becomes $U(q^c) - G(Q - q^c)$. Therefore, the optimal quantity of consumption is determined by

$$U'(q_Q^{cT}) = -G'(Q - q_Q^{cT}), \tag{4}$$

where Q stands for quota. When the remainder is recycled, on the other hand, the consumer's utility becomes $U(q^c) - f(1) \cdot G(Q - q^c)$, and the optimal quantity of consumption is determined by

$$U'(q_Q^{cR}) = -f(1) \cdot G'(Q - q_Q^{cR}). \tag{5}$$

Suppose the objective function is concave so that the maximization problem is well defined. Then, conditions (4) and (5) above, combined with the assumption that $f(1) < 1$, would imply $q_Q^{cT} > q_Q^{cR}$, which leads to our next hypothesis.

H3: *When a fixed amount of resource is allocated to a consumer, he consumes less resource when the remainder is recycled than when it is trashed.*

While H1 is driven by the positive emotions induced by recycling used resources, H3 is driven by the negative emotions mitigated by recycling wasted resources. In particular, when the remainder is trashed, the consumer feels more negatively about the waste than when it

is recycled. As a result, he tries to eliminate the negative emotions in the former case by reducing the amount of waste and increasing the amount of consumption. If the consumer does not feel negatively about wasting or recycling does not make him feel less negatively, then the amount consumed should remain the same across the two scenarios.

In this study, we use a mathematical aptitude paradigm and scrap paper to test our hypotheses jointly in an effort to find further support for our theoretical framework.

Design and Procedure. Three hundred fifty-two undergraduate students (52% female) from a private North-Eastern US university participate in this study in exchange for course credit. Participants enter the lab and are randomly assigned to the conditions of a 2 (disposal: trash vs. recycle) $\times$ 2 (frame: used vs. unused) $\times$ 2 (quota: small vs. large) between-subjects design.

All participants receive the following instructions:

Many Americans admit that there have been times that they've found themselves saying they can't do math and have had difficulty figuring out the sale discount at a store or calculating the waiters tip at a restaurant. In fact, the overwhelming majority of Americans believe that the lack of emphasis on developing good math skills will have a negative impact on the future of our economy. In this study, we are interested in students' abilities to do some basic math calculations. Please answer these questions as best you can.

All of participants who achieve a score of 80% or better will be entered in a draw for $25.

Please use the scrap paper provided to solve the problems. Use as much paper as you need.

You CAN NOT use calculators.

Consistent with our previous studies, participants are randomly assigned to disposal conditions of trash (N = 170) or recycle (N = 182). Unlike our previous studies, however, we manipulate two other factors.

First, we manipulate the frame condition. Participants assigned to the used frame (N = 184) are told that the paper that they use will be either trashed or recycled (depending on their assigned disposal conditions), whereas those in the unused frame (N = 168) are told that the paper that is left unused will be either trashed or recycled.

Second, we manipulate the quota, i.e., the amount of scrap paper available to solve math problems in our task. Those in the small quota condition (N = 173) are provided with 5 sheets of scrap paper, whereas those in the large quota (N = 179) condition are provided with 20 sheets of scrap paper. In both conditions the scrap paper measures $5\,1/2 \times 8 1/2$ inches. Prior to this study we conduct a pretest with 53 participants on the amount of paper typically used by participants when given this task to make sure that 5 sheets is enough paper to complete the task. For the pretest, participants answer the same math questions without any information about whether the paper would be recycled or trashed. The paper used is the same size as in the experiment. Pretest results show that participants use 1.91 pieces of paper of average (Median = 2). Only 2 participants use more than 3: one participant uses 4 pieces, and one participant uses 6 pieces.

Participants then complete 20 math problems of medium difficulty (e.g., 27% of 159; $12 \times (4 + 15) - 1125 \div 25$; problems available from authors upon request). After they finish the math problems participants are asked; "Please count how many pieces of paper you used and fill in that amount below." This self report of real behavior serves as the dependent variable. Next, participants respond to items asking for their gender and age. They are then asked to answer an open-ended question as to what they think the purpose of the study is. None of the participants are able to guess any of our hypotheses or identify the purpose of the study. Finally they are given the option to enter the draw for $25, which the majority opt to do.

Results and Discussion. The 352 participants on average use 1.88 pieces of paper (Median = 2, SD = .912). The minimum number used is zero (2 participants, .5% of the sample)

and the maximum number used is 6 (1 participant, .3% of the sample).

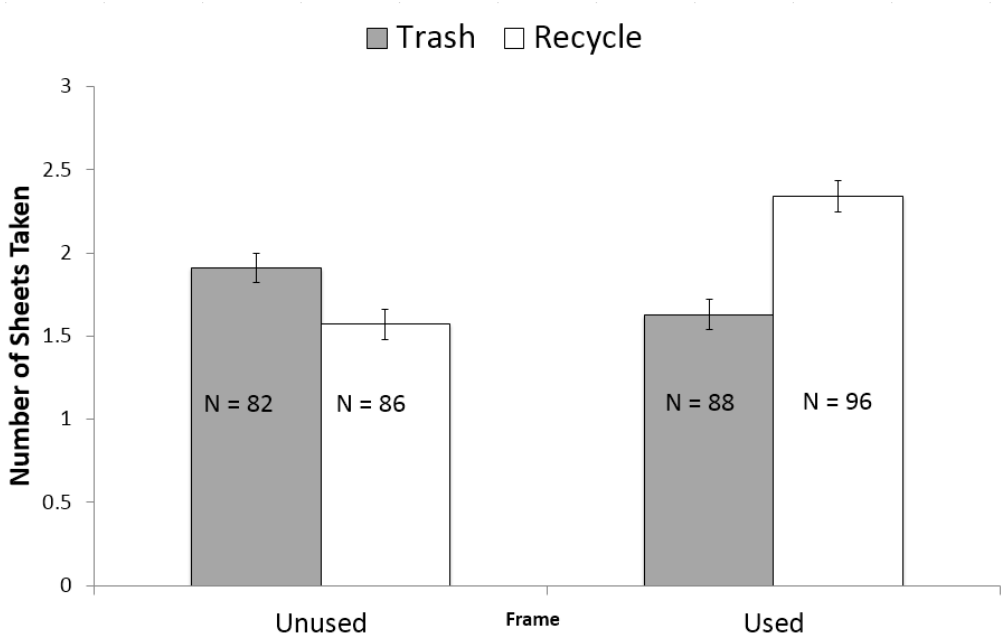
A $2 \times 2 \times 2$ ANOVA reveals significant main effects of disposal ($F(1, 344) = 4.90, p < .05$) and frame conditions ($F(1, 344) = 6.58, p = .01$). A significant disposal by frame interaction is also revealed ($F(1, 344) = 31.15, p < .001$). All main and interaction effects with quota, on the other hand, prove not to be reliable ($Fs < 1$). For this reason, we collapse across quota conditions and re-analyze the data using a 2 (disposal) x 2 (frame) ANOVA.

A 2 (disposal) x 2 (frame) ANOVA reveals significant main effects of frame ($F(1, 348) = 7.11, p < .01$) and disposal conditions ($F(1, 348) = 4.02, p < .05$). Consistent with H1, planned comparisons reveal that participants use significantly more paper when they are told that the used paper would be recycled ($M = 2.34, SD = .97$) versus trashed ($M = 1.63, SD = .85; F(1, 348) = 31.56, p = .001$). Consistent with H3, participants use significantly more paper when they are told that the unused paper would be trashed ($M = 1.91, SD = .85$) versus recycled ($M = 1.57, SD = .74; F(1, 348) = 6.75, p = .01$). Consistent with both hypotheses H1 and H3, the analyses uncover the predicted disposal by frame interaction ($F(1, 348) = 33.18, p < .001$; Figure 3).

Planned comparisons also reveal significant differences between the two trash conditions. Participants use significantly more paper when they are told that the *unused* paper would be trashed ($M = 1.91, SD = .85$) in comparison to when they are told that the *used* paper would be trashed ($M = 1.63, SD = .85; F(1, 348) = 4.63, p < .05$).

The ranking of average consumption quantities across the four scenarios (2 disposal $\times$ 2 frame) in the scrap paper experiment above suggests that $q^{cR} > q_Q^{cT} > q_Q^{cR} = q^{cT} = q^U$ in our modelling framework (Figure 3). Interestingly, $q_Q^{cR} = q^{cT}$, suggesting that in the case of a quota, recycling the remainder appears to almost fully eliminate the participants' negative emotions toward wasting. The ranking above has striking implications for government agencies and nonprofit organizations that aim to protect the environment by promoting recycling.

Figure 2: The Amount of Material Used by Disposal Option and Framing

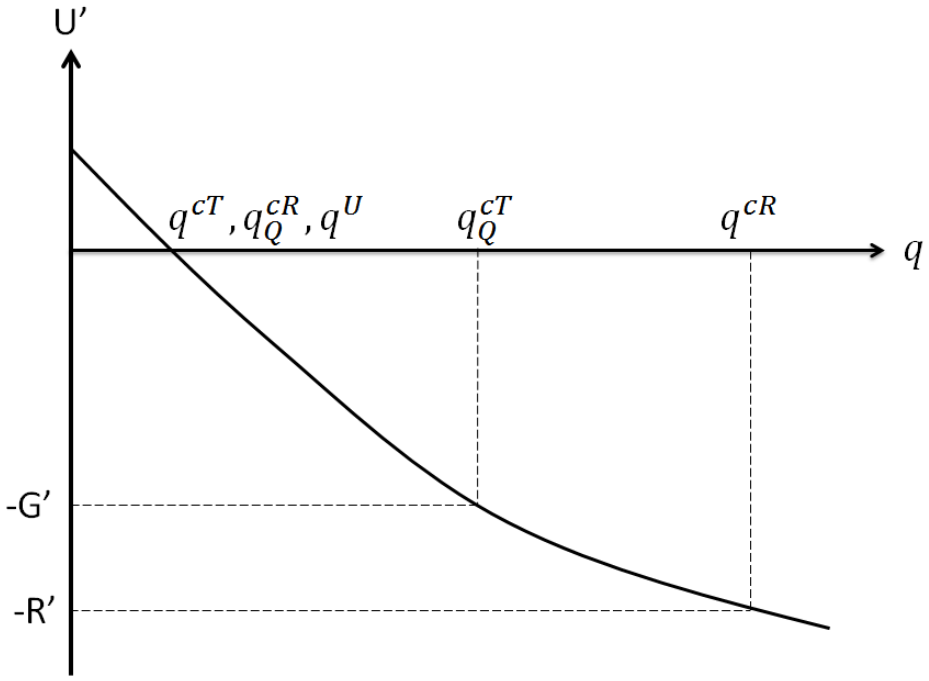


Note: Error bars represent one standard error from the mean for number of sheets taken.

Most importantly, the ranking suggests that consumption could exceed what maximizes the consumption utility when the consumer takes into account how the used and unused resources get disposed later on. The finding contradicts the intuitive expectation that a conscientious consumer would prioritize saving resources above all other options, which is consistent with the EPA's "Reduce, Reuse, Recycle" hierarchy as reducing one's consumption is the most cost effective and sustainable option when compared with reusing and recycling. Our findings suggest that the consumers do not internalize this priority: they derive so much positive emotion from recycling used resources that they keep using more resources even after the marginal consumption utility becomes zero. As a result, the option to recycle used resources leads to an ultimate waste of resources.

In particular, upon comparing the "Used, Recycle" bar (q^{cR}; $M = 2.34, SD = .97$) and the "Unused, Trash" bar (q_Q^{cT}; $M = 1.91, SD = .85$; $F(1, 348) = 9.68$, $p = .002$) in Figure 3, we find that the consumers' marginal utility gain from recycling used resources (R') seems to

Figure 3: Ranking of the Four Average Consumption Quantities in Experiment 3



Note: the two quantities q^{CT} and q_Q^{CR} are equal and defined by $U' = 0$ in this figure, and $f(1) = 0$.

dominate their marginal utility loss (G') from wasting unused resources, at least for a large initial range of quantity. In other words, although consumers feel negatively about taking un unnecessary napkin, the positive emotions they derive from recycling that napkin, once it is used, can dominate the negative emotions. In other words, the positive emotions associated with recycling can lead to wasteful consumption.

Upon comparing the "Used, Trash" bar (q^{cT}; $M = 1.63$) and the "Unused, Recycle" bar (q_Q^{cR}; $M = 1.57$), we also find that these two quantities are not statistically different ($F<1$, $p= .62$). Given our model predictions above, this suggests that $f(1) = 0$ for scratch paper among the participants in this experiment. In other words, as long as the unused paper can be recycled, the participants do not seem to feel negatively about leaving more paper unused.

3 Extensions of the Model

To make the model most useful, we have intentionally kept our model as parsimonious as possible. For this purpose, we have abstracted away from certain aspects of recycling behavior that occur in the real world that are well controlled for in our choice problems and behavioral studies. In this section, we discuss how some of these aspects can potentially be incorporated into the model. This is not meant to capture all of the different possibilities but rather to highlight how the model can be extended to predict consumption and recycling behavior in more complex real-world scenarios.

3.1 Acquisition Utility

While people are generally aversive to waste, we often still observe waste in reality. People may acquire more resources than they need for practical reasons. They may prefer to acquire a large amount of resources, such as to avoid the mental cost of estimating the amount of resources needed and the potential physical cost of making a second acquisition in case they need more resources. To incorporate the endogenous preference of over-acquisition into the model, suppose that consumers derive "acquisition utility" $A(q^t)$ and his utility function is

$$A(q^t) + U(q^c) - f(\alpha) \cdot G(q^t - q^c) + R(\gamma \cdot q^c),$$

Furthermore, suppose $A' \geq 0$ and $A'' < 0$ so that the consumer generally prefers to acquire more resources, while the marginal return of acquisition decreases as the total amount of acquired resources increases. As before, the consumer's utility is maximized at an interior solution that is determined by the first order conditions.

To illustrate the impact of acquisition utility, start by considering what happens when there is no option to recycle. In this case, again, $\alpha = \gamma = 0$, and the consumer maximizes

$A(q^t) + U(q^c) - G(q^t - q^c)$. The total amounts acquired and used are now jointly determined by the system of equations:

$$A'(q^t) - G'(q^t - q^c) = 0 \text{ and } U'(q^c) + G'(q^t - q^c) = 0. \tag{6}$$

The optimal amount acquired is obtained when the marginal utility from acquiring more equals the marginal disutility of wasting that comes from the negative emotions. Given that $G' > 0$, we know that at the optimal q^c we have $U' < 0$. That is, the consumer over-acquires resources to prevent future mental and physical costs, and consumes more than what would maximize his consumption utility in order to avoid the negative emotions from wasting.

When the consumer recycles all the resources, $\alpha = \gamma = 1$. In the simple case where recycling completely eliminates the consumer's negative emotions from wasting, the consumer maximizes $A(q^t) + U(q^c) + R(q^c)$. The optimal consumption amount is determined by $U' + R' = 0$ and is the same as in our main model. Once again, the consumer uses more resources until the marginal utility gain from recycling the used resource equals the marginal disutility from consumption. On the other hand, the optimal acquisition amount is now determined by $A' = 0$, higher than that with no recycling. This is because recycling eliminates the negative emotions from wasting and the consumer acquires more resources for convenience and other practical reasons.

3.2 Cost of Recycling

The cost of recycling can affect consumption through multiple channels. Consumers may experience stronger emotions, for example, when recycling is associated with higher cost or effort. Intuitively, recycling may lead to stronger emotions when it is associated with higher financial cost (e.g., purchasing of expensive recycling equipment or recycling depot fees), physical cost (e.g., travelling to a specialty recycling station), and mental cost (e.g., classify-

ing materials into different types of recycling bins). To incorporate these considerations, one could think of the emotions as being moderated by the cost of recycling, so that the utility function can be re-written as

$$U(q^c) - f(\alpha, e) \cdot G(q^t - q^c) + m(e) \cdot \gamma \cdot R(q^c) - e,$$

where e is the consumer's cost of recycling. Suppose that $f(\alpha, e)$ decreases with e so that a higher recycling cost makes recycling more effective in reducing the negative emotions associated with wasting, and $m(e) \in [0, 1]$ increases with e so that a higher recycling cost enhances the positive emotions from recycling used resources.

To understand how a change in the cost of recycling may change the optimal consumption, consider the representative case in which the consumer could recycle all resources ($\alpha = \gamma = 1$) and recycling can fully eliminate the negative emotions from wasting. In this case, his utility becomes $U(q^c) + m(e)R(q^c) - e$. Optimal consumption is determined by $U' + mR' = 0$. As e increases, m goes up, and the optimal amount of consumption increases. Intuitively, the stronger positive emotions from recycling in this case exacerbates over-consumption.

If the cost of recycling increases with the amount being recycled, e then becomes a function of the amount recycled and $e' \geq 0$. Given $\alpha = \gamma = 1$, the consumer's utility is now $U(q^c) + m(e(q^c)) \cdot R(q^c) - e(q^c)$, and optimal consumption is determined by

$$U' + mR' = e'(1 - m'R).$$

Relative to the case in which the cost of recycling is fixed ($U' + mR' = 0$), the optimal consumption quantity decreases if $m'R < 1$. That is, if the moderating effect of higher recycling cost on the positive emotions is weaker than the direct effect such as higher monetary, mental and physical cost, the consumer would decrease his consumption. Otherwise, he would increase consumption.

3.3 Other Extensions

The extensions of the model described above demonstrate the model's potential to predict consumption and recycling behavior in different situations. There are other boundary conditions and limitations that point to interesting directions for future research. For example, the consumption utility in our experiments is comparable in magnitude to the felt negative and positive emotions associated with disposal. In some situations, the consumption utility can be much more dominant: some customers truly enjoy wearing new clothes while others may love drinking beer. In these situations, the effect of recycling used clothes or beer cans on the amount of consumption can be either smaller due to the inelasticity of demand, or larger as recycling more effectively reduces the negative emotions associated with wasting. It may be interesting to investigate how the impact of the recycling option changes across different consumption categories and how closely each of these categories reflect the consumer's self-identity.

We intentionally exclude social influence in our experiments by separating the participants so that they do not observe each other's consumption quantity. It would be interesting to see how the results would change when consumers are explicitly aware that they are being observed by others. While the increased social presence could enhance people's negative emotions from wasteful consumption, it may either strengthen or weaken the pleasure from recycling. As a result, consumption could either increase or decrease. Future research investigating the role of social influence and social norms on disposal has the potential to be particularly fruitful.

In our model, we focus on the tradeoff between integral emotions arising from disposal choices — that is, the positive and negative emotions associated with disposing of material in the trash versus recycling. However, incidental emotions have also been shown to influence decision making in a variety of areas (Lerner et al., 2015). Incidental emotions are emotions that carry over from one situation to the next but are unrelated to the choice itself. It would

be interesting to see if a more general investigation into incidental emotions and disposal behavior would reveal some interesting behavioral insights related to the present work.

4 Implications for Policy and Consumer Behavior

One interpretation of our findings is that current promotions of recycling may not emphasize the cost of recycling enough. Although modern technologies have considerably lowered the cost to recycle, the labor and equipment involved in this task are still substantial. When these costs are ignored or underestimated, the positive emotions that result from recycling could completely override the negative emotions from wasting. As a result, people might pursue recycling even at the cost of using more resources than needed. Future promotions of recycling should, therefore, emphasize the significant cost of recycling and make a conscious effort to prioritize "reduce" over "recycle."

Another important implication of our results stems from significant differences in consumption between the two recycle conditions. Out of the four conditions in our problem-solving experiment, participants use the most paper when being told that the used paper would be recycled ($M = 2.34, SD = .97$) and they use the least paper when being told that unused paper would be recycled ($M = 1.57, SD = .74; F(1, 348) = 36.74, p < .001$). This result on framing has profound impact for policy makers: the shift of emphasis from used resources to remaining resources could greatly reduce consumption quantity. Intuitively, while recycling used resources could encourage consumption by generating pleasure, recycling leftover resources could promote savings by creating a tradeoff between usage and the positive emotions derived from recycling. As a result, when promoting recycling programs, government agencies and nonprofit organizations should think carefully about ways to remind people of how resources are limited by nature, and how even small leftover amounts of a particular resource can still be reused or recycled.

4.1 Implications for Other Sustainable Behavior

We demonstrate in a final exploratory study the potential applicability of our model to other sustainable behaviors. In this study, we ask a sample of consumers to forecast how many miles a day they would drive a new car.

Design and Procedure. One hundred eighty-six American consumers (34% female) aged 19-75 (M = 34.09) participate in this study. Participants are recruited from Amazon's Mechanical Turk website. Participants are randomly assigned to either a hybrid car condition or a gas car condition. In both conditions, the cars are equally efficient, i.e. they have the same fuel efficiency.

Participants in the hybrid car condition receive the following instructions:

Imagine the following scenario —

You have just purchased a new HYBRID car — the Toyota Corolla HYBRID. It has excellent gas mileage averaging 41 mpg.

On average, how many miles a day would you drive the hybrid vehicle.

Participants in the gas car condition receive the following instructions:

Imagine the following scenario —

You have just purchased a new car — the Toyota Corolla. It has excellent gas mileage averaging 41 mpg.

On average, how many miles a day would you drive the vehicle.

Participants respond on a slider scale (0 to 1000 miles) to forecast how many miles a day they would drive the car. Finally, participants respond to the demographic questions of gender and age, are provided a completion code, and paid for their participation.

Results and Discussion. Two participants do not respond on the slider scale and five others are removed from the data set as outliers (more than 3 standard deviations from the

mean), leaving 179 valid observations. Analysis of Variance reveals a marginally significant effect of car condition on the forecasted amount of driving each day. Participants assigned to the hybrid car condition ($M = 81.29, SD = 122.58$) forecast that they would drive the hybrid car more than participants assigned to the gas car condition ($M = 53.46, SD = 73.52; F(1, 177) = 3.40, p = .067$). The results are consistent with our recycling data and may even be more striking since participants are not actually feeling the associated emotions but instead are only forecasting those emotions (Loewenstein and Schkade 1999; Mellers and McGraw 2001). The results suggest that, similar to what we find in the recycling studies, the pleasure of "being a good citizen" from driving a hybrid car may in fact lead people to drive more.

5 Concluding Remarks

In this paper, we explore consumers' underlying emotions when they make decisions on how much of a resource to use when there is an option to recycle. We propose an evidence-based theoretical framework in which recycling can reduce the consumer's negative emotions from wasting resources and increase his positive emotions from disposing used resources in the recycling. We then generate testable predictions based on the theoretical framework that can help guide policy making, and test these predictions in experiments with real consumption and disposal behavior. In general, we find strong evidence for both effects of recycling discussed above. As a result, people could use more resources than they need when the option to recycle is present. That is, the positive emotions that recycling can induce could dominate the consumer's negative emotions from wasting.

Finally, we hope that our theoretical model of recycling and this research stimulates a dialogue that leads to a better understanding of consumers' disposal decision making. Over the years we have built up a tremendous amount of knowledge regarding consumption

behavior but we know very little about disposal behavior. It is our hope that this nascent area of research gains momentum and reaches its full potential.

References

Abbott, Andrew, Shasikanta Nandeibam, and Lucy O'Shea (2013), "Recycling: Social Norms and Warm-Glow Revisited." *Ecological Economics*, 90, 10-18.

Ariely, Dan, Uri. Gneezy, and Ernan Haruvy (2006), "Social Norms and the Price of Zero," Working paper.

Arkes, Hal R.(1996), "The Psychology of Waste." *Journal of Behavioral Decision Making*, 9(3), 213-224.

Arrow, Kenneth (1987), "Economic Theory and the Hypothesis of Rationality," in *The New Palgrave: Utility and Probability*, 25-39, W. W. Norton & Company.

Baumeister, Roy F., Arlene M. Stillwell, and Todd F. Heatherton (1994), "Guilt: An Interpersonal Approach," *Psychological Bulletin,* 115(2), 243-267.

Bettman, James R., Mary Frances Luce, and John W. Payne (1998), "Constructive Consumer Choice Processes," *Journal of Consumer Research*, 25(3), 187-217.

Bolton, Lisa E., and Joseph W. Alba (2012), "When Less is More: Consumer Aversion to Unused Utility," *Journal of Consumer Psychology,* 22(3), 369-383.

Camerer, Colin F., George Loewenstein, and Matthew Rabin, Eds (2011), *Advances in Behavioral Economics.* Princeton University Press.

Catlin, Jesse R., and Yitong Wang (2013), "Recycling Gone Bad: When the Option to Recycle Increases Resource Consumption," *Journal of Consumer Psychology*, 23(1), 122-127.

Cialdini, Robert B., Raymond R. Reno, and Carl A. Kallgren (1990), "A Focus Theory of Normative Conduct: Recycling the Concept of Norms to Reduce Littering in Public Places," *Journal of Personality and Social Psychology*, 58(6), 1015-1026.

EPA (2012), Municipal Solid Waste Generation (MSW) in the United States: Facts and Figures for 2010, http://www.epa.gov/waste/nonhaz/municipal/pubs/2012_msw_fs.pdf, accessed on April 18, 2014,

Effron, Daniel A., Dale T. Miller, and Benot Monin (2012), "Inventing Racist Roads Not Taken: The Licensing Effect of Immoral Counterfactual Behaviors." *Journal of Personality and Social Psychology*, 103(6), 916-932.

Gneezy, Uri, and Aldo Rustichini (2000), "Pay Enough or Don't Pay At All," *Quarterly Journal of Economics,* 115(3), 791-810.

Fullerton, Don, and Thomas C. Kinnaman (1996), "Household Responses to Pricing Garbage by the Bag," *The American Economic Review*, 86(4), 971-84.

Gigerenzer, Gerd (2004), "Dread Risk, September 11, and Fatal Traffic Accidents." *Psychological Science*, 15(4), 286-287.

Goldstein, Noah J., Robert B. Cialdini, and Vladas Griskevicius (2008), "A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels," *Journal of Consumer Research,* 35(3), 472-482.

Haws, Kelly L., Karen Page Winterich, and Rebecca Walker Naylor (2014), "Seeing the World through GREEN-tinted Glasses: Green Consumption Values and Responses to Environmentally Friendly Products," *Journal of Consumer Psychology,* 24(3), 336-354.

Hoch, Stephen J., and George F. Loewenstein (1991), "Time-Inconsistent Preferences and Consumer Self-Control," *Journal of Consumer Research,* 17(4), 492-507.

Johnson, Eric J., and Amos Tversky (1983),"Affect, Generalization, and the Perception of Risk," *Journal of Personality and Social Psychology*, 45(1), 20-31

Khan, Uzma, and Ravi Dhar (2006), "Licensing Effect in Consumer Choice." *Journal of Marketing Research,* 43(2), 259-266.

Kahneman, Daniel, and Amos Tversky (1979), "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, 47(2), 263-291.

Keeler Emmett, Michael Spence, and Richard Zeckhauser (1971), "The Optimal Control of Pollution," *Journal of Economic Theory*, 4(1), 19-34.

Kidwell, Blair, Adam Farmer, and David M. Hardesty (2013), "Getting Liberals and Conservatives to Go Green: Political Ideology and Congruent Appeals." *Journal of Consumer Research*, 40(2), 350-367.

Lerner, Jennifer S., Li, Ye, Valdesolo, Piercarlo. and Kassam, Karim S., (2015), "Emotion and Decision Making", *Annual Review of Psychology*, 66, 799-823.

Lewis, Michael (1997),"The Self in Self-Conscious Emotions." *Annals of the New York Academy of Sciences*, 818 (1), 119-142.

Lord, Kenneth R. (1994), "Motivating Recycling Behavior: A Quasiexperimental Investigation of Message and Source Strategies," *Psychology Marketing,* 11(4), 341-358.

Loewenstein, George (1996), "Out of Control: Visceral Influences on Behavior," *Organizational Behavior and Human Decision Processes*, 65(3), 272-292.

Loewenstein, George, and Jennifer S. Lerner (2003), "The Role of Affect in Decision Making." *Handbook of Affective Science,* 619-642, Oxford University Press.

Loewenstein, George F., Elke U. Weber, Christopher K. Hsee, and Ned Welch (2001), "Risk as Feelings," *Psychological Bulletin*, 127(2), 267-286.

Loewenstein, George, and David Schkade (1999), "Wouldn't it be Nice? Predicting Future Feelings," *Well-being: The Foundations of Hedonic Psychology*, 85-105, Russel Sage Foundation.

Lusky, Rafael (1976), "A Model of Recycling and Pollution Control," *Canadian Journal of Economics*, 9(1), 91-101.

Mazar, Nina, and Chen-Bo Zhong (2010), "Do Green Products Make Us Better People?" *Psychological Science*, 21(4), 494-498.

McCarty, John A., and L. J. Shrum (2001), "The Influence of Individualism, Collectivism, and Locus of Control on Environmental Beliefs and Behavior," *Journal of Public Policy Marketing,* 20(1), 93-104.

Mellers, Barbara A., and A. Peter McGraw (2001), "Anticipated Emotions as Guides to Choice." *Current Directions in Psychological Science,* 10(6), 210-214.

Merritt, Anna C., Daniel A. Effron, and Benot Monin (2010), "Moral Self-Licensing: When Being Good Frees Us To Be Bad." *Social and Personality Psychology Compass,* 4(5), 344-357.

Plourde, C. G. (1972), "A Model of Waste Accumulation and Disposal," *Canadian Journal of Economics*, 5 (1), 119-125.

Sanfey, Alan G., James K. Rilling, Jessica A. Aronson, Leigh E. Nystrom, and Jonathan D. Cohen (2003), "The Neural Basis of Economic Decision-Making in the Ultimatum Game." *Science,* 300, 1755-1758.

Schultz, P. Wesley, Jessica M. Nolan, Robert B. Cialdini, Noah J. Goldstein, and Vladas Griskevicius (2007), "The Constructive, Destructive, and Reconstructive Power of Social Norms." *Psychological Science*, 18(5), 429-434.

Shampanier, Kristina, Nina Mazar, and Dan Ariely (2007), "Zero as a Special Price: The True Value of Free Products." *Marketing Science*, 26 (6), 742-757.

Smith, Vernon L. (1972), "Dynamics of Waste Accumulation: Disposal Versus Recycling," *Quarterly Journal of Economics*, 86(4), 600-616.

Taylor, Gabriele (1985), "Pride, Shame, and Guilt: Emotions of Self-Assessment," Clarendon.

Tierney, John (1996), "Recycling is Garbage," *The New York Times*, June 30, 1996.

Tracy, Jessica L., and Richard W. Robins (2004), "Putting the Self Into Self-Conscious Emotions: A Theoretical Model," *Psychological Inquiry*, 15(2), 103-125.

Tracy, Jessica L., Richard W. Robins, and June Price Tangney, eds (2007), *The Self-Conscious Emotions: Theory and Research.* Guilford Press.

Trudel, Remi, and Jennifer J. Argo (2013), "The Effect of Product Size and Form Distortion on Consumer Recycling Behavior," *Journal of Consumer Research*, 40(4), 632-643.

Trudel, Remi, Jennifer J. Argo, and Matthew D. Meng (2015). "Trash or Recycle? How Product Distortion Leads to Categorization Error During Disposal." *Environment and Behavior*, forthcoming.

Trudel, Remi, Jennifer J. Argo, and Matthew D. Meng (2016). "The Recycled Self: Consumers Disposal Decision of IdentityLinked Products, *Journal of Consumer Research*, forthcoming.

White, Katherine, Rhiannon MacDonnell, and Darren W. Dahl (2011), "It's the Mind-Set that Matters: The Role of Construal Level and Message Framing in Influencing Consumer Efficacy and Conservation Behaviors." *Journal of Marketing Research*, 48 (3), 472-485.