Enhancing recycling behavior intention in student dormitories applying the extended Theory of Planned Behavior

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Abstract

Increased waste generation has been an alarming consequence of our linear economic system worldwide (Stahel, 2016). The circular economy may offer a solution for reintroducing waste into the production cycle, and recycling is one strategy to achieve this goal (Pearce & Turner, 1989). The municipality of Groningen is an example for implementing circular waste management systems with the aim of becoming waste-free by 2030 (OECD, 2020). In line with this goal, this paper investigated which persuasive messages had a positive effect on recycling intention in student dormitories. The extended Theory of Planned Behavior with perceived moral obligation and descriptive social norms (Largo-Wight et al., 2012; White et al., 2009) was applied as the theoretical framework. It was hypothesized that students who were presented with moral obligation posters and descriptive norms posters would have a higher level of recycling intention than those in the control condition. The analyses yielded unexpected results, with the recycling intention in the control condition being the highest, indicating a significant counter effect. The discussion includes possible explanations for these findings as well as limitations of the study. To investigate these contradictory results and to overcome the study's limitations, future research is needed.

Key words: recycling intention, Theory of Planned Behavior, perceived moral obligation, descriptive norms

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The amount of waste generated worldwide has been increasing and is estimated to reach 3.40 billion tonnes by 2050 (Kaza et al., 2018). This increase is due to various factors, such as population growth, urbanization, modernization, industrial manufacturing (Alam & Ahmade, 2013), and the current linear economic system, which follows the principle of „make-use-dispose" (Stahel, 2016). The generation and disposal of waste are concerning because they contribute to the depletion of finite natural resources (Sariatli, 2017). Furthermore, they have a significant negative impact on the environment and human health (Elagroudy et al., 2016) and contribute to climate change (UNEP, 2015). Waste disposal on landfills and through incineration can lead to contamination of water resources, soil, and air (El-Fadel et al., 1997; Sabbas et al., 2003; Vaverková, 2020). Additionally, they are responsible for 5% of global greenhouse gas emissions, which are a significant contributor to climate change (UNEP, 2015).

In order to address issues related to linear economy and conventional waste management practices, the concept of Circular Economy (CE) has been introduced (Pearce & Turner, 1989). The objective of CE is to establish an economic system where products that are no longer in use become resources for new ones, creating a closed loop in industrial production that can contribute to the reduction of waste (Stahel, 2016) and greenhouse gas emissions (Wijkman & Skånberg, 2015). The European Union (EU) has supported CE through the development of the Circular Economy Action Plan (CEAP, 2020). This plan aims to help the EU achieve its climate neutrality goal by 2050. It requires municipalities in the EU to adapt to sustainable goals, including sustainable waste management regimes (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives). The municipality of Groningen in the Netherlands is an

example of the transformation of a circular waste management system, with the aim of achieving waste neutrality by 2030 (OECD, 2020). One of the instruments for reaching this goal is the implementation of recycling regimes, which are the most commonly applied circular strategies in the EU (Mhatre et al., 2021).

Recycling can be defined as the process in which used materials are collected, sorted, processed, remanufactured and reused (Mhatre et al., 2021; Ruiz,1993, as cited in Schultz et al., 1999). It has several benefits, including conserving natural resources such as primary raw materials, saving energy, and reducing emissions and pollution resulting from waste disposal strategies (Pietzsch et al., 2017; UNEP, 2015; Zaman, 2016; Zaman & Lehmann, 2011).

Effective recycling systems rely not only on technological innovations and facilities but also on waste separation at the source (UNEP, 2015). The separation of different types of waste at the source ensures that they remain clean and uncontaminated by other waste streams, and prevents materials from being cross-contaminated which can lead to a loss of recyclability (UNEP, 2015). People's commitment to waste separation at the source, also referred to as recycling behavior, is necessary for the successful implementation of waste separation programs (Hoornweg & Bhada-Tata, 2012; Kelly et al., 2006; UNEP, 2015; Varotto & Spagnolli, 2017; Zaman & Lehmann, 2011).

Recycling behavior

Three theoretical frameworks are commonly applied in the research of recycling behavior and its determinants: the Theory of Planned Behavior (TPB, Ajzen, 1985), the Norm Activation Model (NAM, Schwartz, 1977), and the Value-Belief-Norms Theory (VBN, Stern, 2000). The NAM and the VBN both aim to explain prosocial behavior, which is defined as "any action that benefits another" (Schroeder & Graziano, 2015, p.5). Many pro-environmental behaviors, including recycling behavior can be considered as prosocial behaviors because they require effort from the individual while benefiting the public interest

(Wang et al., 2019). Furthermore, engaging in prosocial behavior involves considering what is morally right to do in a given situation (Schwartz, 1977; Steg & De Groot, 2019). The NAM (Schwartz, 1977) posits that activated personal norms directly predict pro-environmental behavior. Personal norms are determined by the activation of problem awareness, ascription of responsibility, outcome efficacy, and self-efficacy (Steg & De Groot, 2019). The VBN extends the NAM by including values and ecological worldviews as determinants of problem awareness (Stern, 2000).

In order to explain pro-environmental behavior, a few studies have compared the Theory of Planned Behavior (TPB), which will be explained in detail in the next section, with either the NAM or the VBN. (Aguilar-Luzón et al., 2012; Chaisamrej & Zimmerman, 2014; Kaiser et al., 2005; Thøgersen, 1996). These studies suggest that the TPB model is a better fit for explaining recycling intention and behavior than the NAM and the VBN model. Specifically, Aguilar-Luzón et al. (2012) found that the TPB model better predicted Spanish housewives' intention and behavior towards glass recycling compared to the VBN model. Kaiser et al. (2005) reached a similar conclusion regarding conservation behavior. In a comparison of TPB and NAM, Chaisamrej and Zimmerman (2014) found that students' paper recycling behavior was better predicted by the TPB than the NAM. Although the literature lacks systematic research on which theory is most sufficient in explaining pro-environmental (and recycling) behavior (Steg & De Groot, 2019), the above findings suggest the application of the Theory of Planned Behavior as the theoretical framework for current research over NAM and VBN.

The Theory of Planned Behavior

According to the TPB, individuals make reasoned decisions about engaging in a behavior by weighing its costs and benefits (Ajzen, 1985). The primary determinant of behavior is intention, or the plan to perform the behavior. White et al. (2009) found a

significant positive correlation between households' intention to recycle and their actual recycling behavior. Empirical evidence has shown a positive correlation between intention and behavior, with a range of .45 to .62, as reported in meta-analyses by Fishbein and Ajzen (2011).

Ajzen (1985) identifies three factors that determine intention: attitudes, perceived behavioral control, and subjective norms. *Attitudes* reflect an individual's positive or negative evaluation of executing a certain behavior (Ajzen, 1985). The more positively a behavior is appraised, the higher the probability of its performance. Attitudes are formed based on behavioral beliefs, which weigh the expected positive or negative outcomes of the behavior. The more positive the expected outcome, the more positive the attitude towards the behavior. Cho's (2019) study found a positive association between students' attitudes towards recycling and their intention to engage in recycling behavior on campus.

The second determinant of intention is *subjective norms*, which are defined as an individual's perception of significant others' approval or disapproval of executing a certain behavior. It functions as social pressure from important others (Ajzen, 1985). People are more likely to perform a behavior when it is supported by important others. Subjective norms are derived from normative beliefs, which represent an individual's perception of what significant others expect of their behavior. It depends on the individual's willingness to conform to those expectations (Ajzen, 1985). Hu et el. (2021) found that subjective norms significantly related to recycling intention in student dormitories in Japan.

Perceived behavioral control (PBC) is the third factor that determines intention (Ajzen, 1985, 1991). It refers to an individual's perception of their capability to perform a behavior in a given situation. PBC is based on control beliefs, which are defined as "beliefs about the presence of factors that may facilitate or hinder that behavior" (Steg & De Groot, 2019, p.219). PBC can influence behavior directly and indirectly through intention (Ajzen,

1991). In the domain of recycling, studies have found that PBC has the strongest positive correlation with intention when compared to other variables in the TPB (Cho, 2019; Hu et al., 2021).

Several empirical studies have found that the TPB is a robust model for explaining various social behaviors (e.g. Hu et al. 2021; De Leeuw, 2015; Tonglet et al., 2004). However, when considering household recycling, the TPB determinants - attitudes, subjective norms, and PBC - accounted for 26.1% of the explained variance in recycling intention (Tonglet et al., 2004). An advantage to the TPB is that it allows for additional variables to be included in the models (Ajzen, 2011; Yuriev et al., 2020). To enhance the predictive power of the model, many studies have added extra variables to the original TPB model. According to a scoping review by Yuriev et al. (2020), 72% of the analyzed papers included additional predictors.

Extension of TPB

In research on recycling behavior, additional predictors have been found to be important, in particular, perceived moral obligation and descriptive norms.

Perceived Moral obligation (PMO)

Many studies have included a moral component as a predictor of behavioral intention, but the terms they used to define this moral component varied between personal norms, moral norms, and moral obligation (see e.g. Harland et al., 1999; Botetzagias et al., 2015; Heidari et al., 2018). In their meta-analysis, Bamberg and Möser (2007) use the terms "personal" and "moral" norms interchangeably, defining them as "feelings of strong moral obligations that people experience for themselves to engage in prosocial behavior" (Bamberg & Möser, 2007, p.15). Schwartz (1977) defines moral obligation as the operationalized form of personal/moral norms. When personal norms are activated, they are "experienced as feelings of moral obligation" (Schwartz, 1977, p.227). In current study, the term "perceived moral obligation"

was used to refer to an individual's "perceptions that engaging in recycling work is correct or incorrect in an ethical or moral sense, and also reflects an internalized pressure to be consistent with one's value system." (Chu & Chiu, 2003, p.608). When discussing the moral component in previous findings, the original terms are used without modification.

The Theory of Planned Behavior assumes that individuals make reasoned decisions about whether to engage in a behavior, taking into account its costs and benefits, based on their own self-interest (Bamberg & Möser, 2007). According to Bamberg and Möser (2007), pro-environmental behavior is a combination of self-interest and prosocial behavior. Therefore, it is suggested that moral aspects should be included in pro-environmental research. Recycling is often viewed as a social dilemma, as it can create a conflict between self-interest and public-interest (Chu & Chiu, 2003). While it may be more convenient for individuals to not recycle, this behavior ultimately harms the community. Therefore, recycling requires moral decision-making processes (Chu & Chiu, 2003).

Empirical studies in the recycling domain have supported the extension of TPB with perceived moral obligation (Botetzagias et al., 2015; Chan & Bishop, 2013; Chu & Chiu, 2003; Heidari et al., 2018; Park & Ha, 2014; Zhang et al., 2015). According to the meta-analysis conducted by Bamberg and Möser (2007), moral norms were found to be distinct from attitudes and direct determinants of intention. Empirical research on recycling (Chu & Chiu, 2003; Razali et al., 2020) further supports this direct relation. Botetzagias et al. (2015) found that moral norms had both a direct and indirect effect on recycling intention, but the direct relationship was stronger.

Descriptive norms (DN)

Descriptive norms are included in the extended TPB due to criticism of subjective norms. This determinant of the TPB often has the weakest or no association with behavioral intention (see e.g. Cho, 2019; Fishbein & Ajzen, 2011; Ioannou et al., 2013; Rivis & Sheeran,

2003; Tonglet et al., 2004). One explanation for this phenomenon is that subjective norms are often narrowly conceptualized, only describing a portion of social norms, specifically injunctive norms (Fishbein & Ajzen, 2011; Rivis & Sheeran, 2003). The theory of normative conduct (Cialdini et al., 1991) distinguishes between two types of social norms that influence people's behavior in different ways. Injunctive norms refer to other people's approval or disapproval of a certain behavior. People are motivated to conform to injunctive norms to gain social rewards or avoid social punishments, which is called normative social influence (Deutsch & Gerard, 1955 as cited in Steg & De Groot, 2019). On the other hand, descriptive norms refer to other people's behavior, or in other words, what they do. People conform to these norms because following the crowd often leads to the right behavior in a given situation, and people are motivated to be correct. This motivation is called informational social influence. Descriptive norms are not measured in the original TPB, as subjective norms reflect injunctive norms (Fishbein & Ajzen, 2011; Rivis & Sheeran, 2003). Two meta-analyses found evidence on that descriptive and subjective norms are indeed conceptually distinctive constructs (Manning; 2009; Rivis & Sheeran, 2003).

Rivis and Sheeran (2003) conducted a meta-analysis on behavior in different domains. They found that including descriptive norms increased the explained variance of intention by 5%, which supports the inclusion of descriptive norms in the Theory of Planned Behavior (TPB). Additionally, empirical studies on household recycling have found that descriptive norms are significant predictors of recycling intention (Fornana et al., 2011; Nigbur et al., 2010; White et al., 2009) and behavior (Fornana et al., 2011; Nigbur et al., 2010) in extended TPB models.

Extended TPB with perceived moral obligation and descriptive norms

Some studies have attempted to extend the TPB by including perceived moral obligation and descriptive norms in a single model. However, the results of these studies have

been inconsistent. For example, White et al. (2009) found that both descriptive social norms and personal injunctive norms (which are similar to perceived moral obligation) significantly contributed to household recycling intentions. Largo-Wight et al. (2012) found a significant association between perceived moral obligation and on-campus recycling intention among students. However, descriptive norms did not significantly predict recycling intention. Based on these findings, it can be assumed that moral obligation is a stronger predictor of recycling intention than descriptive norms.

Current study

The study is based on an expanded version of the TPB (see Figure 1) that includes descriptive norms (DN) and perceived moral obligation (PMO) (Largo-Wight et al., 2012; White et al., 2009). The objective of this study is to investigate which persuasive message has a more positive effect on recycling intention. To the best of our knowledge, no research has yet investigated the effect of perceived moral obligation and descriptive norms on recycling intentions in a quasi-experimental design. This study aims to investigate whether PMO and DN increase the intention to recycle, while accounting for attitudes, subjective norms, and perceived behavioral control. The following hypotheses will be tested:

**H1**: Students in the moral obligation condition will report stronger intention to recycle than those in the control condition.

H2: Students in the descriptive social norms condition will report stronger intention to recycle than students in the control condition.

H3: Students in the moral obligation condition will report stronger recycling intention than those in the descriptive social norms condition.

Figure 1

Determinants of recycling intention based on the Theory of Planned Behavior model with the

extension of descriptive norms and perceived moral obligation
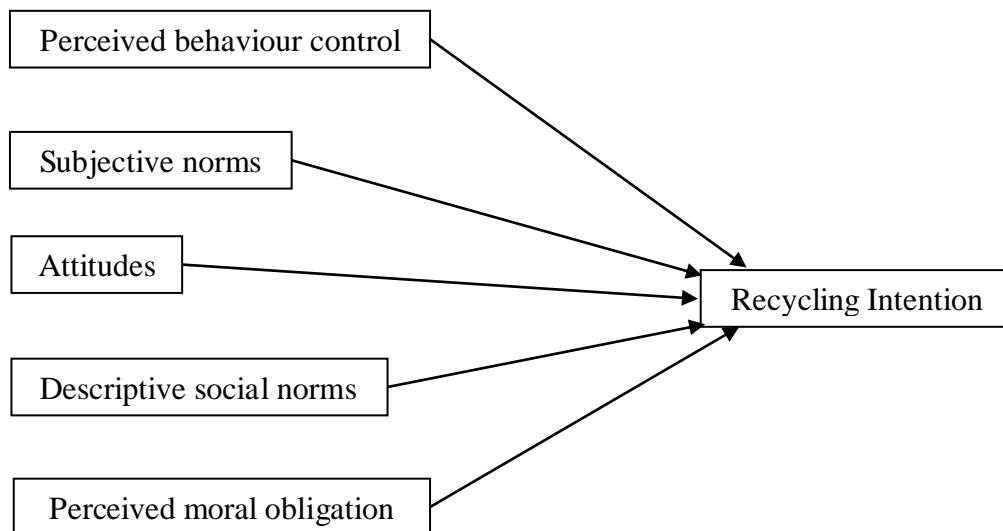
Methodology

Design

The research is based on a quasi-experimental design with three conditions between subjects. The study was conducted in three student dormitories in Groningen, the Netherlands, each representing an experimental condition. The *Control dormitory* represented the control condition where an informational poster titled "Waste Guide" (Appendix A, Figure 2) was displayed. The dormitory labeled as *PMO dormitory* represented the perceived moral obligation condition. Motivational posters were displayed with a message intended to induce a sense of moral obligation (Appendix A, Figure 3). The dormitory labeled as *DN dormitory* represented the descriptive norms condition, where motivational posters displayed a message about descriptive norms (Appendix A, Figure 4).

The three student dormitories shared common features. They accommodated students from both international and Dutch backgrounds. Each kitchen unit, shared by seven to eight residents, contained two recycling bins for paper and glass, as well as bins for residual waste. Waste collection and disposal were the responsibility of the residents. The average length of

stay for residents in the dormitories was approximately one to two years. The dormitories had some different features, including varying occupancy levels and distinct poster displays. The Control dormitory housed 467 students and had only one Waste Guide poster. The PMO dormitory displayed 38 posters and was home to 325 individuals. Finally, DN dormitory had 42 posters for its 325 residents.

Participants

The sample size was determined prior to data collection using G*Power 3.1 software (Faul et al., 2009). A power analysis was conducted with an alpha of .05, power of .80, and a medium effect size (f = .30), resulting in a desired sample size of N = 111. A total of 172 responses were initially collected, but 39 responses were excluded from the dataset due to lack of consent for participation and/or personal data use. Twenty responses were removed from the dataset because the participants did not answer the mandatory research questions. One respondent was excluded for failing the attention check. Upon examination, the subject gave identical responses to all research questions and the attention check. Overall, the total sample size was N = 112. The sample size differed across conditions. The control condition had 56 participants, while the PMO and DN conditions had 28 each. The sample consisted of both international (67.9%) and Dutch participants (32.1%). Of these individuals, 60.7% identified as female (n = 68) and 36.6% as male (n = 41), while 2.7% indicated "other" or preferred not to respond. The mean age of the participants was 21.5 (SD = 3.57; Min = 17; Max = 38). During the data collection phase, 92.8% of the participants were students in higher education institutions, with the majority of students enrolled in a bachelor's program (73.2%), followed by a master's program (19.6%). The remaining participants were either enrolled in a Ph.D. program or did not indicate their education level.

In order to promote participation and to compensate participants for their time investment, an online raffle was held. All respondents who chose to participate in the raffle

had equal chances to win a €23.99 digital gift card for 4 HD movies at Pathé Thuis. A total of three gift cards, each with a value of €23.99, were drawn. The gift cards were financed by the municipality of Groningen. The probability of winning was 3.3% (3 / 90).

Procedure

The informational and motivational posters were placed in the three designated student dormitories as part of an internship project provided by the municipality of Groningen. In the Control dormitory, one Waste Guide poster was displayed near the main entrance of the building in June 2023. In the PMO and DN dormitories, the Waste Guide and the motivational posters were combined, and placed in each kitchen unit of the buildings in October 2023. Residents of PMO and DN dormitories were notified of the poster installation through the digital application of the buildings. One week after the posters were placed in PMO and DN dormitories, the property managers of all three buildings distributed a recruitment text (Appendix B) containing a link to the questionnaire.

The recruitment differed in the distribution channel between the control dormitory and PMO and DN dormitories. The Control dormitory's residents received the recruitment text via email, while the other two buildings' residents had the recruitment text posted on the student dormitories' digital application. Following the initial week of recruitment, residents were sent two additional reminders to encourage participation. Due to the low response rate in the PMO and DN dormitories, the researcher personally visited these buildings to recruit additional participants during the last week of data collection. The researcher waited at the entrance of the buildings and approached residents to ask if they knew about the current study and if they wanted to participate. The residents were given the opportunity to scan the questionnaire's QR code using their mobile phones.

The digital questionnaire was implemented using Qualtrics and took approximately 15-20 minutes to complete. First, participants received information regarding the research and

personal data management, and then asked to give their consent to participate (Appendix C).

Second, demographic questions were asked such as internationality, student dorm residency,

age, gender, study program, and visit of other student dorms. Next, respondents answered

statements about the psychological variables under study. These statements were presented in

random order. They were followed by two questions regarding the manipulation check. After

completing the questionnaire, participants were given the option to enter a raffle to win gift

cards. If interested, they were directed to a separate digital platform that was disconnected

from the research questions, and asked to provide their email address. This ensured that

participants' email addresses could not be linked to their research data, providing a higher

level of anonymity to subjects.

The study withheld information from the respondents. The information form did not

disclose the primary goal of the study, the experimental design with three different conditions,

and the posters. The debriefing text (Appendix D) was distributed by the property managers

through email or the digital application in November 2023.

Materials and Measures

As previously stated, posters were installed in the three student dormitories, and a

questionnaire was distributed among the residents. This section will provide a detailed

discussion of these materials and measurements.

Manipulation: posters

Based on a pilot study conducted in the Control dormitory in 2019, the municipality of

Groningen decided to place posters in other student dormitories to improve recycling behavior

in those locations. The Waste Guide was updated in June 2023. In addition to the Waste

Guide poster, the current study used motivational posters to investigate which persuasive

message improves recycling intention. The Waste Guide and the PMO and DN posters were

created in collaboration with the communication department of the municipality of

Groningen.

The informational posters (Waste Guides) provided objective information about

different types of waste and the appropriate recycling bins for each. In addition, a map

indicated the locations of recycling containers in the area near residents' accommodation

(Appendix A). The Waste Guides were present in all three conditions. In the Control

dormitory, the Waste Guide was printed on A2 size paper, whereas in PMO and DN

dormitories, it was combined with the motivational posters on A3 size paper.

The motivational posters depicting moral obligation were installed in the kitchen units

of PMO dormitory. It aimed to highlight the importance of the one person's recycling action

on the larger community (Largo-Wight et al., 2012). The displayed text read: "We only have

one planet – don't waste it" (Appendix A, Figure 3). In DN dormitory, descriptive social

norms posters were displayed in each kitchen unit to encourage student participation in waste

separation, emphasizing dorm/ student membership: "More and more students separate their

waste – don't waste our efforts" (Appendix A, Figure 4).

Measures

The psychological variables were measured with 17 statements. The items were

adapted from Chu & Chiu (2003), Nigbur et al. (2010), and Onel & Mukherjee (2017), with

modifications made to suit the student dormitory setting. Respondents indicated their level of

agreement with the statements on 7-point Likert scales, with options ranging from 1 (*strongly

disagree*) to 7 (*strongly agree*). The 18th statement functioned as an attention check, stated

"Please select disagree for this statement".

Dependent variable: behavior intention to recycle. Three items measured the

residents' intention to engage in recycling behavior, adapted from Onel & Mukherjee (2017).

For instance, the statement "I intend to engage in recycling behavior in the forthcoming

months" was measured. The reliability of the scale, as measured by Cronbach's alpha, was $\alpha = .89$ ($N = 112$).

Independent variables: perceived moral obligation, descriptive social norms.
Three items were used to assess perceived moral obligation, adapted from Chu and Chiu's (2003) research. For example, one item stated that "Everybody is obligated to recycle their waste in my student dorm because it is immoral to use additional natural resources." The scale reliability was $\alpha = .66$ ($N = 112$). Descriptive social norms were measured with three items, adapted from Nigbur et al. (2010), which included statements such as "Most of the students in my dorm like to recycle wherever possible". The Cronbach's Alpha was $\alpha = .87$ ($N = 112$).

Control variables: attitudes, subjective norms, perceived behavioral control.
Attitudes were assessed using a 4-item scale adapted from Chu & Chiu (2003). The scale reliability was $\alpha = .66$ (N = 112). It contained statements such as "It is worthwhile to recycle waste in my student dorm." Subjective norms were measured with two items, adapted from Chu & Chiu (2003) For example "People (or organizations) who influence my decisions strongly oppose/ strongly support my recycling behavior." The reliability of the scale was $\alpha = .54$ ($N = 112$). Perceived behavior control was also measured using two items adapted from Chu and Chiu's (2003) study. An example statement is "Whether or not I recycle my garbage is entirely up to me." The scale had a reliability of $\alpha = .72$ ($N = 112$).

Manipulation check. The manipulation check was included in the questionnaire, asking participants if they saw the posters in their kitchen units (or near the entrance in case of the Control dormitory) as well as what the posters conveyed to them ("What was the topic of the posters?"; see Appendix E). The manipulation checks indicated that the manipulation was unsuccessful. In total, 53.15% of the participants reported not seeing the displayed posters, and one participant did not provide answers for the manipulation checks. The distribution of the passed and failed manipulation checks in each condition can be found in Appendix F.

Participants who did not pass the manipulation checks were not excluded in order to maintain the power of the analyses.

Statistical analysis

The hypotheses were statistically analyzed using IBM SPSS Statistics 28. After conducting preliminary analyses, two one-way Analyses of Covariance (ANCOVAs) were performed, each with three covariates. Additionally, I tested the adjusted mean differences between conditions using Bonferroni post-hoc tests.

Results

Preliminary analyses and assumptions

Before conducting the main analysis, it is necessary to test the ten assumptions of ANCOVA with multiple covariates (Laerd Statistics, 2017). These include assuring that the dependent variable and the covariates were measured on continuous scales, the independent variable consisted of categorical groups, ensuring independent observations, testing for homogeneity of variances, checking for normality, linearity between the covariates and the dependent variable at each level of the independent variable, homogeneity of regression slopes, homoscedasticity, and ensuring that there are no significant outliers and there is no multicollinearity of covariates.

The study design ensured that the assumptions of a continuous dependent variable and covariates were met. The independent variable consisted of three categorical, independent groups. It can be assumed that most participants were only exposed to the poster displayed in their own kitchen unit, as 85% of the respondents did not regularly visit other student dormitories.

Outliers were identified by examining the standardized residuals of recycling intention. Any values greater than ±3 standard deviations were considered outliers and were further investigated (Laerd Statistics, 2017). Two influential outliers were present in the

dataset with values of -4.23 and -4.45. After investigation, no measurement or data processing errors were found, indicating that the outliers are likely true values of the dataset. Therefore, two main analyses were performed, one with and one without outliers (Weisberg, 2013).

The normality assumption was tested using Shapiro-Wilk tests, which were significant and indicated non-normal distributions in both the control condition ($W = .75$, $p < .001$) and the PMO condition ($W = .89$, $p = .007$). Violations of normality were also observed in histograms and QQ-plots. Normality improved when the two outliers were removed from the analysis, however, the Shapiro-Wilk tests remained significant in the control and moral obligation conditions, control ($W(54) = 0.95$, $p = .038$), perceived moral obligation ($W(28) = 0.89$, $p = .007$), descriptive norms ($W(28) = 0.97$, $p = .689$). Despite the violation of the normality assumption, the ANCOVA tests were performed because they are robust to such violations (Huitema, 2011). Furthermore, Blanca et al. (2017) conducted a simulation study that demonstrated the robustness of ANOVA in unequal and small sample sizes, as well as in cases of moderate and severe violation of normality, provided that there was homogeneity of variances. Therefore, based on their findings, the current data was not transformed, and two ANCOVAs were conducted.

Scatterplots visually displayed linear relationships between recycling intention and attitudes towards recycling, perceived behavior control, and subjective norms in all groups of the independent variable. To test the homoscedasticity assumption in the three conditions, the standardized residuals were plotted against the predicted values in scatterplots. The points in each scatterplot are approximately randomly spread, indicating no severe violation of homoscedasticity. The visual plots for the aforementioned assumptions were similar when outliers were not present in the analysis. The visual plots of the regression slopes suggest that the slopes in the different conditions interact with each other. However, the ANCOVA test showed non-significant interaction effects, indicating that the assumption of homogeneity of

the regression slopes can be made. Table 2 presents the results of the tests of interaction

effects between the independent variable and the covariates with and without outliers.

Table 2

Test of homogeneity of regression slopes: interaction effects between conditions and

covariates

	With outliers			Without outliers		
Interaction	*F*	*dfs*	*p*	*F*	*dfs*	*p*
conditions x attitudes	1.08	2; 100	.35	0.47	2; 98	.63
conditions x PBC	1.27	2; 100	.29	2.06	2; 98	.13
conditions x SN	1.58	2; 100	.21	1.75	2; 98	.18

Note: $N = 112$; PBC = perceived behavior control; SN = subjective norms

Multicollinearity among the covariates was tested by displaying the bivariate

correlations of the three covariates (Appendix G, Table 3). Although some of the Pearson's

correlations were significant, the correlation coefficients were less than .80 (Field, 2009),

indicating that multicollinearity is not strong among the covariates. In addition, a regression

of the covariates on recycling intention was conducted, and variance inflation factors (VIFs)

were assessed for the attitude scales ($VIF = 1.09$), the PBC scales ($VIF = 1.04$), and the

subjective norm scales ($VIF = 1.05$). When two outliers were removed, the VIFs for attitudes,

PBC, and subjective norms were $VIF = 1.1$, $VIF = 1.04$, and $VIF = 1.06$ respectively. The

findings indicated that there were no strong linear relationships between the three covariates

(Field, 2009).

Main analyses

ANCOVA with outliers

The Levene's test resulted in a non-significant F-test ($F(2,109) = .28$, $p = .76$), indicating equal variances and no violation of the homogeneity of variances assumption. Table 4 presents the descriptive statistics of the analysis, which show that the adjusted mean of recycling intention is highest in the control condition compared to the PMO condition and DN condition when attitudes, PBC, and SN were accounted for. Prior to testing the concrete hypotheses, a one-way ANCOVA was conducted to test whether the adjusted means of recycling intentions in the three different groups were significantly different from each other when controlling for attitudes, PBC, and subjective norms. The ANCOVA test revealed no significant difference between the control, PMO, and DN conditions ($F(2, 106) = 1.29$; $p = .279$; $\eta_p^2 = .024$). I did not find evidence to support the hypotheses that participants who were presented with the moral obligation poster had a higher level of recycling intention than those in the control condition (**H1**), or that subjects in the descriptive norms condition had significantly higher recycling intentions compared to the control condition (**H2**). Finally, the students exposed to the moral obligation poster did not differ significantly from the students exposed to the descriptive norms poster in their intention to recycle (**H3**).

Table 4

Descriptive statistics of ANCOVA with outliers

Groups	M_{adj}	SE	M	SD	n
Control	5.79[a]	.14	5.83	1.22	56
PMO	5.48[a]	.20	5.37	1.09	28
DN	5.46[a]	.20	5.50	1.07	28

Note. M_{adj} = adjusted mean; *SE* = standard error; *M* = unadjusted mean; *SD* = standard deviation; *n* = group size; $N = 112$

[a]Covariates included in the model: attitudes, PBC, SN

ANCOVA without outliers

The Levene's test indicated equal variance (F(2,107)=1.70, p=1.87), satisfying the homogeneity assumption. The adjusted means of recycling intention across conditions show a similar pattern when outliers are removed compared to when outliers are not removed. Table 5 shows that when attitudes, PBC and SN are controlled for, the adjusted means of recycling intention is highest in the control condition in comparison to the PMO and DN conditions. The ANCOVA revealed a significant difference between the three conditions ($F(2,104) = 4.71$; $p = .011$; $\eta_p^2 = .083$), with attitudes ($F(1,104) = 13.18$, $p < .001$, $\eta_p^2 = .112$) and subjective norms ($F(1,104) = 15.12$, $p < .001$, $\eta_p^2 = .127$) being significant covariates. However, perceived behavioral control only had a marginally significant effect on the model ($F(1,104) = 3.27$, $p = .073$, $\eta_p^2 = .030$).

Table 5

Descriptive statistics of ANCOVA without outliers

Groups	M_{adj}	SE	M	SD	n
Control	5.96[a]	.11	6.00	0.84	54
PMO	5.48[a]	.16	5.37	1.09	28
DN	5.46[a]	.16	5.50	1.07	28

Note. M_{adj}= adjusted mean; *SE* = standard error; *M* = unadjusted mean; *SD* = standard deviation; *n* = group size; *N* = 110.
[a]Covariates included in the model: attitudes, PBC, SN.

Bonferroni post hoc tests were conducted to investigate significant differences between groups. The results are presented in Table 6. The adjusted mean of recycling intention (see Table 5) was significantly higher in the control condition than in the PMO and DN conditions. Participants in the control condition had a greater intention to recycle than students who were presented with the moral obligation poster or those in the descriptive norms condition. These results contradict hypotheses **H1** and **H2**. Furthermore, there was no

significant difference between the PMO and DN conditions. The results indicate that people in the PMO condition did not have higher recycling intention than those in the DN condition, leading to the rejection of **H3**.

Table 6

Bonferroni post hoc tests

Conditions		M_{diff}	*SE*	*p*
Control	PMO	.48	.19	.047
	DN	.50	.19	.035
PMO	DN	.02	.22	1.000

Note. $N = 110$; M_{diff} = Mean difference; SE = Standard error; p = significance value.

Discussion

The current study aimed to better understand which persuasive message is more effective in enhancing recycling intention in student dormitories. The Theory of Planned Behavior with extension of perceived moral obligation and descriptive social norms (Largo-Wight et al. 2012; White et al., 2009) was used as the theoretical framework in this quasi-experiment. Three hypotheses were tested to examine the impact of perceived moral obligation and descriptive social norms on recycling intention when attitudes, subjective norms, and perceived behavior control were taken into account in the analysis. The first hypothesis stated that students who were exposed to posters about moral obligation would report higher recycling intention than those in the control condition (**H1**). Similarly, the second hypothesis investigated whether students who were presented with posters about descriptive norms would have stronger recycling intention than those in the control condition (**H2**). Finally, the third hypothesis examined whether students in the perceived moral obligation condition would report stronger recycling intention than those in the descriptive social norms condition (**H3**).

Although previous studies have suggested that moral obligation and descriptive norms are effective determinants of recycling behavior or intention (Chaisamrej & Zimmerman, 2014; Chan & Bishop, 2013; Largo-Wight et al. 2012; De Leeuw et al., 2015, White et al., 2009; Zhang et al., 2015), and have encouraged the implementation of interventions that target these factors, none of the hypotheses in the current research were supported by the statistical results. The main analysis was conducted twice due to influential outliers. The first analysis, which included the outliers, showed no significant difference between the control, perceived moral obligation, and descriptive social norms conditions on recycling intention when attitudes, subjective norms, and PBC were taken into account. However, the second analysis without two influential outliers yielded unexpected significant results, which are further discussed in this section. Interestingly, recycling intention was significantly higher in the control condition than in the perceived moral obligation and descriptive social norms conditions. These findings contradict the original hypotheses that students presented with either perceived moral obligation posters (H1) or descriptive norms posters (H2) would have a higher recycling intention than those in the control condition.

One of the possible explanations might be the different data collection procedure in the control and experimental conditions. During the data collection phase, in addition to digitally distributing the questionnaire, the researcher needed to collect responses from residents in person by visiting the PMO and DN dormitories due to a low participation rate. The control condition was not included in this in-person data collection. Therefore, it is possible that the participants from this building consisted of more students who already recycle and were more motivated to fill in the recycling questionnaire. This may be because these participants felt a greater personal relevance when completing the questionnaire (Frymier & Shulman, 1995). On the other hand, it is possible that the researcher's personal contact with the students in the experimental conditions may have influenced their motivation to participate, potentially

motivating those who do not typically recycle. According to Roghanizad and Bohns (2021), asking for a favor in person is more effective than using other channels, such as email or apps. This may have encouraged the students to participate simply because they were asked for the favor face-to-face, rather than because of the personal relevance to recycling.

Another alternative explanation could be the quasi-experimental design, where participants were not randomly assigned to different conditions. The three dormitories may have had different characteristics that could have influenced the results, but were not considered in the study. For instance, recycling facilities were present in all student dormitories, but they differed in their implementation. The control dormitory had recycling bins installed, while the PMO and DN dormitories used plastic boxes as recycling facilities, which might have had influence on recycling intention. Some studies found that recycling facilities and their perceived convenience can influence recycling behavior (Robertson & Walkington, 2009; Valle et al., 2005). Therefore, differences in recycling facilities may explain the higher recycling intention observed in the control condition.

Limitations

The study has some methodological limitations that need to be considered when interpreting the current findings. Firstly, more than half of the participants failed the manipulation check as they were not aware of the presence of posters in the kitchen units. As the study intended to explore the effect of persuasive messages conveyed by posters, the failed manipulation check can have a negative impact on the interpretation of the final results (Ejelöv & Luke, 2020). This suggests that the differences between conditions cannot be attributed solely to the effect of the posters, and that other potential explanations should be considered when interpreting the results. Participants that failed the manipulation check were not excluded from the analysis because of the small sample sizes that may affect the power of the analysis.

Furthermore, it is important to note that low Cronbach's alpha scores for the attitudes, subjective norms, and perceived moral obligation scales can lead to unreliable results, which may impact the interpretation of the findings. These low reliability scores are inconsistent with the Cronbach' Alpha scores from the study where they were adapted (Chu & Chiu, 2003), where the reliability of attitudes, subjective norms, and perceived behavioral control were at least adequate. One adjustment was made comparing to the original scales. The expression of „in my student dorm" was added to each statement. The inclusion of this expression may have changed the overall meaning of some statements. For example, one of the attitude scale items states that "recycling waste in my student dorm is good." This statement could be interpreted in two different ways. On one hand, it could be seen as a positive attitude towards recycling in the student dormitory, as originally intended. On the other hand, it can also be interpreted as a descriptive social norm that suggests residents generally engage in recycling behavior. However, this adjustment may not have resulted in ambiguous interpretation in other statements. For instance, one of the PMO scale items stated that "everybody is obligated to recycle their waste in my student dorm because it is shameful to throw away recyclable resources". This statement does not allow for varying interpretations. Overall, the low reliability scores of the attitudes, subjective norms, and perceived moral obligation scales require further investigation and improvement.

Another limitation of the research is that it only measured behavioral intention and not actual behavior. While many studies only measure behavioral intention, it has been found that there is often a gap between intention and behavior (Yuriev et al., 2020). This means that intending to execute a certain behavior does not necessarily result in actual behavior. In the current study, the significant difference in recycling intention results between the conditions may not necessarily reflect actual recycling behavior. Yuriev et al. (2020) conducted a scoping review and found that, in the domain of pro-environmental research, the average gap

in the explained variance between intention and behavior was 22.5%. Therefore, researchers are encouraged to investigate and close this intention-behavior gap.

Finally, the independence of observation assumption may be violated due to the presence of subgroups in each dormitory. Dependency among individuals can be expected; however, it was not accounted for (Huitema, 2011). One kitchen unit was shared by 7 to 8 residents, which can be considered as a subgroup. Depending on which kitchen unit they use, participants' recycling intentions and behaviors may differ. Kitchen units function as clusters, which can affect results, as participants in the same cluster (i.e. same kitchen unit) may directly influence each other's responses, for example, by filling out the questionnaire together, or indirectly by sharing similar characteristics as kitchen mates. It can violate the independent observation assumption of the analysis, resulting in unreliable findings (Fitzmaurice et al., 2011).

Strengths

One strength of this study is its application of a quasi-experimental design. The extended Theory of Planned Behavior, including perceived moral obligation and descriptive norms, has not previously been applied in this type of design to my knowledge. The research was conducted in a real-life setting, which enhances external validity and generalizability of the results to the population (Reichardt, 2019).

The other strength of the research is that it designed an intervention based on theoretically explained psychological determinants. According to Varotto and Spagnolli (2017), there is often a gap between intervention-based and theory-based studies, with low correlation between the two groups. Implemented interventions seldom refer to theories and behavioral determinants, while theory-based research usually does not suggest methods for changing behavior. In their scoping review, Yuriev et al. (2020, p.2) suggested that the TPB is „one of the most effective models for developing behavioral interventions". They also

indicated that interventions based on the TPB are lacking in the environmental domain. The current intervention was based on research about the effectiveness of persuasive information provision (Varotto & Spagnolli, 2017). Furthermore, the content of the posters was partially designed based on the criteria of how to induce feelings of moral obligations (Sabucedo et al., 2018) and descriptive norms (Priebe & Spink, 2012).

Practical implications and suggestions for future research

The findings of the current study should be interpreted with caution due to methodological limitations. These limitations include low reliability of three measurements, a failed manipulation check, and nested data that was not accounted for. Therefore, until further research addresses these limitations and unexpected results, policy recommendations cannot be made.

Some of the limitations could be the subject of future research. First, based on a non-systematic observation during the implementation phase, there were differences in tidiness, cleanliness, decoration, and furnishing among kitchen units. In future studies it would be interesting to determine the underlying reasons for these differences and measure whether they have an impact on recycling intention. For instance, measuring group identity and group norms may affect recycling behavior in different kitchen units. According to self-categorization theory (Turner & Reynolds, 2011), individuals who strongly identify with a particular group internalize group norms that can influence their attitudes and behavior. For example, it can be examined whether an individual's recycling behavior in a kitchen unit with strong social bonds and positive recycling norms is influenced by their level of group identity.

A repeated-measure design could help adjust for the intention-behavior gap by measuring actual behavior before and after the intervention. This design would increase the internal validity of current research, while a higher level of external validity can be assumed due to the quasi-experimental characteristic (Reichardt, 2019).

Conclusion

The research aimed to investigate the persuasive messages that can influence recycling intention. It was aligned with the municipality of Groningen overarching goal to become waste-free by 2030 (OECD, 2020). In order to reach their goals, different subpopulations of citizens could be targeted to improve their recycling behavior. This study aimed to focus on students who lived in student dormitories. The findings suggested that the initial hypotheses had to be rejected. Specifically, recycling intention was significantly higher in the control group than in the groups that were exposed to perceived moral obligation or descriptive norms, which contradicts the expected results. In order to investigate the unexpected results and to overcome some of the limitations, further research should be conducted. In dormitory settings with shared kitchen units, it is important to consider that observations may be dependent, resulting in nested data that must be taken into account in the study design. Additionally, the intention-behavior gap can be addressed by implementing a repeated-measures design, which would also enhance the study's internal validity. Until further research is conducted, no recommendations can be made about which persuasive message influences students' intention to recycle.

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Appendix A

Posters displayed in the three dormitories

Figure 2

Poster displayed in the control condition

Figure 3

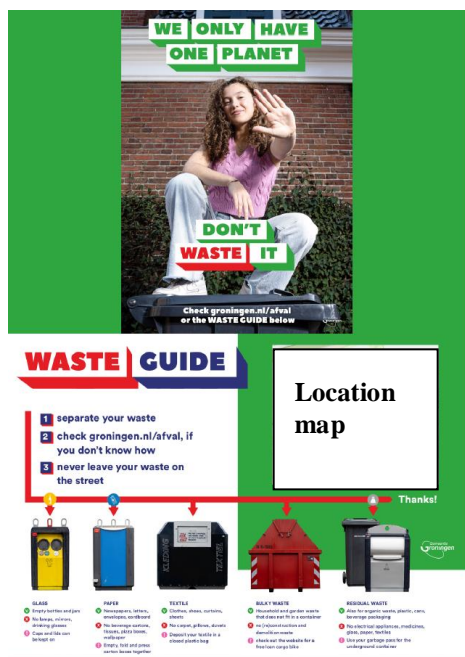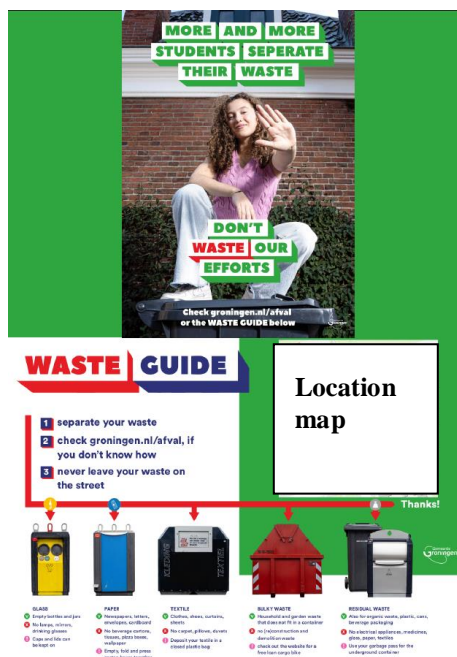Poster displayed in the PMO condition

Figure 4

Poster displayed in the DN condition

Appendix B

Recruiting text for participation

„Dear residents,

I am currently studying Environmental Psychology at the University of Groningen. As part of my master's thesis I am studying recycling behaviour among students living in student dorms. I would like to invite you to participate in my research by filling out the questionnaire below, which will take you about **15-20 minutes** to complete. Your participation is greatly appreciated.

In addition, if you decide to take part, you will have the chance to win one of the three **gift cards of €23.99** (for 4 HD movies at Pathé Thuis) that will be raffled off among the participants.

Questionnaire: https://rug.eu.qualtrics.com/jfe/form/SV_6WLTQNR2m1mhR0W

In case you have any questions, feel free to contact me (d.toth.1@student.rug.nl).

Thank you in advance for investing your time!

Have a nice day,

Dóra Tóth"

Appendix C

Consent form

- I have read the information about the research. I have had enough opportunity to ask questions about it.

- I understand what the research is about, what is being asked of me, which consequences participation can have, how my data will be handled, and what my rights as a participant are.

- I understand that participation in the research is voluntary. I myself choose to participate. I can stop participating at any moment. If I stop, I do not need to explain why. Stopping will have no negative consequences for me.

- Below I indicate what I am consenting to.

Consent to participate in the research:

[ ] Yes, I consent to participate; this consent is valid until 19 November 2023.

[ ] No, I do not consent to participate

Consent to processing my personal data:

[ ] Yes, I consent to the processing of my personal data as mentioned in the research information. I know that until 19 November 2023, I can ask to have my data withdrawn and erased. I can also ask for this if I decide to stop participating in the research.

[ ] No, I do not consent to the processing of my personal data.

Appendix D

Debriefing text

Thank you to those who participated in the study about recycling behavior in student dorms. Further information about the purpose and nature of the research is available below.

The research aims to better understand the effects of different posters on recycling behavior intentions in student dorms. Different dorms are involved in the study. Posters were placed in the kitchen units. The content of the posters is different in each student dorm, representing different experimental conditions. Poster one emphasizes the individual responsibility for recycling, poster two displays other students' recycling behavior, poster three provides information about recycling principles. Differences in the impact of posters will be investigated.

In case you have further questions about the research or you decide to withdraw your consent of participation, you may contact the researcher Dóra Tóth (email: d.toth.1@student.rug.nl). You have the right to withdraw your consent without any negative consequences at anytime until 19 November 2023.

The gift cards will be drawn on 9 November 2023. Winners will be notified shortly thereafter.

Appendix E

Manipulation check

Did you see the poster in your kitchen unit? (in PMO and DN conditions)

- o   yes

- o   no

Did you see a poster about recycling principles in your student dorm? (control condition)

- o   yes

- o   no

What was the topic of the poster?

- o   information about recycling and other students recycling behavior.

- o   information about recycling and personal responsibility for recycling.

- o   information about recycling.

Appendix F

Distribution of the manipulation check per condition

Table 1

Number of participants per group who passed and failed the manipulation check

Group	Pass	Fail	% fail
Control	40	16	28.57
MO	4	23	85.19
DN	4	24	85.71

Note: $N = 111$.

Appendix G

Correlation between covariates

Table 3

Pearson's correlation matrix of the three covariates

Covariates	Attitudes	PBC	SN
Attitudes	-		
PBC	.19*	-	
SN	.22*	.05	-

Note. $N = 112$; * $p < .05$.