CALIFORNIA STATE UNIVERSITY SAN MARCOS

THESIS SIGNATURE PAGE

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE

MASTER OF

ARTS IN PSYCHOLOGICAL SCIENCE

TITLE: **Referent Group Specificity: Optimizing Normative Feedback to Increase Residential Recycling**

AUTHOR(S): **Samantha Mertens**

DATE OF SUCCESSFUL DEFENSE: **04/17/2020**

THE THESIS HAS BEEN ACCEPTED BY THE THESIS COMMITTEE IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS IN PSYCHOLOGICAL SCIENCE

Heike I. M. Mahler
COMMITTEE CHAIR

Heike I. M. Mahler
SIGNATURE

04/28/2020
DATE

Wesley Schultz
COMMITTEE MEMBER

Wesley Schultz
SIGNATURE

05/03/2020
DATE

Nathan Carnes
COMMITTEE MEMBER

Nathan Carnes
SIGNATURE

05/03/2020
DATE

Nancy Caine
COMMITTEE MEMBER

Nancy Caine
SIGNATURE

05/04/2020
DATE

Running head: REFERENT GROUP SPECIFICITY

Referent Group Specificity: Optimizing Normative Feedback to Increase Residential Recycling

Samantha N. Mertens

California State University San Marcos, California

Table of Contents

Abstract	3
1.1 Social Norms	5
1.2 Personalized Normative Feedback	6
1.3 Social Norms and Group Identification	8
1.4 Current Study	10
Method	15
2.1 Participants	15
2.2 Materials	16
2.3 Procedure	17
Results	18
3.1 Inter-rater Reliability	18
3.2 Diversion	19
3.3 Treatment Effects	20
3.4 Contamination	25
Discussion	28
4.1 Limitations	32
4.2 Future Directions	33
4.3 Conclusion	34
Supplemental Results	35
6.1 Recycling Treatment Effects	36
6.2 Trash Treatment Effects	39
Supplemental Discussion	43
7.1 Supplemental Conclusion	44
References	45
Appendix A.1	53
Appendix A.2	54
Personalized Home Waste and Recycling Feedback Report (back)	54
Appendix B	55
Recycling Contamination Flyer	55
Appendix C	56

Abstract

Research has shown that messages containing descriptive normative feedback can induce behavior change in the direction of the norm. However, the literature is mixed regarding the relative influence of more specific referent groups. This study compared the effectiveness of social normative feedback at increasing waste diversion, across four referent groups varying in their degree of specificity. A sample of 1,560 single-family households in California was randomly assigned to one of six possible conditions: specific normative feedback about their immediate neighbors, exemplary normative feedback about the best recyclers in their city, generic normative feedback about the other residents in their neighborhood, normative feedback about a statewide waste diversion target, information-only, or no-contact control. Households in the feedback conditions received a mailed personalized Home Waste and Recycling report comparing their diversion rate to an assigned referent group. Results showed that the normative feedback increased diversion rates compared to the control condition, but results did not show significant differences between the treatments. Additionally, negative reports were more impactful than positive reports. Findings are discussed within the framework of the Focus Theory of Normative Conduct, and the implications for large-scale applications.

Keywords: social norms, feedback, referent group, recycling

Referent Group Specificity: Optimizing Normative Feedback to Increase Residential Recycling

Among the many environmental problems we face in the 21st century, the amount of solid waste being produced is one of the most pressing. The global production of solid waste is about 2 billion tons per year, of which approximately 37% is landfilled, 33% is openly dumped, 14% is recycled, 11% is incinerated, and 5% is composted (Kaza, Yao, Bhada-Tata, & Van Woerden, 2018). In 2015, the United States generated 262 million tons of solid waste, 52% of which was landfilled and 26% was recycled. However, of the 138 million tons that were landfilled, 47% of it could have been recycled within existing programs (EPA, 2018). The problem is not just managing the large amount of solid waste being landfilled, but also the resources that could have been saved by reusing or recycling this waste. If these materials were properly disposed of through recycling collection programs, the landfilling rate in the U.S. would be nearly cut in half.

Increasing the proper disposal of waste requires changes in human behavior. Almost without exception, waste and recycling programs worldwide require that an individual select the proper bin for the item. While we can envision a future in which an automated sorting system will remove the individual person from the process, modern recycling is a matter of behavior. A sizable amount of psychological research has focused on the behavioral aspects of recycling, aimed at understanding the factors that predict who recycles and when (Burn, 1991; Osbaldistan & Schott, 2012; Schultz, Oskamp, & Mainieri, 1995). In addition, a growing body of research has tested intervention strategies—both structural and psychological—that can effectively increase recycling and reduce waste (Dupré & Mainieri, 2016; Fornara, Carrus, Passafaro, & Bonnes, 2011; Varotto & Spagnolli, 2017). Among the many tested intervention strategies, social norms and normative feedback have emerged as promising directions.

1.1 Social Norms

Social norms refer to the rules and standards that guide the behaviors of members of a group (Cialdini & Goldstein, 2004). The process of normative social influence is driven by the human tendency for individuals to evaluate themselves by comparing their thoughts and behaviors to the thoughts and behaviors of similar others (Festinger, 1954). Both the perceptions of common behaviors (descriptive norms) and the expectations of social approval or disapproval (injunctive norms) drive conformity toward the perceived norm.

According to the Focus Theory of Normative Conduct, social norms act as behavioral cues that must first be activated or made salient in order to influence behavior (Cialdini, Reno, & Kallgren, 1990). Descriptive and injunctive norms tend to exert the strongest influence on behavior when the normative information presented is aligned with the target behavior, rather than highlighting the frequency of undesired behaviors, or conversely highlighting the infrequency of a desired behavior (Cialdini, Demaine, Sagarin, Barrett, Rhoads, & Winter, 2006; Kallgren, Reno, & Cialdini, 2000; Reno, Cialdini, & Kallgren, 1993). For example, highlighting that a behavior is socially disapproved but commonly engaged in (e.g. littering) focuses individuals on the frequency of the offense, thus normalizing the undesired behaviors (Cialdini, 2003). Instead, normative messages tend to be more influential when the descriptive and injunctive norm both point in the same direction—for example, the large number of residents in your neighborhood who recycle, and the social approval that others hold for recycling.

Using the Focus Theory of Normative Conduct as a foundation, a range of interventions have been implemented across a variety of environmental contexts including water conservation (Jaeger & Schultz, 2017; Kurz, Donaghue, & Walker, 2005), electricity consumption (Allcott, 2011; Bergquist & Nilsson, 2016; Dolan & Metcalfe, 2015; Dwyer, Maki, & Rothman, 2015),

and residential recycling (Dai et al., 2015; De Leon, & Fuqua, 1995; Dupré & Meineri, 2016; Shearer, Gatersleben, Morse, Smyth, & Hunt, 2017). Over the last two decades, researchers have examined the different components of these interventions in an attempt to determine the best ways to guide environmental behaviors (Abrahamse & Steg, 2013; Varotto & Spagnolli, 2017). Consistently, research has shown that some of the most effective behavioral interventions are those which utilize social normative messages (Jaeger & Schultz, 2017; Nolan, Schultz, Cialdini, Griskevicius, & Goldstein, 2008).

Social norm messages can influence behavior, even when the messages are brief. Stok and colleagues (2013) provided a sample of high school students with descriptive or injunctive norms about fruit consumption of similar high school students. The researchers measured fruit intake intention immediately after exposure to the normative message and measured fruit consumption during follow-up. They found that while the descriptive norm produced low fruit intake intentions, it had a significant effect on actual fruit consumption. The injunctive norm also produced low intake intentions, but fruit consumption was not significantly different than the control. These findings are consistent with other research showing the influence of normative messages on behaviors (Jaeger & Schultz, 2017; Nolan et al., 2008).

1.2 Personalized Normative Feedback

Studies on the influence of social norms typically convey a normative message by describing the number or percentage of similar others who engage in the target behavior (for example, the percentage of college students who get drunk on the weekends, or the percentage of guests who choose to reuse their bath towel when staying in a hotel room). By comparison, personalized normative feedback provides individuals information about their own level of behavior relative to the social norm. Personalized normative feedback interventions provide

information about task performance in comparison with the norm of a social referent group.

While the feedback is typically presented at the level of the individual, there are examples where the feedback is about the group (e.g., your dorm, neighborhood, or school; Varotto & Spagnolli, 2017). Group feedback is information provided about the behaviors of the group as a whole, whereas individual feedback is specific to a single person (Abrahamse & Steg, 2013). When group norms are made salient, individuals who are deviant from the norm experience pressure to conform and change their behavior to be more similar to the group (Cialdini & Goldstein, 2004; Schultz, 2002).

Normative feedback can be displayed through a variety of mediums (i.e. flyers, written messages, digital displays, online communication systems) and in some cases even near real-time feedback about the level of consumption (Schultz, Estrada, Schmitt, Sokoloski, & Silva-Send, 2015). The effects of individual and group normative feedback interventions have been examined in both environmental (Carrico & Riemer, 2011; DeDominicis, Sokoloski, Jaeger, & Schultz, 2019; Dupré & Meineri, 2016; Nomura, John, & Cotterill, 2011; Schultz et al., 2015; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007) and health-related contexts (Chernoff & Davidson, 2005; Croker, Whitaker, Cooke, & Wardle, 2009; Werch, Pappas, Carlson, DiClemente, Chally, & Snider, 2000).

As an example, Schultz and colleagues (2015) utilized in-home displays (IHDs) to assess the effectiveness of different types of feedback on household energy consumption. The IHDs were randomly assigned to display the household's current kW consumption (feedback only), the current kW consumption and associated cost (feedback plus cost), or the current kW consumption in addition to the average kW consumption of similar neighbors (normative feedback). The results showed that the normative feedback condition was the most effective in

reducing energy consumption. Subsequent results showed that the normative feedback evidenced durable reductions in energy consumption over a two-year period of time (DeDominicis et al., 2019).

1.3 Social Norms and Group Identification

While the basic principles of normative influence have been well established, fewer studies have examined the role of the referent group. For our purposes, a referent group is a defined social group used as a standard for behavioral comparison (Borsari & Carey, 2003). Conforming to the social norms of a meaningful group allows individuals to satisfy their psychological needs to understand themselves and belong to a social group; people experience positive emotions when conforming to a meaningful in-group and thus, are more likely to do so (Berger & Heath, 2008; Christensen, Rothgerber, Woods, & Matz, 2004). Several studies in the health domain have shown that normative social influence is stronger when the individual identifies more closely with the referent group. For example, Neighbors and colleagues (2010) collected survey data from a sample of undergraduates about their average level of alcohol consumption, perceived drinking norms, and level of identification with a randomly assigned referent group (i.e. a typical student, a student of the same sex, a student of the same race, or a student of the same Greek membership). Results from a personalized normative feedback intervention showed that a higher level of identification with the assigned referent group moderated the change in reported drinking behaviors. These findings are consistent with other studies suggesting that individuals are influenced by social norms when the referent group is specifically defined, and when the individual identifies more strongly with that referent group (Graffeo, Ritov, Bonini, & Hadjichristidis, 2015; Lewis & Neighbors, 2007).

The moderating role of group identification in normative social influence has also been

tested in the environmental context. Goldstein and colleagues (2008) examined the influence of a less or more specifically defined referent group on guests' tendency to conform to social norms in a hotel towel reuse program. This study found that normative messages significantly increased towel reuse rate by 45% compared to an environmental message alone. Further, guests who received information about a room-specific norm reused their towels more than the guests exposed to a global, citizen, or gender norm. These findings provide additional evidence for the influence of local norms, similar to that of social norms with specifically defined referent groups (Fornara et al., 2011).

While there is evidence showing that referent group specificity can moderate normative social influence, there are other studies that have shown the influence of more generic messages. In a similar hotel study, Schultz et al. (2008) presented either specific, generic, or control messages about the norms for participation in the towel reuse program. The effects of both the specific and generic norm messages were significantly different from the effects of the control condition, however, these prompts were equally as effective. Similarly, Reed and colleagues (2007) found that membership with the referent group was not a critical component of this moderating relationship, even when the referent group was broadly defined as "members of Greek-letter organizations". Merely identifying with the members of a Greek organization, while not actually being a member of the organization, was enough for the Greek norms to influence non-Greek student drinking behaviors—without referencing a specific fraternity or sorority. Collectively, research evidence has shown the influence of social norms, even when the referent group is not highly specific.

While there is conflicting evidence for the importance of referent group specificity in the process of descriptive normative social influence, there is more consistent evidence showing the

moderating effect for injunctive normative influence. Christensen and colleagues (2004) examined the effects of identity to a referent group, norm type (descriptive or injunctive), and conformity or violation of a norm that was either related to the referent group or not clearly associated with a referent group. Participants in the study were provided with feedback about their conformity to or violation of a norm (positive/negative descriptive or injunctive) based on their helping behavior in a puzzle completion task. The referent group in the normative feedback condition was students from the local university; participants in the referent group control condition received feedback without mention of a specific referent group. After receiving the feedback, participants completed a measure of self-evaluation. Participants who highly identified with the referent group reported better self-evaluations after receiving feedback about their conformity to the injunctive norm of the referent group; there was no significant impact of behavior when the feedback was not associated with a group, and when the group was not rated as important. Conversely, participants who strongly identified with the referent group, but violated the descriptive norm, reported more positive emotions. The authors argue that this finding is likely a result of feeling “unique” rather than conflicted about violating a social norm. Overall, this study found that the moderation of group identification on normative influence was particular to the injunctive, but not descriptive, norm (Christensen et al., 2004).

1.4 Current Study

Personalized normative feedback is being increasingly applied to promote behavior change and respond to environmental problems. With advances in measurement technology and rapidly growing use of web and social media communications, personalized normative feedback is becoming possible across a wide range of behaviors (Carrico & Riemer, 2011; Dupré & Meineri, 2016; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2018). Yet despite the

encouraging basic research and the promising results from applications, a number of important questions remain to be addressed. Most notably for this paper is the relative influence of specific versus generic referent groups. Most existing studies (both basic and applied) have compared an individual to a large generic social group, such as students at their university, other households in a neighborhood, or other guests at the same hotel. To date, few studies have directly tested the relative influence of different referent groups that vary in their level of specificity. As evidenced in prior research, it is clear that the referent group may play an important role in the influence of social normative feedback, however, the role of referent group specificity remains unclear (Chernoff & Davidson, 2005; Christensen et al., 2004; Neighbors et al., 2010).

In addition to the need for research testing the relative impact of different referent groups, it is also important to examine the behavioral response of individuals with varying levels of deviation from the norm. Prior research has shown a differential pattern of responses for individuals who are above or below the referent group norm in both energy and water conservation (Schultz, 2019; Schultz et al., 2008). Bergquist and Nilsson (2018) hypothesized a ‘norm distancing effect’, which suggests that people are *more* likely to adjust their behavior to conform to the norm if the discrepancy between the two is small. To test this hypothesis, participants were given normative information on energy use through a smartphone application.

Participants were randomly provided with fictitious energy usage scenarios combining congruent (either proximal or distal) or conflicted (either proximal or distal) normative information. In a second study, participants were exposed to similar fictive energy scenarios, but with five variations of norm distance and three variations in the frequency of the descriptive norm. In both studies, energy usage intentions were measured after exposure to the scenarios. The results showed that participants adjusted their intentions more when others engaged in the

approved behavior, supporting the norm alignment effect. Further, the results showed support for the norm distancing effect—participants were more likely to adjust their intentions to others’ when the discrepancy between their behavior and the behavior of others was small rather than large. These findings suggest that norm distancing is an important consideration in the design of normative feedback interventions aimed at conservation (Bergquist & Nilsson, 2018).

The differential impact of referent group specificity and the differences in the behavioral responses of individuals above or below the norm are two important gaps in the literature that the current study aims to address. Specifically, this study was designed to directly test the effects of personalized normative feedback comparing the recycling and waste diversion of individual households to either a highly specific, exemplary, generic, or statewide target referent group. The behavioral focus of this study was residential recycling, and the target behavior was an increase in *waste diversion*. Unlike previous studies which have looked at just recycling or just trash, the current study focused on normative feedback about waste diversion. Specifically, diversion rate was calculated as the proportion of waste that the household diverted from the landfill:

$$\text{diversion} = \text{total recycling weight} / (\text{total recycling weight} + \text{total trash weight}).$$

Participants were randomly assigned to one of six possible conditions: highly specific social normative feedback, exemplary social normative feedback, generic social normative feedback, statewide target social normative feedback, information only-control, or no-contact control (Table 1). This study tested three hypotheses:

H₁: Households receiving each of the four types of social normative feedback will have higher diversion rates after receiving the intervention materials, compared to the information-only and control conditions.

H₂: Households receiving the exemplary social normative feedback will have higher

diversion rates compared to households in all other feedback conditions. The exemplary normative feedback will be about the performance of the top 20% of recyclers across all single-family households in the study, leaving 80% of the households in that condition to fall below the norm diversion rate. Thus, we hypothesized that the exemplary condition would allow for the most norm discrepancy, and thereby exert a strong influence on diversion rates.

H₃: The effectiveness of each of the four social normative feedback treatments will depend on the discrepancy of the household from the behavior of the referent group. Specifically, we expected households above the norm to maintain diversion rates as a result of the injunctive norm combating the occurrence of a boomerang¹ effect. However, for households below the norm, we expected that a larger discrepancy would result in a stronger change in the direction of the norm.

¹ For individuals outperforming the norm, coupling a descriptive norm with an injunctive norm communicates approval of the described behavior, thus encouraging over-achieving and under consuming individuals to continue behaving better than the norm (see Schultz et al., 2007).

Table 1

Definitions and Descriptions of Social Comparisons

Condition	Referent Group	Description
Specific <i>N</i> = 251	5 closest neighbors	You vs the average diversion rate of your 5 closest neighbors. These neighbors are based on the GPS coordinates of your home.
Exemplary <i>N</i> = 265	Best recycling households	You vs the average diversion rate of the best recyclers in your city. The best recyclers in your city are households that have the top 20% of diversion rates.
Generic <i>N</i> = 258	Other similar households	You vs the average diversion rate of all similar households in your city. All similar households are all other single-family households in Solana Beach, CA.

Note. The description of the assigned referent group was displayed on mailed report.

Method

2.1 Participants

An important consideration in the planning of this study was our ability to collect data before households were serviced by the local waste company. The city of Solana Beach was selected due to its manageable size, as well as the number of households that were serviced each day. Using an opt-out design, an initial sample of 1,860 single-family households across the city were selected for the study.

Households that were being sold were not included in the study and any households that became for sale or for rent during the study were removed. Any homes undergoing apparent demolition or remodeling were also excluded from participation because this could interfere with typical waste behaviors. According to the 2018 U.S. Census Bureau, the city of Solana Beach was 78% Caucasian, 12% Hispanic or Latino, 5% Asian, and 5% Other. Throughout the study, 131 households did not set out any bin during the 4-week baseline period and were removed from the sample. In addition, 65 had undeliverable mailing addresses, 41 opted out, 32 became for sale/rent, 18 began construction, and 13 were removed due to the location of their bin placement, bringing the final sample size to 1,560.

Using publicly available data on Zillow.com and Redfin.com, the research team obtained demographics for all households in the final sample. Household size ranged from 438 square feet to 21,224 square feet, with an average size of 2,439 square feet. Households had an average of 3.73 bedrooms and 2.72 bathrooms. Political party affiliation records were obtained through the San Diego Voter's Registrar office and used to determine the majority party preference for each household. These records indicated that 40% of households in the sample were registered as Democratic voters, 38% registered as Republican voters, 16% had another party preference, and 6% of households had an even split of Democratic and Republican voters. This study was

reviewed and approved by the Institutional Review Board (IRB) at California State University San Marcos.

2.2 Materials

Personalized home waste and recycling reports were designed as single-page reports (double-sided), printed on 100% recycled paper, which were sent to the participants in the experimental conditions (see appendix A). The reports consisted of dates signifying the four weeks being reflected, social normative feedback (tailored to each condition), information about recyclable materials, a historical self-comparison, tips to reduce household waste, the mathematical equation used to calculate diversion rates, and contact information for the research lab. A contamination flyer was obtained from the local service provider and was used for the information-only condition (see Appendix B). This was a one-page flyer that provided a detailed description of the types of materials that could be placed in the recycling bin to avoid recycling contamination.

Trash and recycling data were collected by a university research team at selected time points across a 4-month period. All research assistants were provided with data collection field bags equipped with a clipboard containing data collection sheets, a contamination guide and coding system, instructions for making volume estimates, and an extensive list of potential questions that could be asked by residents in the field, followed by appropriate responses to each. The materials on the clipboards ensured that research assistants were able to accurately code data and confidently interact with residents. In addition to the clipboards, the field bags were also equipped with pencils, gloves, nametags, flashlights, and rain ponchos. The field bags also included lab contact cards to distribute if requested by a resident. Before the study began, all research assistants participated in an extensive training session in preparation for timely and

efficient data collection. Research assistants were trained to determine the size and type of each bin, which household the bin belonged to, how to estimate the volume of the bin contents, and how to identify and code for recycling and trash contamination. Research assistants completed pre- and post-training assessments in addition to being periodically observed in the field.

2.3 Procedure

In February of 2019, research assistants gathered addresses and relevant property information, as well as visual confirmation of all household locations and eligibility for participation. On February 20th, 2019 all households were sent a pre-notification postcard informing them of the study and their rights as participants. Ten days after the pre-notification postcards were sent through the postal mail service (by March 2nd, 2019), any household that did not contact the lab to opt-out of the study was included as a participant.

The research team also conducted ‘lid-flips’ for all recycling and trash bins to collect data on bin volume and contamination. Bin volume was scored as quarterly percentages (i.e. 25%, 50%, 75% or 100%). In cases when the bin was less than 25% full but not empty, the volume was scored as 10%. Similarly, when a bin was overfilled and the lid was unable to shut, volume was scored as 110%. Volume was aggregated across the number of bins when more than one of the same type of bin was placed at the curb. For example, if a household set out two recycling bins that were both 50% full (and of the same size), recycling volume was recorded as 100%. There were only three houses in the study that had inconsistent bin sizes for the same type of bin, and volume levels were adjusted on a case by case basis. For example, if a household set out one large bin that was 100% full and one medium bin that was 50% full, the estimate was recorded as a large bin that was 125% full.

During all four weeks of the baseline period, data were collected for all recycling and

trash bins in the study. To be eligible for participation in the study, all households had to set out at least one recycling or trash bin at some point during the baseline period; households that failed to set out anything during this four-week window were excluded from the study. Our timeframe for the baseline measure was long enough to allow households ample opportunity to meet our baseline criteria. Shortly after the baseline period, households in the feedback and information-only conditions received either a personalized feedback report or recycling contamination flyer. Follow-up data were collected for all households during month 1 (week 7), month 2 (week 11), and month 3 (week 15). At the end of the intervention (week 17), all households were sent debriefing postcards to inform them that the study had concluded.

Results

There were two instances in which a collection truck serviced households in the sample earlier than the scheduled time. Thus, data was unable to be collected for nine trash bins during week 1 (baseline) and 22 trash bins during week 11 (month 2). For this missing data, volume estimates were imputed using the average estimates of the bins set out within the same route on that same day and all bins were scored as having no contamination. However, because the missing data was minor and only occurred twice, these cases were retained in the analyses.

3.1 Inter-rater Reliability

We correlated data collected by separate teams of student researchers to test the inter-rater reliability of volume estimates. This was a strong measurement of inter-rater reliability because neither team was aware that their estimates were being compared to one another. A Pearson correlation revealed a strong positive relationship for volume estimates made by the field and validation teams, $r = 0.87, p < .001, N = 164$. This relationship remained strong and positive when looking at estimates of recycling ($r = 0.88, p < .001, N = 82$) and trash bins ($r =$

0.86, $p < .001$, $N = 82$) individually.

3.2 Diversion

In this study, the primary dependent variable was diversion rate across the four time points. Diversion rate was calculated as the proportion of weekly waste that the household diverted from the landfill: $\text{diversion} = \text{total recycling weight} / (\text{total recycling weight} + \text{total trash weight})$. Using a portable scale, a validation team measured the weight and volume of recycling and trash bins for 82 households in the study. This data was used in a series of linear regression analyses to predict bin weight based on volume estimates, bin type, and bin size. For example, the regression for predicting the weight of a large recycling bin was: $\text{Weight} = 7.75 + 24.48 * \text{bin volume}$. The regression for predicting the weight of a large trash bin was: $\text{Weight} = 15.01 + 57.74 * \text{bin volume}$. A similar procedure was used to calculate weight for medium and small bins.

Diversion rates were calculated for baseline (average across four weeks), month 1 (week 7), month 2 (week 11), and month 3 (week 15) of the study. While this computation of diversion is intuitive, it mischaracterizes instances where a home did not set out any bin as the lowest possible diversion score (a score of 0%). To better quantify diversion, instances where a home failed to set out at least one bin (either trash or recycling) were omitted. Using this procedure, a diversion rate was calculated for each week, omitting households that didn't set out at least one bin. These weekly diversion scores were then summed across the four baseline weeks, and divided by the number of weeks in which the household set out at least one bin (1-4). Using this modified approach, households with a 0% diversion rate set out no recyclables and only trash. At the other end of the scale, a score of 100% represented a home that only set out recycling, and no trash. Overall, households had average diversion rates of 38% at baseline (March), 39% at month 1 (April), 37% at month 2 (May), and 38% at month 3 (June).

3.3 Treatment Effects

There was a delay in the postal mail delivery of the home waste reports and informational flyers, which caused the households to receive their assigned communication just days before the measurement of month 1. The window between receiving the report and the first follow-up measurement did not allow enough time for behavior change to be reflected at the first follow-up period. Because of this delay, month 2 was used as our primary measure of behavior change, with month 3 as the longer-term impact.

Initial inspection of the diversion results showed considerable variation in the baseline diversion rates between conditions. This despite the use of random assignment to condition and the relatively large sample size. In order to balance this variability across treatment conditions, baseline diversion was used as a covariate in subsequent analyses, rather than as a time point in the repeated measure. A 6 (condition) X 3 (time) repeated measures analysis of variance (ANCOVA) was conducted to examine changes in diversion rates across conditions and time (months 1, 2, and 3), with baseline diversion and dwelling characteristics (home value, # of bedrooms, # of bathrooms, and size) as covariates. Mauchly's test indicated that the assumption of sphericity was not violated (Mauchly's $W = .99, p = .342$). Baseline diversion was a significant covariate ($F(1, 849) = 415.11, p < .001$), but value ($F(1, 849) = .29, p = .589$), number of bedrooms ($F(1, 849) = 2.02, p = .156$), number of bathrooms ($F(1, 849) = 2.98, p = .085$), and size ($F(1, 849) < .01, p = .982$) were not significant covariates. Results from the repeated measures ANCOVA showed no significant main effect of time, $F(2, 1698) = 1.44, p = .237$ or condition, $F(5, 849) = .19, p = .968$ on diversion rates. The hypothesized time*condition interaction approached significance, $F(2, 1698) = 1.64, p = .090$.

Although the omnibus test of the interaction was not statistically significant ($p = .090$),

we proceeded with our *a priori* planned comparisons to further investigate the differences between conditions and time. The results indicated that at month 2 (our primary measure of behavior change), the specific and generic social normative messages were statistically different than the control, while the exemplary and statewide target social comparisons approached significance (see Table 2). As shown in Table 2, these effects did not persist over time and at month 3 (our measure of longer-term impact) none of the normative feedback conditions differed from the control. The information-only condition did not differ significantly from the control at any of the follow-up time points. Note that statistical significance is indicated in Table 2 by comparing the top end of the 95% confidence interval of the control condition with the mean of the treatment conditions at each time point.

Table 2

Planned Comparisons of Diversion Rates Across Conditions and Time

		<i>M</i>	<i>SE</i>	95% Confidence Interval	
				Upper	Lower
Control <i>N</i> = 142	Month 1	0.38	0.02	0.35	0.41
	Month 2	0.35	0.02	0.32	0.38
	Month 3	0.40	0.02	0.36	0.43
Flyer <i>N</i> = 145	Month 1	0.38	0.02	0.35	0.42
	Month 2	0.35	0.02	0.32	0.38
	Month 3	0.40	0.02	0.36	0.43
Specific <i>N</i> = 141	Month 1	0.38	0.02	0.35	0.41
	Month 2	0.39*	0.02	0.36	0.42
	Month 3	0.37	0.02	0.34	0.40
Exemplary <i>N</i> = 147	Month 1	0.40	0.02	0.37	0.43
	Month 2	0.38 ^a	0.02	0.35	0.41
	Month 3	0.39	0.02	0.36	0.42
Generic <i>N</i> = 139	Month 1	0.39	0.02	0.36	0.42
	Month 2	0.40*	0.02	0.36	0.43
	Month 3	0.34	0.02	0.31	0.38
Target <i>N</i> = 146	Month 1	0.38	0.02	0.35	0.42
	Month 2	0.38 ^a	0.02	0.34	0.41
	Month 3	0.37	0.02	0.34	0.40

Note. * $p < .05$, ^a $p < .10$.

To directly test the first hypothesis, a 2 (treatment vs no treatment) X 3 (time) repeated measures ANCOVA was conducted to examine the difference in diversion rates for households that received one of the social normative feedback reports (coded as 1), compared to households that did not receive reports (coded as zero). This analysis combined the four treatment conditions together into one group, and the two control conditions together into a second group. As hypothesized, the results showed a time x condition interaction ($F(2,1706) = 5.83, p < .01$). The planned contrast showed that households in the treatment conditions had higher diversion rates at

month 2 ($M=.385$, $CI_{95\%}$ from .369 to .401), compared to households in the combined control and information-only conditions ($M=.352$, $CI_{95\%}$ from .330 to .375).

Our third hypothesis predicted that the strongest change in behavior would occur among households further below the presented norm, while those receiving reports showing a positive deviation from the norm would maintain their high levels of diversion rates. To begin, a change score was calculated for each household, showing the difference between the diversion rate at month 2 (primary measure of behavior change), compared to baseline. These change scores were analyzed using an analysis of covariance (ANCOVA) including dwelling characteristics as covariates. The dependent variable in these analyses was the amount of change in diversion rates from baseline to month 2.

Two ANCOVAs were conducted: one for households that received a positive report (i.e., households that were above the norm in their diversion rate), and one for households that received a negative report (i.e., households that were below the norm). For the households that received positive reports, there was no significant main effect of condition on change in diversion rate, $F(5, 593) = 1.47, p = 0.197$. However, there was a significant effect of condition on change in diversion for households that received negative reports, $F(5, 957) = 4.37, p = 0.001$. Household characteristics were not significant covariates for either of the analyses. As shown in Table 3, planned comparisons revealed that, for households below the norm, receiving specific, generic, and exemplary social comparisons significantly increased diversion rates compared to those in the control condition. Results for the statewide target social comparison were trending in the predicted direction but failed to reach statistical significance ($p = .10$). These results provide an initial test of hypothesis three and demonstrate the absence of a boomerang effect for households receiving a positive report.

Table 3

Planned Comparisons Testing Change in Diversion from Baseline to Short-term Follow-up

95% Confidence Interval					
	<i>N</i>	<i>M</i>	<i>SE</i>	Lower	Upper
Positive Reports					
Control	208	-0.04	0.02	-0.07	-0.01
Flyer	184	-0.02	0.02	-0.05	0.02
Specific	89	-0.02	0.02	-0.06	0.03
Exemplary	16	--	--	--	--
Generic	103	-0.05	0.02	-0.10	-0.01
Target	3	--	--	--	--
Negative Reports					
Control	208	-0.04	0.02	-0.07	-0.01
Flyer	184	-0.02	0.02	-0.05	0.01
Specific	104	0.05*	0.02	0.01	0.09
Exemplary	189	0.02*	0.02	-0.02	0.05
Generic	97	0.05*	0.02	0.01	0.10
Target	185	0.00 ^a	0.02	-0.03	0.03

Note. Change calculated as month 2 diversion minus baseline diversion; positive mean values represent an increase in diversion whereas negative mean values represent a decrease in diversion. Data for positive reports of exemplary and statewide target conditions are omitted due to insufficient sample sizes. * $p < .05$, ^a $p < .10$.

To further explore hypothesis three, diversion rates were recoded into six levels for households in each condition (three below the norm: low-low, low-medium, low-high and three above the norm: high-low, high-medium, high-high). Households in the low-low category made up the bottom 16.7% of the diversion rates, low-medium as 16.8%-33.4%, low-high as 33.5%-50%, high-low as 50.1%-66.7%, high-medium as 66.8%-83.4%, and high-high as 83.5%-100%. To directly test hypothesis three, ANCOVAs were conducted for each condition individually to examine changes in diversion rates for households at different levels below and above the norm. Surprisingly, we found no significant difference in the size of change for any of the conditions relative to the control.

3.4 Contamination

A detailed coding system was developed to classify the materials that were considered contamination within a bin, based on visual inspection of the bin contents. Each bin was coded as either being contaminated or not contaminated. Throughout the entire intervention, contamination data was collected for 8,033 recycling bins and 8,463 trash bins. Overall, the results showed that 67% of recycling bins were contaminated, and 47% of trash bins were contaminated (see Figure 1). The difference was statistically significant, with more contamination occurring in recycling bins than in trash bins. This suggests that individuals might be “wishfully” recycling—that is, putting materials in the recycling bin in the hopes that they could be recycled. The issue of contaminated recycling bins is a critical worldwide issue, and one that we’ll return to in the discussion section.

Figure 1. Recycling and trash contamination percentages at baseline and follow-up months.

A breakdown of the types of contaminants found in recycling and trash bins across the

city is shown in Figures 2 and 3. In recycling bins, 78% of contamination was made of up soft plastics such as trash bags, grocery bags, shrink wrap, and soft plastic packaging. In trash bins, 25% of contamination was made up of green yard waste, which is a bin that is not provided to residents of Solana Beach. Again, this suggests that the most common contaminants could be a result of individuals “wishfully” recycling and convenience.

Separate chi-square analyses were conducted to examine the relationship between contamination rates and conditions at baseline and month 2 for recycling and trash. There was no significant relationship between recycling contamination rates and condition at baseline, $\chi^2(5) = 1.73, p = .885$, or month 2, $\chi^2(5) = 3.51, p = .622$. Similarly, there was no significant relationship between trash contamination rates and condition at baseline, $\chi^2(5) = 2.92, p = .713$, or month 2, $\chi^2(5) = 1.76, p = .881$. This suggests that contamination rates did not change as a result of the assigned condition. Further, contamination rates did not change as a result of time throughout the study.

Figure 2. Summary of contaminants found in recycling bins.

Figure 3. Summary of contaminants found in trash bins.

Discussion

This paper presents the results from a large scale field experiment with 1,560 single-family households, to compare the effects of different messages with normative referent groups on recycling behaviors. The results showed three clear findings. First, personalized normative feedback produced a significant short-term increase in diversion rates—especially when using highly specific or generic referent groups. Second, households below the norm in their level of waste diversion were more influenced as a result of the social normative feedback than were households above the norm. And third, there is a high level of contamination in the recycling and trash bins, with more contamination in recycling bins than in trash bins (67% versus 47%, respectively).

The first finding was that social normative feedback, for both highly specific and generic referent groups, significantly increased diversion rates. The success of the feedback reports can be attributed to the Social Comparison Theory (Festinger, 1954) which suggests that individuals evaluate themselves by comparing their thoughts and behaviors to the thoughts and behaviors of similar others, as well as the Focus Theory of Normative Conduct (Cialdini et al., 1990). The effectiveness of our feedback reports can be attributed to the aligned descriptive and injunctive social norms, and the socially comparative feedback for households to evaluate themselves. The overall effectiveness of the social normative feedback was consistent with our first hypothesis, and that of previous literature (Abrahamse & Steg, 2013; DeDominicis et al., 2019; Dupré & Meineri, 2016; Schultz, 1999; Varatto & Spagnolli, 2017).

Although effective in the short-term, we found that the treatment effects did not persist past month 2 of follow-up, which was consistent with literature suggesting that feedback needs to be repeated in order to sustain changes in behavior (Nomura et al., 2011; Sparkman & Walton,

2017). However, some research has shown that the effect of one-shot treatments can persist over short periods of time for water conservation behaviors (Richetin et al., 2016). A large consideration here is the difference in recycling and other types of conservation behaviors such as water or energy. In water, for example, conservation can occur through investments in new technologies such as low-flow showerheads or water efficient toilets (Kurz et al., 2005). Once implemented, these technologies can exert a continuing influence on consumption, even in the absence of changes in behavior. On the other hand, recycling requires a sustained effort on the part of the individual, specifically, to take the time to consider how to correctly dispose of materials as well as engaging in proper sorting practices. Thus, we argue that interventions that require more effort from the individual are more effective when feedback is repeated.

While the results overall showed the effectiveness of normative feedback on recycling, the results did not support our second hypothesis, which predicted that the exemplary social comparison would have the strongest effect compared to all other referent groups. We reasoned that this comparison would have the largest effect because it would place 80% of the households below the norm, thus encouraging the largest group-level increase in diversion rates. To elaborate, we expected that this type of social comparison was meaningful enough to maintain a sense of similarity to the comparison group (the best recyclers in your city) while setting the social norm high enough to avoid applauding mid-range diversion rates. Again, because the act of recycling requires more effort on the part of the individual, it is possible that using a more generic or specific comparison created a stronger sense of similarity to the referent group by producing a more achievable social norm.

Our reported results showed a general effect for social normative comparisons on waste diversion, regardless of referent group. While previous research has shown that social

comparisons can be more effective for more specific referent groups (Goldstein et al., 2008), our results showed the success of social normative feedback on diversion behaviors, regardless of the level of specificity. Based on this finding, we recommend that behavioral interventions in an applied context consider other logistics when determining a level of specificity, such as feasibility and communicating with large populations. However, it is possible that this finding is unique to behaviors that require sustained effort, such as recycling and waste diversion.

Our third hypothesis predicted that the effect of the normative feedback would depend on the discrepancy between the household and the norm. In other words, we expected that households that were further below the norm would show a larger increase in diversion rates from baseline to follow-up. Our results were not supportive of this hypothesis, suggesting that there was no difference in the amount of change for different referent group comparisons at different levels below the norm. This was inconsistent with research showing this hypothesized effect for water conservation and energy use intentions and their difference for very high consumers (Bergquist & Nilsson, 2018; Schultz, 2019). However, this is one of the first studies to test the differences in the specificity of the norm referent group so comparisons to previous literature should be interpreted with caution.

Instead, we found a general effect of negative reports on the increase in diversion rates. Specifically, we compared the effect of positive and negative reports across conditions and found that households below the norm were more inclined to change their behavior, regardless of the referent group, but especially when using highly specific or generic comparisons. Thus, we argue that the overall effect of negative reports is a more meaningful finding.

In addition to showing a stronger influence of negative reports for low-diverting households, the results also showed no evidence of an increase for high-diverting households.

That is, our results did not show a boomerang effect. As per the Focus Theory of Normative Conduct, we aligned the descriptive and injunctive norms in the design of the personalized reports to encourage above average recyclers to maintain high levels of recycling. A notable difference in our reports, compared to normative feedback used in similar studies, was the absence of a direct injunctive norm for households below the norm. Specifically, those above the norm received a report with a thumbs-up emoticon in addition to a green indication on the temperature bar, whereas households below the norm only received a report with a red/orange indication on the temperature bar. We decided to omit the red thumbs down emoticon on below average reports to avoid angering residents, especially because 80% of households in the exemplary condition received negative reports. Regardless, this finding was consistent with the social norms literature across other domains of environmental behaviors that include both positive and negative injunctive norms (Jaeger & Schultz, 2017; Schultz, 2002).

Finally, our results showed that recycling bins were contaminated far more often than were trash bins, and soft plastics emerged as the biggest contaminant. We found this pattern of result throughout the four-month intervention, and across all conditions. It seems likely that when individuals are unsure about whether or not an item can be recycled, they prefer to recycle it than send it to the landfill. Based on resident encounters in the field and phone calls made to the research lab, there was a clear misunderstanding about how to properly dispose of soft plastics, such as grocery bags and packaging. These products often display a recycling symbol, with small print indicating that it should not be placed in a recycling bin, which can cause confusion among consumers. Thus, recycling knowledge and “wishfully recycling” seem to be two of the largest psychological reasons behind contaminated recycling.

When looking at trash bins, organic yard waste emerged as the largest contaminant. This

is likely because Solana Beach residents are not provided with green yard waste bins, although this type of waste is still serviced by the local facility. Instead, residents are expected to purchase their own yard waste bins. In fact, almost every occurrence of green yard waste contamination occurred when designated green waste bins were not present. Thus, convenience seems to be the largest predictor of contamination in the trash bin.

4.1 Limitations

While these results are encouraging and partially supportive of our hypothesis, there are a few limitations that should be noted. First, our follow-up measurements are based on a single week of collection and used to reflect an entire month of behavior. It is possible that the weeks we used as follow-up measurements did not fully capture the behavior across all households in our sample (i.e. those who did not set out). However, our modifications to the data prior to analyzing allowed us to examine the effects of only households that set out for collection that week and omit those who did not set out. While more weeks of data would have given us a more precise estimate of the treatment effect, the use of random assignment to condition means that week-to-week variability is not a confound. Instead, it serves to increase the variability in our observed trash, recycling, and diversion scores and inflates the probability of a type-II error. Fortunately, the large sample size was sufficient to overcome the high degree of variability and our results were statistically significant.

A second limitation worth noting was our exploration in the effect of positive and negative reports on the amount of change in diversion rates. As a result of the high norms set for households in the exemplary and statewide target social feedback conditions, a majority of those households fell below the norm and received a negative report. Consequently, the sample sizes for households receiving positive reports in those conditions were too small to report in the

analyses. Consequently, our results showing the absence of a boomerang effect was reflective of all other conditions and not the exemplary and statewide target social comparisons. Still, because the success of injunctive norms combating boomerang effect has been shown in previous literature, it's reasonable that the same effect would have occurred in the exemplary and statewide target conditions had the sample sizes for those above the norm been larger. More importantly, when looking at the effects of the negative reports, the sample sizes for these two conditions were similar to that of all other conditions, allowing our conclusions to be generalized across the four feedback conditions.

A third limitation was the missing data attributable to early truck collection. In these situations, the missing data were imputed using the neighborhood average specific to that bin type; because we were just minutes behind the collection truck, our team was able to tell which houses to impute data because the empty bins remained at the curb. However, this situation only occurred for 31 trash bins throughout the entire 17-week intervention and was minor compared to the total data collected throughout the study.

4.2 Future Directions

The results of this study are encouraging and warrant the exploration of scalable applications for recycling interventions. A meaningful step in this line of research would be to scale the measurement and personalized feedback through technology. Specifically advancements in smart truck technology will allow for ongoing measures of the weight for individual trash, recycling, and organics bins. Once collected, this smart truck technology could also provide opportunity to enhance communication with consumers. The ability to provide social normative feedback through multiple platforms such as apps, or weekly email updates would avoid the costs, materials, and delays associated with postal mail communications.

4.3 Conclusion

The results from the reported field experiment show that personalized normative feedback can successfully influence residential recycling, both for specific and generic referent groups. Importantly, the four levels of tested referent group specificity for the normative feedback did not differ from each other. Despite the type of referent group comparison, households below the norm were more inclined to change their behavior, compared to the control condition. In addition, the inclusion of an injunctive norm helped to combat the potential boomerang effect for households above the norm. From an applied perspective, these findings add to the growing body of literature about normative social influence, and offer a scalable solution to increasing the diversion of waste from landfills.

Supplemental Results

The preceding summary was based on a submission for publication to a special issue of a peer reviewed academic journal. Because it was prepared for a journal submission, the length was constrained, and therefore unable to address several additional aspects of the study. The supplemental material reported below serves as an extension to the above manuscript to meet the thesis requirements for the Psychological Science Master's program.

While the main focus for this research was examining the changes in diversion (defined as changes in residential recycling in relation to the changes in residential trash), this supplemental document provides more detailed analyses by analyzing the results for recycling and trash as separate dependent variables. To maintain consistency with the primary analyses, these supplemental analyses are limited to cases deemed eligible through the modified approach to diversion (see section 3.2), dwelling characteristics, and with the appropriate baseline measures used as covariates. The analyses will mirror the *a priori* planned comparisons reported for diversion in order to test the treatment effects separately for recycling and trash.

As mentioned previously, recycling and trash weights were obtained by conducting 'lid-flips' to visually inspect the contents of each bin. During the visual inspection, research assistants coded each bin for volume, bin type, and bin size. These variables were then used in a regression analysis to predict the weight of the bin's contents (see Section 3.2). Throughout the four-month intervention, the average weight for recycling was 13.81 pounds ($SD = 6.81$) and the average weight for trash was 25.54 pounds ($SD = 15.49$). This reflects the average contents of each bin across all seven weeks of measurement (i.e. weeks 1-4, 7, 11, and 15). Table 4 below displays the average contents of each bin during the four-week baseline period and the single weeks reflecting each of the three follow-up months, respectively.

As shown in Table 4, the overall pattern for recycling weights showed small increases and decreases at each month. Specifically, there was an increase in recycling from baseline to month 1, a similar decrease at month 2, and the largest increase at month 3. For trash weights, Table 4 shows a steady increase in average weight across time. These changes reflect seasonal fluctuations in trash and recycling, but do not directly reflect the impact of the intervention materials.

Table 4

Average Weight of Bin Contents Across Time

	Baseline (weeks 1-4)		Month 1 (week 7)		Month 2 (week 11)		Month 3 (week 15)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Recycling	13.59	7.44	14.11	9.77	13.65	9.35	14.44	10.16
Trash	24.92	16.70	25.75	20.55	26.19	20.19	27.07	22.89

6.1 Recycling Treatment Effects

To examine changes in recycling across conditions and time, a 6 (condition) X 3 (time) repeated measures ANCOVA was conducted with baseline recycling and dwelling characteristics (e.g. household value, number of bedrooms, number of bathrooms, and size) as covariates. Mauchly's test indicated that the assumption of sphericity was not violated (Mauchly's $W = .99$, $p = .076$). The results indicated that baseline recycling ($F(1, 849) = 544.27$, $p < .001$) and household value ($F(1, 849) = 4.25$, $p = .040$) were significant covariates. However, the number of bedrooms ($F(1, 849) = 1.69$, $p = .195$), number of bathrooms ($F(1, 849) = .49$, $p = .485$), and household size ($F(1, 849) = 1.31$, $p = .253$) were not statistically significant. The ANCOVA revealed no significant main effect of time ($F(2, 1698) = .49$, $p = .615$), condition ($F(5, 849) = .64$, $p = .670$), nor a significant time*condition interaction ($F(10, 1698) = .36$, $p = .965$) on residential recycling.

While the omnibus test of the interaction was not statistically significant ($p = .965$),

planned comparisons were used to further investigate differences in recycling across conditions and time. As mentioned in the primary analyses, there was a mailing delay for the delivery of the intervention materials, resulting in month 2 as the primary measure of behavior change. The results from the planned comparisons revealed that none of the feedback conditions, nor the information-only condition, were statistically different from the control across any of the three follow-up measures (Table 5). However, as shown in Table 5, the exemplary and generic conditions were trending in the predicted direction during month 2. Thus, had the households received a second feedback report, it is possible that recycling rates would have reached statistical significance during the three-month follow-up. As evidenced by the decreased effects at month three, these results are consistent with previous literature suggesting the repeated feedback can produce longer lasting changes in behavior.

Table 5

Planned Comparisons of Recycling Across Conditions and Time

				95% Confidence Interval	
		<i>M</i>	<i>SE</i>	<i>Lower</i>	<i>Upper</i>
Control <i>N</i> = 142	Month 1	14.42	0.70	13.05	15.79
	Month 2	13.43	0.70	12.06	14.79
	Month 3	14.54	0.74	13.09	15.99
Flyer <i>N</i> = 145	Month 1	13.57	0.69	12.21	14.92
	Month 2	13.87	0.69	12.52	15.22
	Month 3	14.12	0.73	12.69	15.55
Specific <i>N</i> = 141	Month 1	13.46	0.70	12.08	14.83
	Month 2	13.52	0.70	12.14	14.89
	Month 3	14.07	0.74	12.62	15.52
Exemplary <i>N</i> = 147	Month 1	14.62	0.69	13.27	15.96
	Month 2	14.41	0.69	13.07	15.76
	Month 3	14.32	0.73	12.90	15.74
Generic <i>N</i> = 139	Month 1	14.73	0.70	13.35	16.12
	Month 2	14.28	0.71	12.90	15.66
	Month 3	13.98	0.75	12.51	15.44
Statewide target <i>N</i> = 146	Month 1	13.98	0.69	12.63	15.34
	Month 2	12.87	0.69	11.51	14.22
	Month 3	13.63	0.73	12.20	15.07

To get a closer look at the effects of the social normative feedback messages, the differences in recycling during the primary follow-up measurement and baseline were analyzed. Consistent with the diversion analyses, the increases/decreases from baseline to month 2 were used to compare changes in recycling rates across conditions. A change score was computed for

each household to examine the difference in recycling at month 2, compared to baseline. These change scores were analyzed using two separate ANCOVAs to examine changes in households that received positive feedback reports, and households that received negative feedback reports, in comparison to households in the control condition. The results from these analyses revealed no significant main effect of condition on change in recycling for households that received a positive report, $F(5, 593) = 1.25, p = 0.286$, or for households that received a negative report, $F(5, 957) = 1.89, p = 0.093$. In both analyses, household dwelling characteristics were not significant covariates ($p > .05$). However, the planned comparisons showed significant increases in recycling for households in the specific, generic, and exemplary conditions when a negative feedback report was provided (Figure 4).

Figure 4. Change in recycling from baseline to month 2 for households receiving negative feedback reports, compared to households in the control condition. Error bars represent 95% confidence intervals.

6.2 Trash Treatment Effects

To examine changes in trash production across conditions and time, a 6 (condition) X 3

(time) repeated measures ANCOVA was conducted with baseline trash and dwelling characteristics (e.g. household value, number of bedrooms, number of bathrooms, and size) as covariates. Mauchly's test indicated that the assumption of sphericity was not violated (Mauchly's $W = .99, p = .275$). The results indicated baseline trash ($F(1, 849) = 683.79, p < .001$) as a significant covariate, however, household value ($F(1, 849) = 2.25, p = .134$), number of bedrooms ($F(1, 849) = .11, p = .743$), number of bathrooms ($F(1, 849) = .55, p = .460$), and household size ($F(1, 849) = .74, p = .391$) were not statistically significant. The ANCOVA revealed no significant main effect of time ($F(2, 1698) = 1.04, p = .354$), condition ($F(5, 849) = 1.12, p = .349$), nor a significant time*condition interaction ($F(10, 1698) = .1.59, p = .105$) on residential trash production.

While the omnibus test of the interaction was not statistically significant ($p = .105$), planned comparisons were examined to further investigate differences in trash production across conditions and time. The results revealed that, at month 2 (the primary measure of behavior change) the specific and statewide target social normative messages were significantly different from the control, while the exemplary social comparison approached significance (see Table 6). As shown in Table 6, these effects did not persist over time and at month 3 (the measurement of longer-term impact) none of the normative feedback conditions differed from the control. Note that statistical significance is indicated in Table 6 by comparing the top end of the 95% confidence interval of the control condition with the mean of the treatment conditions at each time point.

Table 6

Planned Comparisons of Trash Production Across Conditions and Time

		<i>M</i>	<i>SE</i>	95% Confidence Interval	
				Lower	Upper
Control <i>N</i> = 142	Month 1	27.54	1.48	24.64	30.44
	Month 2	27.38	1.38	24.68	30.09
	Month 3	27.43	1.57	24.35	30.51
Flyer <i>N</i> = 145	Month 1	23.71*	1.46	20.85	26.57
	Month 2	27.02	1.36	24.35	29.69
	Month 3	23.75*	1.55	20.71	26.80
Specific <i>N</i> = 141	Month 1	24.42*	1.48	21.51	27.32
	Month 2	23.75*	1.38	21.04	26.46
	Month 3	26.75	1.58	23.66	29.85
Exemplary <i>N</i> = 147	Month 1	26.10	1.45	23.26	28.95
	Month 2	24.79 ^a	1.35	22.14	27.45
	Month 3	26.51	1.54	23.48	29.54
Generic <i>N</i> = 139	Month 1	25.96	1.49	23.04	28.89
	Month 2	25.83	1.39	23.10	28.56
	Month 3	29.85	1.59	26.73	32.96
Statewide target <i>N</i> = 146	Month 1	27.68	1.45	24.82	30.53
	Month 2	23.93*	1.36	21.26	26.59
	Month 3	26.70	1.55	23.66	29.73

Note. * $p < .05$, ^a $p < .10$.

Similar to the previous analyses, a change score was computed to examine differences in trash production at month 2 compared to baseline trash production. The change scores were again analyzed by conducting separate ANCOVAs for households that received positive reports and households that received negative reports. The results showed no significant main effect of condition on the change in trash production for households that received a positive feedback report ($F(5, 593) = .75, p = .589$), however, households that received a negative feedback report were significantly different from households in the control condition, $F(5, 957) = 3.06, p = .009$

(Figure 5). In both analyses, dwelling characteristics were not significant covariates ($p > .05$). Specifically, the results display significant decreases in trash production for households in the specific, generic, and statewide target conditions when a negative feedback report was provided (Figure 5). While trash production slightly increased for households that received a negative exemplary social comparison, this increase was significantly less than households in the control condition ($p < .05$).

Figure 5. Change in trash production from baseline to month 2 for households receiving negative feedback reports, compared to households in the control condition. Error bars represent 95% confidence intervals.

Supplemental Discussion

The supplemental material presented below is an extension to the main manuscript, providing more detailed analyses for recycling and trash as separate dependent variables. The results from these additional analyses showed two clear findings: first, the impact of the feedback reports was different across recycling and trash production, and second, the negative feedback reports were more influential than the positive reports.

The first finding was that the social normative feedback messaging had differential impacts on recycling and trash. Specifically, there were no significant changes in recycling behaviors as a result of the feedback reports given. A close look at these results revealed that increases in recycling for the exemplary and generic social comparisons were trending in the predicted direction but failed to reach statistical significance. However, the trash production analyses found that the specific and statewide target social normative comparisons significantly decreased trash production, while the exemplary and generic comparisons trended in the predicted direction. Consistent with the results for diversion rates, the effects of the social normative feedback reports did not persist past the short-term follow-up measure at month 2. This finding is not surprising, as it is consistent with previous literature which suggests that feedback needs to be repeatedly provided in order to produce sustainable changes in behavior.

This discrepancy in the immediate effects of the social comparison messaging highlights the importance of evaluation using diversion rates, as opposed to recycling and trash as separate dependent variables. Recyclable materials are typically lighter in weight, whereas trash materials can be much heavier. Thus, similar changes in the number of recycling and trash items would not necessarily equate to similar changes in weight. However, evaluating the differences in the ratio of these two materials allows for a more realistic comparison of behavior change.

The second finding was that the negative social normative feedback reports were more influential than the positive social normative feedback reports. Specifically, households below the norm of their assigned comparison group were more likely to increase recycling and decrease trash, compared to households above the norm of their comparison group. These findings were consistent with similar analyses for the effects of positive and negative social normative feedback reports on diversion rates.

7.1 Supplemental Conclusion

While the recycling results failed to reach statistical significance, significant changes in the trash results still evidence decreases in waste. In other words, decreases in trash production are just as beneficial as increases in recycling, and are probably more likely to be captured when using a weight-based measurement. Thus, looking at recycling and trash as separate variables can misrepresent the overall changes that are actually occurring. These results provide support for the use of diversion rates as the primary tool for evaluation of a recycling intervention as a way to capture and represent both variables.

References

- Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change*, 23, 1773-1785. [Science Direct "https://doi.org/10.1016/j.gloenvcha.2013.07.029"](https://doi.org/10.1016/j.gloenvcha.2013.07.029)
- Allcott, H. (2011). Social norms and energy conservation. *Public Economics*, 95, 1082-1095. [Science Direct "https://doi.org/10.1016/j.jpubeco.2011.03.003"](https://doi.org/10.1016/j.jpubeco.2011.03.003)
- Berger, J., & Heath, C. (2008). Who drives divergence? Identity signaling, outgroup dissimilarity, and the abandonment of cultural tastes. *Journal of Personality and Social Psychology*, 95(3), 593–607. [American Psychological Association "http://dx.doi.org/10.1037/0022-3514.95.3.593"](http://dx.doi.org/10.1037/0022-3514.95.3.593)
- Bergquist, M., & Nilsson, A. (2016). I saw the sign: Promoting energy conservation via normative prompts. *Journal of Environmental Psychology*, 46, 23-31. [Science Direct "http://dx.doi.org/10.1016/j.jenvp.2016.03.005"](http://dx.doi.org/10.1016/j.jenvp.2016.03.005)
- Bergquist, M., & Nilsson, A. (2018). Using social norms in smart meters: The norm distance effect. *Energy Efficiency*, 11(8), 2101-2109. [Springer link "https://doi.org/10.1007/s12053-018-9709-6"](https://doi.org/10.1007/s12053-018-9709-6)
- Borsari, B., & Carey, K. (2003). Descriptive and injunctive norms in college drinking: A meta-analytic integration. *Journal of Studies on Alcohol*, 64(4), 331–341. [Journal of Studies on Alcohol and Drugs "https://doi.org/10.15288/jsa.2003.64.331"](https://doi.org/10.15288/jsa.2003.64.331)
- Burn, S. M., (1991). Social psychology and the stimulation of recycling behaviors: The block leader approach. *Journal of Applied Social Psychology*, 21(8), 611-629. [Science Direct "https://doi.org/10.1111/j.1559-1816.1991.tb00539.x"](https://doi.org/10.1111/j.1559-1816.1991.tb00539.x)
- Carrico, A.R., Riemer, M., (2011). Motivating energy conservation in the workplace: An

- evaluation of the use of group-level feedback and peer education. *Journal of Environmental Psychology* 31(1), 1–13. [Science Direct](https://doi.org/10.1016/j.jenvp.2010.11.004)
["https://doi.org/10.1016/j.jenvp.2010.11.004"](https://doi.org/10.1016/j.jenvp.2010.11.004)
- Chernoff, R. A., & Davison, G. C. (2005). An evaluation of a brief HIV/AIDS prevention intervention for college students using normative feedback and goal setting. *AIDS Education and Prevention*, 17(2), 91–104. [Guilford Press](https://doi.org/10.1521/aeap.17.3.91.62902)
["https://doi.org/10.1521/aeap.17.3.91.62902"](https://doi.org/10.1521/aeap.17.3.91.62902)
- Christensen, P., Rothgerber, H., Wood, W., & Matz, D. C. (2004). Social norms and identity relevance: A motivational approach to normative behavior. *Personality and Social Psychology Bulletin*, 30(10), 1295-1309. [SAGE Journals](https://doi.org/10.1177/0146167204264480)
["https://doi.org/10.1177/0146167204264480"](https://doi.org/10.1177/0146167204264480)
- Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current directions in psychological science*, 12(4), 105-109. [SAGE Journals](https://doi.org/10.1111/1467-8721.01242)
["https://doi.org/10.1111/1467-8721.01242" h](https://doi.org/10.1111/1467-8721.01242)
- Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., & Winter, P. L. (2006). Managing social norms for persuasive impact. *Social Influence*, 1(1), 3-15. [Taylor & Francis Online](https://doi.org/10.1080/15534510500181459) ["https://doi.org/10.1080/15534510500181459"](https://doi.org/10.1080/15534510500181459)
- Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annu. Rev. Psychol.*, 55, 591-621. [Annual Reviews](https://doi.org/10.1146/annurev.psych.55.090902.142015)
["https://doi.org/10.1146/annurev.psych.55.090902.142015"](https://doi.org/10.1146/annurev.psych.55.090902.142015)
- Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (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. [American Psychological Association](https://doi.org/10.1037/0022-3514.58.6.1015)

["http://dx.doi.org/10.1037/0022-3514.58.6.1015"](http://dx.doi.org/10.1037/0022-3514.58.6.1015)

Crocker, H., Whitaker, K. L., Cooke, L., & Wardle, J. (2009). Do social norms affect intended food choice? *Preventive Medicine*, 49(2-3), 190–193.

[Science Direct "https://doi.org/10.1016/j.ypmed.2009.07.006"](https://doi.org/10.1016/j.ypmed.2009.07.006)

Dai, Y. C., Gordon, M. P. R., Ye, J. Y., Xu, D. Y., Lin, Z. Y., Robinson, N. K. L., . . . Harder, M. K. (2015). Why doorstep recycling can increase household waste recycling. *Resources, Conservation and Recycling*, 102, 9-19.

[Science Direct](https://doi.org/10.1016/j.resconrec.2015.06.004)

["https://doi.org/10.1016/j.resconrec.2015.06.004"](https://doi.org/10.1016/j.resconrec.2015.06.004)

DeDominicis, S., Sokoloski, R., Jaeger, C. M., & Schultz, P. W. (2019). Making the smart meter social promotes long-term energy conservation. *Palgrave Communications*, 5(1), 51.

[Nature.com Palgrave Communications "https://doi.org/10.1057/s41599-019-0254-5"](https://doi.org/10.1057/s41599-019-0254-5)

De Leon, I. G., & Fuqua, R. W. (1995). Effects of public commitment and feedback on curbside recycling. *Environment and Behavior*, 27(2), 233-250.

[SAGE Journals](https://doi.org/10.1177/0013916595272007)

["https://doi.org/10.1177/0013916595272007"](https://doi.org/10.1177/0013916595272007)

Dolan, P., & Metcalfe, R. (2015). Neighbors, knowledge, and nuggets: Two natural field experiments on the role of incentives on energy conservation. Becker Friedman Institute for Research in Economics Working Paper, (2589269).

[SSRN](http://dx.doi.org/10.2139/ssrn.2589269)

["http://dx.doi.org/10.2139/ssrn.2589269"](http://dx.doi.org/10.2139/ssrn.2589269)

Dupré, M., & Meineri, S. (2016). Increasing recycling through displaying feedback and social comparative feedback. *Journal of Environmental Psychology*, 48, 101-107.

[Science](https://doi.org/10.1016/j.jenvp.2016.07.004)

[Direct "https://doi.org/10.1016/j.jenvp.2016.07.004"](https://doi.org/10.1016/j.jenvp.2016.07.004)

Dwyer, P. C., Maki, A., & Rothman, A. J. (2015). Promoting energy conservation behavior in public settings: The influence of social norms and personal responsibility. *Journal of*

- Environmental Psychology*, 41, 30-34. [Science Direct](#)
["https://doi.org/10.1016/j.jenvp.2014.11.002"](https://doi.org/10.1016/j.jenvp.2014.11.002)
- Environmental Protection Agency. (2018). National overview: Facts and figures on materials, wastes, and recycling. Retrieved, August 21, 2019, from [EPA.gov](#)
["https://www.epa.gov/facts-andfigures-about-materials-waste-and-recycling"](https://www.epa.gov/facts-andfigures-about-materials-waste-and-recycling)
- Festinger, L.A. (1954). A theory of social comparison processes. *Human Relations*, 7(2), 117–140. [Sage Journals](#) ["https://doi.org/10.1177/001872675400700202"](https://doi.org/10.1177/001872675400700202)
- Fornara, F., Carrus, G., Passafaro, P., & Bonnes, M. (2011). Distinguishing the sources of normative influence on proenvironmental behaviors: The role of local norms in household waste recycling. *Group Processes & Intergroup Relations*, 14(5), 623-635. [SAGE Journals](#) ["https://doi.org/10.1177/1368430211408149"](https://doi.org/10.1177/1368430211408149)
- Graffeo, M., Ritov, I., Bonini, N., & Hadjichristidis, C. (2015). To make people save energy tell them what others do but also who they are: A preliminary study. *Frontiers in Psychology*, 6, 1287. [frontiers in Psychology](#) ["https://doi.org/10.3389/fpsyg.2015.01287"](https://doi.org/10.3389/fpsyg.2015.01287)
- Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research*, 35(3), 472-482. [Journal of Consumer Research](#)
["https://doi.org/10.1086/586910"](https://doi.org/10.1086/586910)
- Jaeger, C. M., & Schultz, P. W. (2017). Coupling social norms and commitments: Testing the underdetected nature of social influence. *Journal of Environmental Psychology*, 51, 199-208. [Science Direct](#) ["https://doi.org/10.1016/j.jenvp.2017.03.015"](https://doi.org/10.1016/j.jenvp.2017.03.015)
- Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A focus theory of normative conduct: When norms do and do not affect behavior. *Personality and social psychology*

- bulletin*, 26(8), 1002-1012. [SAGE Journals](#)
["https://doi.org/10.1177/01461672002610009"](https://doi.org/10.1177/01461672002610009)
- Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. (2018). What a waste 2.0: A global snapshot of solid waste management to 2050. World Bank Publications.
[World bank Group elibrary](#) ["https://doi.org/10.1596/978-1-4648-1329-0"](https://doi.org/10.1596/978-1-4648-1329-0)
- Kurz, T., Donaghue, N., & Walker, I. (2005). Utilizing a social-ecological framework to promote water and energy conservation: A field experiment 1. *Applied Social Psychology*, 35(6), 1281-1300. [Wiley Online Library](#) ["https://doi.org/10.1111/j.1559-1816.2005.tb02171.x"](https://doi.org/10.1111/j.1559-1816.2005.tb02171.x)
- Lewis, M. A., & Neighbors, C. (2007). Optimizing personalized normative feedback: The use of gender-specific referents. *Journal of Studies on Alcohol and Drugs*, 68(2), 228–237. [Journal of Studies on Alcohol and Drugs](#) ["https://doi.org/10.15288/jsad.2007.68.228"](https://doi.org/10.15288/jsad.2007.68.228)
- Neighbors, C., LaBrie, J. W., Hummer, J. F., Lewis, M. A., Lee, C. M., Desai, S., & ... Larimer, M. E. (2010). Group identification as a moderator of the relationship between perceived social norms and alcohol consumption. *Psychology of Addictive Behaviors*, 24(3), 522-528. [American Psychological Association](#)
["https://doi.org/10.1037/a0019944"](https://doi.org/10.1037/a0019944)
- Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and social psychology bulletin*, 34(7), 913-923. [Sage Journal](#) ["https://doi.org/10.1177/0146167208316691"](https://doi.org/10.1177/0146167208316691)
- Nomura, H., John, P. C., & Cotterill, S. (2011). The use of feedback to enhance environmental outcomes: A randomized controlled trial of a food waste scheme. *Local Environment*, 16(7), 637-653. [Taylor & Francis Online](#)
["https://doi.org/10.1080/13549839.2011.586026"](https://doi.org/10.1080/13549839.2011.586026)

- Osbaldiston, R., & Schott, J. P. (2012). Environmental sustainability and behavioral science: Meta-analysis of proenvironmental behavior experiments. *Environment and Behavior*, 44(2), 257-299. [SAGE Journals "https://doi.org/10.1177/0013916511402673"](https://doi.org/10.1177/0013916511402673)
- Reed, M. B., Lange, J. E., Ketchie, J. M., & Clapp, J. D. (2007). The relationship between social identity, normative information, and college student drinking. *Social Influence*, 2(4), 269-294. [Taylor & Francis Online "https://doi.org/10.1080/15534510701476617"](https://doi.org/10.1080/15534510701476617)
- Reno, R. R., Cialdini, R. B., & Kallgren, C. A. (1993). The transsituational influence of social norms. *Journal of Personality and Social Psychology*, 64(1), 104-112. [American Psychological Association "http://dx.doi.org/ 10.1037/0022-3514.64.1.104"](http://dx.doi.org/10.1037/0022-3514.64.1.104)
- Richetin, J., Perugini, M., Mondini, D., & Hurling, R. (2016). Conserving water while washing hands: The immediate and durable impacts of descriptive norms. *Environment and Behavior*, 48(2), 343-364. [SAGE Journal "https://doi.org/10.1177/0013916514543683"](https://doi.org/10.1177/0013916514543683)
- Schultz, P. W. (1999). Changing behavior with normative feedback interventions: A field experiment on curbside recycling. *Basic and Applied Social Psychology*, 21, 25-36. [Taylor & Francis Online "https://doi.org/10.1207/s15324834basp2101_3"](https://doi.org/10.1207/s15324834basp2101_3)
- Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In *Psychology of sustainable development* (pp. 61-78). Springer, Boston, MA.
- Schultz, P. W. (2019). Social comparison as a tool to promote residential water conservation. *Frontiers in Water*, 1, 2. [Frontiers in Water "https://doi.org/10.3389/frwa.2019.00002"](https://doi.org/10.3389/frwa.2019.00002)
- Schultz, P. W., Estrada, M., Schmitt, J., Sokoloski, R. & Silva-Send, N. (2015). Using in-home displays to provide smart meter feedback about household electricity consumption: A randomized control trial comparing kilowatts, cost, and social norms. *Energy*, 90, 351–358. [Science Direct "https://doi.org/10.1016/j.energy.2015.06.130"](https://doi.org/10.1016/j.energy.2015.06.130)

- Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, 18(5), 429-433. [SAGE Journal "https://doi.org/10.1111/j.1467-9280.2007.01917.x"](https://doi.org/10.1111/j.1467-9280.2007.01917.x)
- Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2018). The constructive, destructive, and reconstructive power of social norms: Reprise. *Perspectives on psychological science*, 13(2), 249-254. [SAGE Journal "https://doi.org/10.1177/1745691617693325"](https://doi.org/10.1177/1745691617693325)
- Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, 15(2), 105-121. [Science Direct "https://doi.org/10.1016/0272-4944\(95\)90019-5"](https://doi.org/10.1016/0272-4944(95)90019-5)
- Schultz, P. W., Tabanico, J., & Rendón, T. (2008). Normative beliefs as agents of influence: Basic processes and real-world applications. *Attitudes and attitude change*, 385-409.
- Shearer, L., Gatersleben, B., Morse, S., Smyth, M., & Hunt, S. (2017). A problem unstuck? Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour. *Waste Management*, 60, 164-172. [Science Direct "http://dx.doi.org/10.1016/j.wasman.2016.09.036"](http://dx.doi.org/10.1016/j.wasman.2016.09.036)
- Sparkman, G., & Walton, G. M. (2017). Dynamic norms promote sustainable behavior, even if it is counternormative. *Psychological Science*, 28(11), 1663-1674. [SAGE Journals "https://doi.org/10.1177/0956797617719950"](https://doi.org/10.1177/0956797617719950)
- Stok, F. M., Ridder, D. T., Vet, E., & Wit, J. B. (2014). Don't tell me what I should do, but what others do: The influence of descriptive and injunctive peer norms on fruit consumption in adolescents. *British Journal of Health Psychology*, 19(1), 52-64.

[Wiley Online Library "https://doi.org/10.1111/bjhp.12030"](https://doi.org/10.1111/bjhp.12030)

U.S. Census Bureau (2018). QuickFacts. Solana Beach city, California. Retrieved August 21,

2019, from [US Census Bureau](https://www.census.gov/quickfacts/fact/table/solanabeachcitycalifornia,US/PST045218)

["https://www.census.gov/quickfacts/fact/table/solanabeachcitycalifornia,US/](https://www.census.gov/quickfacts/fact/table/solanabeachcitycalifornia,US/PST045218)

[PST045218"](https://www.census.gov/quickfacts/fact/table/solanabeachcitycalifornia,US/PST045218)

Varotto, A., & Spagnolli, A. (2017). Psychological strategies to promote household recycling. A

systematic review with meta-analysis of validated field interventions. *Journal of*

Environmental Psychology, 51, 168-188. [Science Direct](https://doi.org/10.1016/j.jenvp.2017.03.011)

["https://doi.org/10.1016/j.jenvp.2017.03.011"](https://doi.org/10.1016/j.jenvp.2017.03.011)

Werch, C. E., Pappas, D. M., Carlson, J. M., DiClemente, C. C., Chally, P. S., & Snider, J. A.

(2000). Results of a social norm intervention to prevent binge drinking among first-year

residential college students. *Journal of American College Health*, 49, 85-92. [Taylor &](https://doi.org/10.1080/07448480009596288)

[Francis Online "https://doi.org/10.1080/07448480009596288"](https://doi.org/10.1080/07448480009596288)

Appendix A.1

Personalized Home Waste and Recycling Feedback Report (front)

Recycling & Waste Report

Report Period: March, 2019

Current Resident
(ADDRESS)
Solana Beach, CA 92075

During the past month, your household recycled 60% of your trash. Other similar households in Solana Beach recycled 30% of their trash. Your household recycled more and sent less to the landfill compared to other similar households in your neighborhood.

* See backside for a definition of similar households

We Want Your:

This report is printed on 100% recycled paper

Appendix A.2

Personalized Home Waste and Recycling Feedback Report (back)

Your Weekly Average

Tips to Reduce Household Waste

- ♻️ Buy products with recyclable packaging
- ♻️ Precycle by using reusable products
- ♻️ Buy in Bulk

Comments or Questions?

phone: (760) 750-3022
email: info@trackingtrash.com

How Do **You** Stack Up?

$$\frac{\text{Total pounds of recycling}}{\text{Total recycling} + \text{total waste}} = \frac{60.0}{100.0} = 60\%$$

* Other similar households are all single-family households in Solana Beach that are serviced by EDCO's curbside recycling program on the same day as you.

Appendix B

Recycling Contamination Flyer

Help Reduce Recycling Contamination

We all know how important recycling is to our community and environment, but keeping it free from contamination is also an essential element to having successful recycling programs. Contamination happens when non-recyclable items or trash are mixed in with recyclable items. Too much contamination can potentially ruin a whole load of recyclable material and be counterproductive to your recycling efforts.

Knowing what can be recycled is a significant step towards reducing contamination in recycling carts. Below is a list of many acceptable items in EDCO's recycling program. Keeping trash and other non-recyclable items out of recycling carts is another important step. If possible, you should never isolate recycling containers. By setting recycling containers and trash containers side-by-side throughout your home, you reduce the risk of recycling contamination. Having recycling containers without a readily available trash container might lead others to throw trash in with the recycling.

CARTON CONTAINERS:

Aseptic cartons, including milk cartons and juice boxes, half-gallon juice cartons, soup/broth cartons, and wine cartons.

These items go inside EDCO's blue commingled recycling carts!

CARDBOARD:

Cardboard, including boxes used for moving and shipping or any other box or packaging made of corrugated cardboard.

ALUMINUM:

Clean aluminum foil, clean aluminum trays, and pie tins.

GLASS CONTAINERS:

Glass containers including food jars and beverage bottles.

MIXED PAPER:

Mixed paper, including junk mail, catalogs, telephone books, magazines, newspaper, and paper used for computer printing.

SHREDDED PAPER:

Shredded paper (placed in a sealed, labeled paper bag for easier handling).

PAPERBOARD:

Paperboard boxes such as cereal boxes, tissue boxes, refrigerated food boxes, boxes from toiletries, and soda/beer cases.

#1 - #7 PLASTICS:

All plastic containers, lids, and packaging with a recycling symbol of #1-7 (*all containers accepted with caps and lids*): water and soda bottles, peanut butter and other food jars, mouthwash bottles, vegetable oil containers, ovenable food trays, milk jugs, juice bottles, shampoo and conditioner bottles, detergent & bleach containers, condiment bottles, medicine bottles, bottle caps, butter and yogurt tubs, CD cases, baby bottles, 3-gallon water bottles, CDs, medical storage containers, and rigid plastics such as 5-gallon buckets.

STYROFOAM:

Clean foam cups, meat trays, plates, egg cartons, block packaging, rigid polystyrene, and carry-out containers.

ALUMINUM:

Aluminum, steel & tin cans, such as food and beverage cans for soda, soup, beer, beans, fruit, and vegetables.

****All food and beverage containers do not require rinsing as long as they are empty and free of food and liquids.***

Did you know? Residential customers can receive additional blue recycling carts at **NO ADDITIONAL COST!** Call our office or **order fast and easy online** at edcodisposal.com through the Contact EDCO tab, after entering your zip code, to request additional recycling carts.

Family Owned & Operated
EDCO

Website:
edcodisposal.com

"We'll Take Care of It"

Text to flyer

Help Reduce Recycling Contamination

We all know how important recycling is to our community and environment, but keeping it free from contamination is also an essential element to having successful recycling programs. Contamination happens when non-recyclable items or trash are mixed in with recyclable items. Too much contamination can potentially ruin a whole load of recyclable material and be counterproductive to your recycling efforts.

Knowing what can be recycled is a significant step towards reducing contamination in recycling carts. Below is a list of many acceptable items in EDCO's recycling program. Keeping trash and other non-recyclable items out of recycling carts is another important step. If possible, you should never isolate recycling containers. By setting recycling containers and trash containers side-by-side throughout your home, you reduce the risk of recycling contamination. Having recycling containers without a readily available trash container might lead others to throw trash in with the recycling.

RECYCLE

These items go inside EDCO's blue commingled recycling carts!

CARTON CONTAINERS:

Aseptic cartons, including milk cartons and juice boxes, half-gallon juice cartons, soup/broth cartons, and wine cartons.

ALUMINUM: clean aluminum foil, clean aluminum trays, and pie tins.

GLASS CONTAINERS: Glass containers including food jars and beverage bottles.

CARDBOARD: Cardboard, including boxes used for moving and shipping or any other box or packaging made of corrugated cardboard.

MIXED PAPER: Mixed paper, including junk mail, catalogs, telephone books, magazines, newspaper, and paper used for computer printing.

SHREDDED PAPER: Shredded paper (placed in a sealed, labeled paper bag for easier handling).

PAPERBOARD: Paperboard boxes such as cereal boxes, tissue boxes, refrigerated food boxes, boxes from toiletries, and soda/beer cases.

STYROFOAM: clean foam cups, meat trays, plates, egg cartons, block packaging, rigid polystyrene, and carry-out containers.

ALUMINUM: Aluminum, steel & tin cans, such as food and beverage cans for soda, soup, beer, beans, fruit, and vegetables.

#1 - #7 PLASTICS: All plastic containers, lids, and packaging with a recycling symbol of #1-7 (all containers accepted with caps and lids): water and soda bottles, peanut butter and other food jars, mouthwash bottles, vegetable oil containers, ovenable food trays, milk jugs, juice bottles, shampoo and conditioner bottles, detergent & bleach containers, condiment bottles, medicine bottles, bottle caps, butter and yogurt tubs, CD cases, baby bottles, 3-gallon water bottles, CDs, medical storage containers, and rigid plastics such as 5-gallon buckets.

**All food and beverage containers do not require rinsing as long as they are empty and free of food and liquids*

Did you know? Residential customers can receive additional blue recycling carts at **NO ADDITIONAL COST!** Call our office or *order fast and easy online* at edcodisposal.com through the Contact EDCO tab, after entering your zip code, to request additional recycling carts.

Family owned & operated EDCO

Website : edcodisposal.com

"We will take care of It"

Appendix C

California State University
SAN MARCOS

Exempt Review Application Form

Instructions:

Please fill out this application form using clear language and lay terms. Please answer each section as completely and as concisely as possible. Some questions may not apply to your study. In that case, please add "not applicable" in the text box. Please upload this application form along with additional documents that are supplemental (as applicable) to your submission in IRBNet. For more information, please visit the IRB website. For questions, please contact IRB office at (760) 750-4029 or irb@csusm.edu.

Project
Title

Using Feedback to Increase Residential Recycling

Proposed Start Date March 4th, 2019

Faculty/Staff Investigator:

Name

Department/College

Phone Number

E-mail:

Date CITI Training Completed

Student Investigator: *(if the student is the principal investigator)*

Name

Samantha Mertens

Department/College

Psychology, CHABBS

Phone Number

(760) 521-4648

E-mail:

merte001@cougars.csusm.edu

Date CITI Training Completed

06-30-2017

Faculty Advisor Name

P. Wesley Schultz

Department/College

Psychology, CHABBS

Phone Number

(760) 750-8045

E-mail:

wschultz@csusm.edu

Date CITI Training Completed

07-05-2017

REMINDER: Once the student investigator has completed this application form, he or she must e-mail it to their faculty advisor for review and feedback. Once the faculty advisor gives permission to the student to move forward, then the student will upload this application form along with additional documents to IRBNet. Once the student uploads all the documents, then s/he will share the IRBNet package with the faculty advisor. The faculty advisor must have an IRBNet account to approve the package as the "advisor" by logging into IRBNet. The faculty advisor will receive a notification via e-mail that the package has been shared with them and that they need to sign the package in IRBNet. For more information on how to share a package in IRBNet, please visit the IRB website.

Checklist: Check the additional documents that are uploaded in IRBNet. Check ALL that apply:

- ☒ CITI Training Certificate for the principal investigator and the faculty advisor, if applicable.
- ☐ Letter of support (if you are collecting data off campus, you need to provide a letter of support from the research site. The letter of support must include the letterhead of the organization and list the research activities to provide evidence that the organization is knowledgeable about the study).
- ☐ Survey(s), questionnaire(s), and/or interview questions. If you are using an online survey, please upload a PDF copy of the survey.
- ☐ Ed.D Students in the Joint Doctoral Program Only: Sign, scan, and upload the UCSD-CSUSM JDP IRB Cover Sheet in IRBNet.

A. Exempt Review Categories: The following categories of research are currently approved for exemption. Please check the relevant exemption category/categories for your study.	
☐	Category 1. Research conducted in established or commonly accepted educational settings , that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, research on the effectiveness of the comparison among instructional techniques, curricular, or classroom management methods.
☐	Category 2. Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) IF (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects AND (ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation.
☒	Category 3. Research involving benign behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection IF (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects AND (ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation.
☐	Category 4. Secondary research (study of existing data including documents, records, or biospecimens) for which consent is not required; AND IF (i) The identifiable private information or identifiable biospecimens are publicly available; OR (ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects; OR (iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated for the purposes of "health care operations" or "research" or for "public health activities and purposes;" OR (iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for non-research activities.
☐	Category 5. Research and demonstration projects which are conducted by or subject to the approval of appropriate Federal Department of Agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; OR (ii) procedures for obtaining benefits or services under those programs; OR (iii) possible changes in or alternatives to those programs or procedures; OR (iv) possible changes in methods or levels of payment for benefits or services under those programs.
☐	Category 6. Taste and food quality evaluation and consumer acceptance studies if the food has been found to be safe by the FDA or other food safety agency.

B. Please answer the following questions about your research study.	
☐ Yes ☒ No	My research participants belong to a vulnerable population (e.g. children under 18 years of age if studied outside a normal classroom setting, prisoners, or any other vulnerable population.)
☐ Yes ☒ No	I will record data from participants in such a way that their identity can be readily ascertained, directly or through identifiers linked to the participants AND any disclosure of participants' data outside of the research could be damaging to them or place them at risk of criminal or civil liability, be socially stigmatizing, or influence employability, financial standing, insurability, access to services, educational advancement, or reputation.
☐ Yes ☒ No	My research participants will experience some physical, emotional, or mental stress, discomfort, or harm .
☐ Yes ☒ No	My research involves secondary research where broad consent from research participants will be or has been obtained for collecting, storing, and maintaining identifiable private information or identifiable biospecimens (e.g. saliva, urine, blood, etc.)
☐ Yes ☒ No	My research involves the deception of participants (meaning participants are not provided with or mislead about the purpose of the research study in the beginning of the study) AND participants will not be prospectively agreeing to participant in a study that contains deception.

If you answered 'yes' to any of the above questions, you need to fill out a limited/expedited or full review application.

If you answered 'no' to ALL questions in Section B AND your research study fits within at least one of the exempt categories in Section A, then proceed to answer the following questions about your research study. Please answer each question thoughtfully.

1. Describe the nature and purpose of your research study, including the significance of your research project and your research questions, and how your study will attempt to answer it. Please include three citations in your description. Do not include methodology in this section.

Previous research has tested the role of normative feedback in promoting household energy conservation and water conservation (Schultz, Estrada, Giermet, Sokolowski, & Silva-Bend, 2015; Jaeger & Schultz, 2017; De Dominicis et al., 2015). The results of these studies have shown that providing factual information is generally not sufficient to promote conservation, but that providing feedback with a socially-meaningful comparison can help to promote conservation. Some new research has begun to extend these findings into recycling behavior, and to develop scalable approaches that can be integrated into weekly waste collection activities through trash haulers. Using basic principles of normative messaging, social psychologists have aimed to decrease the amount of waste being produced and increase the amount of residential and industrial recycling in order to preserve resources and reduce pollution (for a review see Yoniss & Spangrud, 2017; Schultz, 1999).

Research suggests normative feedback can be an effective strategy when considering the underlying factors that promote the change in behavior (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007; Schultz et al., 2015; De Dominicis et al., 2015; Schultz, 1999; Jaeger & Schultz, 2017). However, booming effect

2. Provide a step-by-step explanation of your research activities that involve human subjects including data collection methods and how you will store the data you plan to collect. Be thorough. You must provide enough detail so that the IRB can determine that your research qualifies for exemption.

Eleven days after the mailing of the initial postcards, the student researcher and research assistants will begin collecting recycling and trash data as a baseline measurement from households who have not opted out of the study. Measurement systems installed on the trash and recycling trucks will record the weight of the bins as they are being collected. Additionally, the student researcher and trained research assistants will measure the volume and contamination of each bin. Data will only be obtained for bins that are placed at the curb for collection, and the research team will not come onto private property. In teams of two, members of the research team will lift the lid of each bin to determine a volume estimate and take photos of the contents to code for contamination. Data will be collected for 17 consecutive weeks.

3. For research conducted in established educational settings, please state HOW the research activity (not the instructional material) is a "Normal Educational Practice."

N/A

4. For secondary research using biospecimens for which consent is not required, please explain how the identifiable biospecimens are publicly available or data recorded by the researcher such that it is anonymous. Additionally, explain where and how the data is stored and will be disposed.

N/A

5. Describe the participants that will be involved in your research. How will you be selecting/recruiting your population? Will anyone be excluded from participating? If you have multiple participant groups such as students and teachers or children and parents, please describe each population.

Single-family homes within Solana Beach, California will be identified by using online public information (e.g., real estate websites, mapping websites) to determine eligibility. A postcard (Appendix A) will be sent to participants informing them of their selection for the study, and contact information for them to opt-out of the study if desired. Households that do not opt-out will be included in the study.

6. How many participants will be involved in your research? Provide a quantity for each population group.

1,000,000

7. Are you employed at the research site where you plan to collect data? ☐ Yes ☒ No

8. Briefly outline the principal investigator's qualifications and experiences related to the research study.

Samantha Mertens is a second year masters student at CSUSM. She received her B.A. in Psychology from CSUSM. She has completed CITI training for research with human subjects, and has worked on other research projects here at CSUSM.

9. If the principal investigator is a student, include faculty advisor's qualifications.

Dr. Wesley Schultz is currently a professor of Psychology and Dean of Graduate studies at CSUSM. He has an M.A. in experimental psychology and a Ph.D. in social psychology, both from accredited Universities. He has been awarded grants from both private and public sources and has conducted a sizable amount of research on topics of water conservation, recycling, energy conservation, and other issues related to the environment through the use of social psychological principals.

10. If using student or research assistants, please explain how you will ensure that these assistants are trained and qualified to assist the project including obtaining consent forms and collecting data. All assistants must complete the CITI training before starting to work on the project. It is the faculty member's responsibility to keep a copy of student assistants' CITI training certificate on their record.

All research assistants involved in this project will receive extensive training on the data collection process and will be fully prepared to interact with participants, when approached, while collecting data. Further, all research assistants will be required to complete CITI certification on protection of human participants in research prior to the study and will be required to present a copy of their completion form.

11. **For Student Principal Investigators Only:** Please check the box below to verify that you will share your package and obtain your faculty advisor's signature in IRBNet:

☒ I verify that I will share my package with my faculty advisor in IRBNet after I upload this application and other materials, but *before* submitting the package for review.

12. Is this project funded externally? ☐ Yes ☒ No
If Yes, please provide the name of the funder:

IRB Application Modification

1. Eleven days after the mailing of the initial postcards, the student researcher and research assistants will begin collecting recycling and trash data as a baseline measurement from households who have not opted out of the study. Measurement systems installed on the trash and recycling trucks will record the weight of the bins as they are being collected. Additionally, the student researcher and trained research assistants will measure the volume and contamination of each bin. Data will only be obtained for bins that are placed at the curb for collection, and the research team will not come onto private property. In teams of two, members of the research team will lift the lid of each bin to determine a volume estimate and take photos of the contents to code for contamination. Data will be collected for 17 consecutive weeks.

Data collected by members of the research team (volume estimates and contamination ratings) will be stored on a password protected computer and hard copies will remain in a locked filing cabinet behind two locked doors in the research lab. Data collected by the measurement systems installed on the trucks will be securely transferred through a cloud database and stored on a password protected computer, behind two locked doors to the research lab. Files will also be void of identifying information. If a person were to gain access to the computer the data would be in an unrecognizable encrypted format. If they were able to get past the encryption only addresses will be available, no names.

Intervention timeline:

February 20th, 2019: Prenotification postcards (Appendix A) will be mailed to all potential participants.

March 4th-29th, 2019: Recycling and trash data will be collected.

March 30th, 2019: Personalized communications (Appendix B & C) will be mailed to households. April 1st-30th, 2019: Recycling and trash data will be collected.

May 1st, 2019: Personalized communications will be mailed to households.

May 1st-June 1st, 2019: Recycling and trash data will be collected.

June 3rd, 2019: Personalized communications will be mailed to households.

June 3rd-28th, 2019: Recycling and trash data will be collected.

July 1st, 2019: Debriefing postcards (Appendix D) will be sent to all households.

This timeline represents the protocol for the initial study in Solana Beach and a similar timeline will be used for other related studies.