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Recycling as a planned behavior: the moderating role of perceived behavioral control

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Abstract
This study examines the effectiveness of a public service announcement (PSA) video designed based on the theory of planned behavior (TPB) in motivating people to engage in proper recycling. Based on a representative sample of New York State residents ($N = 707$), survey results show that all three TPB variables are significant predictors of recycling intention. The PSA video increases recycling intention through attitude, but this mediated relationship is only significant among individuals with low perceived behavioral control. In terms of practical implication, these results suggest that environmental campaigns using a video format may be particularly effective among audiences who perceive low self-efficacy in recycling. Theoretically, this moderated mediation effect suggests that future research based on the theory of planned behavior should not only examine the main effect of each predicting variable, but also assess the role of perceived behavior control as a moderating factor.

Keywords Recycling · Attitude · Perceived behavioral control · PSA video · Environmental campaigns

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1 Introduction

Recycling is an environmental behavior that contributes to key sustainability goals, including improved waste management and climate change mitigation (Bogner et al., 2008). However, recycling in America is facing unprecedented challenges since China's *National Sword Policy* came into effect in 2018, banning the import of most recyclable materials. Previously, many developed countries, including the USA, had relied on China to process their recyclable waste (Katz, 2019). As a result, many recycling programs in the USA had to adjust to make recycling financially sustainable, including reducing materials that are accepted for recycling or even stopping curbside pickup completely (Javorsky, 2019). These changes have complicated the recycling process, which may directly or indirectly dampen people's enthusiasm for recycling.

Further, although Americans are generally in favor of recycling, contamination is still a big problem (Davis, 2015). The Recycling Partnership's State of Curbside Recycling report (2020) estimates a contamination rate of 17% by weight. Specifically, unrecyclable materials such as straws and plastic bags, when recycled along with recyclable materials, can tangle the processing machines. Other items such as syringes and broken glass can be dangerous for workers who have to manually sort through the recycled materials. Often, if a significant proportion of materials in a recycling unit is contaminated, the entire batch is considered unusable and thrown away. Contamination also increases the costs for recycling facilities, often due to the need to hire more staff or purchase machinery to better sort out contaminated waste. Therefore, there is an urgent need to educate the American public to engage in proper recycling and to reduce "wishful recycling," which refers to the tendency to recycle everything one deems recyclable without consulting local recycling programs.

A public service announcement (PSA) video can be a promising tool in environmental campaigns to increase public awareness and environmental engagement. It is powerful because vivid images conveyed through a video can strengthen the persuasive message's memorability and impact (Goldberg et al., 2019). For instance, compared to textual information, even a short video can increase people's support of climate change mitigation because the video makes climate change risk more concrete and relevant for the audience (Goldberg et al., 2019). In the current study, we test the effectiveness of a PSA video designed based on the principles of the theory of planned behavior (TPB; Ajzen, 1991) in increasing people's intention to recycle properly in the near future. The TPB is one of the most commonly used social psychology theories in environmental communication research. It has been successfully applied to understanding a range of environmental behaviors such as the adoption of public transportation (Heath & Gifford, 2002), water conservation (Lam, 2006), and recycling (Rhodes et al., 2015). In fact, from 1995 to 2019, a total of 531 published studies have applied the TPB to environmental research, and the number is still increasing (Si et al., 2019). Thus, the TPB provides a suitable framework to guide this research.

Although most TPB-based research studies rely on survey methodology (Yzer & van den Putte, 2014), experimental studies have increased in recent years (Steinmetz et al., 2016). In line with this trend, this study adds to the TPB literature by demonstrating message effect through an experimental design. Furthermore, instead of evaluating the role of each TPB variable in contributing to behavioral intention, this research evaluates perceived behavioral control as a moderator in the model. This decision is driven by both a theoretical pursuit to evaluate interaction effect in the TPB framework (Ajzen, 1985, 2020) and a practical reason determined by the research context. That is, most people maintain

favorable attitude toward recycling and view it as a socially desirable thing to do. However, whether they actually engage in recycling is often contingent on whether they view themselves as capable of recycling properly (Rosenthal, 2018). Focusing on perceived behavioral control as a moderator in the TPB framework can also inform the design of communication campaigns because this construct can provide valuable insight for audience segmentation strategy. For instance, the risk perception attitude framework (Rimal & Real, 2003) supports using self-efficacy, a similar construct to perceived behavioral control, as a segmentation tool. This argument has also received empirical support in the past literature (see, for example, Hine et al., 2014). Findings related to this analysis will shed some light on audience segmentation for environmental communication campaigns.

2 Literature review

2.1 Theory of planned behavior

The theory of planned behavior (TPB) is developed based on the theory of reasoned action (TRA; Fishbein, 1979), which proposes that behavioral intention is a function of attitude and subjective norms. However, the TRA is only confined to predicting behaviors under volitional control (i.e., an act based on the power of one's will). When it comes to behaviors that are not under volitional control, the TRA becomes less useful (Eagly & Chaiken, 1993). That is to say, when people lack in required skills or resources to perform a behavior, attitude and subjective norms may not predict behavioral intention well (Yzer, 2012). To improve the predictive power of the TRA, Ajzen (1991) proposed the TPB by adding perceived behavioral control as another determinant of behavioral intention.

The TPB posits that behavioral intention is the most proximate predictor of behavior. In the theorization of behavioral intention, the TPB focuses on three factors—attitude, subjective norms, and perceived behavioral control. These three constructs are related to three types of beliefs that are salient in people's mind when making decisions: Behavioral beliefs influence attitude toward the behavior, normative beliefs contribute to subjective norms, and control beliefs are related to perceived behavioral control (Ajzen, 1991). Attitude refers to the extent to which people hold a favorable or unfavorable evaluation of the target behavior; subjective norms are people's perceived social pressure to perform or not to perform the behavior; perceived behavioral control refers to perceived difficulty or ease in performing the behavior (Ajzen, 1991). In general, the more positive attitude the people have, the greater social pressure they experience, and the greater control they perceive, the more likely that they will engage in the behavior. However, the contribution of each variable varies across contexts (Ajzen, 1991; Rhodes et al., 2015). For some behaviors, it is possible that behavioral intention is shaped by only one or two variables (Yzer & van den Putte, 2014). For instance, for private sphere environmental behaviors such as recycling, attitude and perceived behavioral control may outweigh subjective norms in influencing behavioral intention because social norms associated with proper recycling may not be directly observable (Mannetti et al., 2004).

Not surprisingly, in recycling research, attitude has been found to be the most consistent predictor of behavioral intention (e.g., Knussen et al., 2004; Tang et al., 2011). In this research context, people who have a favorable attitude toward recycling are more likely to maintain this behavior and be better recyclers in the long run (Werner & Makela, 1998). Beyond the recycling context, in a meta-analysis of 185 TPB-based

studies, Armitage and Conner (2001) found that attitude accounts for 24% of the variance in behavioral intention, followed by perceived behavioral control (18%) and subjective norms (12%).

Subjective norms depict the extent to which an individual is influenced by his or her social milieu (Botetzagias et al., 2015). In general, subjective norms refer to the approval or disapproval of a certain behavior by significant others, and thus this variable is typically operationalized as injunctive norm in the TPB (Botetzagias et al., 2015). However, recent research has incorporated other types of norms as well—for instance, moral or personal norm is particularly interesting when applying the TPB to environmental contexts (e.g., Manstead, 2000; White et al., 2009). Because environmental behaviors such as recycling are socially responsible, personal feelings of moral obligation may also influence people's recycling intention through subjective norms (Ajzen, 1991). Specifically, individuals who view recycling as a moral or socially responsible behavior may believe that important others expect them to recycle properly. Some scholars argue that environmental behaviors are determined by both self-interest and prosocial motivations (Bamberg & Möser, 2007; Manstead, 2000). In particular, after reviewing 57 independent samples, Bamberg and Möser (2007) found that besides attitude and perceived behavioral control, moral norm is an important predictor of environmental behavior. Therefore, in addition to injunctive norm, we will also assess moral norm to measure subjective norms in this study. Based on the TPB and existing empirical evidence, we propose the first set of hypotheses:

H1 Attitude (**H1a**), subjective norms (**H1b**), and perceived behavioral control (**H1c**) will be positively related to recycling intention.

Although the TPB has received a vast amount of empirical support, more recent studies have shown inconsistent findings (Sniehotta et al., 2009; 2014). For instance, using a full-factorial experiment, Sniehotta (2009) found that interventions designed to target attitude and perceived behavioral control did not change behavior intention related to physical activity, and interventions designed to address subjective norms only resulted in a change in behavioral intention, not actual behavior. Nevertheless, based on a systematic review of TPB-based interventions across a wide range of behavior domains, Steinmetz et al. (2016) concluded that the TPB provides a valuable framework to inform the design of interventions.

In the current study, we created a PSA video that aims to increase New York State residents' intention to recycle properly based on the new challenges to the recycling industry. Theory-based intervention is generally more effective in changing behaviors than non-theory-based interventions (Ajzen, 2020; Webb et al., 2010). Designed based on the TPB, this video highlights the benefits of recycling, the importance of proper recycling, as well as the fact that most people in New York State recycle, and recycling is an easy action to perform. We expect that after watching the video, people will report a more favorable attitude toward recycling, perceive greater subjective norms as well as behavioral control, and express a stronger intention to recycle properly. Therefore, we propose the second set of hypotheses:

H2 Compared to those in the control group, participants in the video condition will report a more positive attitude toward recycling (**H2a**), perceive greater subjective norms (**H2b**), report higher levels of perceived behavioral control (**H2c**), and express a stronger intention to recycle better (**H2d**).

We also expect the PSA video to influence behavioral intention through the TPB variables. In particular, Bright et al. (1993) argue that behavior change can be achieved by communication messages that specifically target beliefs related to people' attitude, subjective norms, and perceived behavioral control. For instance, Chatzisarantis and Hagger (2005) manipulated attitude in strategic messaging and found that persuasive effect was relayed through attitude, but not through perceived behavioral control or subjective norms. Wang et al. (2018) found that information publicity influenced recycling intention through personal norm and recycling attitude. In this study, we assume that the PSA video will influence recycling intention through attitude and subjective norms because the video primarily emphasizes the benefits of recycling and points out that proper recycling requires community-based effort. Therefore, we posit that:

H3 Attitude will mediate the relationship between video exposure and recycling intention.

H4 Subjective norms will mediate the relationship between video exposure and recycling intention.

2.2 Perceived behavioral control as a moderator

In the TPB framework, perceived behavioral control (i.e., self-efficacy) was proposed as a key predictor of behavioral intention, just like attitude and subjective norms. However, compared to the other two predicting variables, perceived behavioral control seems under researched. For instance, in a systematic review of research related to recycling behavior, Phulwani et al. (2020) identified 788 published papers and 1845 keywords. Among these keywords, "theory of planned behavior," "attitude," and "social norms" frequently appeared, but perceived behavioral control did not.

When the TPB was originally conceptualized, Ajzen (1985) stated that perceived behavioral control might interact with attitude and subjective norms in influencing behavioral intention. That is, the relationships between attitude/subjective norms and behavioral intention likely vary based on different levels of perceived behavioral control. This conjecture echoes other theories about behavioral formation. For instance, Eagly and Chaiken (1993) maintain that there is a potential interaction between attitude and perceived behavioral control in their dual-process heuristic–systematic model. The extended parallel process model (Witte, 1992) proclaims that threat information should be accompanied by efficacy information to induce positive behavioral change. Because threat information is likely to shape attitude, while efficacy information is likely to influence perceived behavioral control, this theoretical framework essentially posits an interaction effect between attitude and perceived behavioral control. Similarly, the risk perception attitude framework (Rimal & Real, 2003) also theorizes an interaction between risk perception and self-efficacy in influencing protective behaviors. Here, risk perception essentially represents individuals' attitude toward a potential threat or hazard.

Luszczynska et al. (2011) argue that perceived behavioral control is likely to function as a moderator in the TPB because people with higher perceived behavioral control are more confident in their ability to perform a behavior and thus are more likely to translate behavioral intention into actual behavior. Based on a systematic review of six studies, Yzer (2007) found that perceived behavioral control often interacts with attitude and subjective norms to influence behavioral intention, although the interaction with attitude seems more persistent. In a later study, Yzer and van den Putte (2014)

found that perceived behavioral control interacts with attitude and subjective norms to influence smokers' intention to quit smoking. Studying HPV vaccination intention, Dillard (2011) also found interaction effects between perceived behavioral control and attitude/subjective norms. Specifically, subjective norms are positively related to vaccination intention only among individuals who have moderate to high levels of perceived behavioral control. Further, the positive relationship between attitude and vaccination intention is strongest among individuals with high perceived behavioral control. Together, these empirical studies suggest that it is theoretically meaningful to evaluate perceived behavioral control as a moderator in the TPB because this approach can advance our understanding of the psychological processes underlying behavioral formation.

In the domain of environmental behavior, perceived behavioral control has been shown to influence behavioral intention both directly and indirectly. Specifically, a few studies have shown the direct effect of perceived behavioral control on behavioral intention related to recycling (Tabernero & Hernández, 2011), water conservation (Yazdanpanah et al., 2015), and reduction in car use (Skarin et al., 2019). In contrast, Oh et al. (2020) found that perceived behavioral control moderated the impact of a persuasive message on behavioral intention related to climate change mitigation. Meinhold and Malkus (2005) found that perceived behavioral control moderated the relationship between attitude and environmental behaviors such as purchasing environmentally friendly products. Related to recycling, Rosenthal (2018) found that the association between recycling intention and recycling behavior was stronger when individuals sought information about how to recycle, because this type of information could increase people's perceived control over recycling.

In this study, we expect perceived behavioral control to moderate the relationship between attitude/subjective norms and recycling intention. Specifically, recycling is a private behavior, and it is a fairly simple action that does not demand high levels of perceived behavioral control. In addition, perceived behavioral control may also influence how participants process the video message. For instance, Lo et al. (2013) found that the more individuals believed that they had control over a risk, the more likely they would pay attention to relevant risk information. Oh et al. (2020) found that people with high self-efficacy in protecting the environment tended to invest more cognitive efforts in processing environmental messages because they believed in their ability to resolve environmental problems. This finding is consistent with the social cognitive theory in that self-efficacy can motivate people to learn and seek solutions for problems (Bandura, 1988; Oh et al., 2020). Together, it is possible that rather than exerting direct influence on recycling intention, perceived behavioral control will influence the extent to which the PSA video contributes to recycling intention through attitude and subjective norms. Specifically, we expect that the mediated relationship between video exposure and recycling intention through attitude and subjective norms should be stronger among those with high perceived behavioral control because these individuals tend to pay more attention to the message and are likely more confident in their ability to solve this problem (Oh et al., 2020). However, given the mixed evidence mentioned above, we will evaluate these relationships through two research questions:

RQ1: Does perceived behavioral control moderate the relationship between video exposure and recycling intention through attitude?

RQ2: Does perceived behavioral control moderate the relationship between video exposure and recycling intention through subjective norms?

3 Method

3.1 Research design

Upon IRB approval, we contracted *Ipsos Public Affairs* to recruit a representative sample ($N = 707$) of New York State residents from January 14 to January 29, 2021. Ipsos Knowledge Panel® is the largest online research panel that is representative of the US population. Panel members are recruited through address-based sampling, and Ipsos provides access to the Internet and hardware for households without Internet access. We conducted a one-way between-subjects experiment to test the hypotheses and research questions. Based on random assignment, all participants were exposed to either the video condition ($n = 342$) or the control condition ($n = 365$). After the experimental manipulation, respondents answered questions that measured their attitude, subjective norms, perceived behavioral control, recycling intention, and demographics.

3.2 Sample

Participants' age ranged from 19 to 92 years old ($M = 48.38$, $SD = 17.28$). The sample had slightly more females ($n = 359$, 50.9%) than males ($n = 347$, 49.1%). The majority of our respondents were White or Caucasian ($n = 415$, 58.8%), followed by Hispanic ($n = 128$, 18.0%), and Black or African-American ($n = 86$, 12.2%). Among the respondents, 39.1% had a Bachelor's degree or higher ($n = 276$), 26.2% received some college education ($n = 185$), 30.4% received high school education ($n = 215$), and 4.3% received less than high school education ($n = 30$). The median household income was in the bracket of $85,000 to $99,999. About two thirds of our respondents were employed ($n = 479$, 67.8%) at the time of data collection. Respondents reported a relatively moderate political ideology (1 = extremely liberal, 7 = extremely conservative, $M = 3.84$, $SD = 1.55$). The sample was weighted to make it properly representative of the adult population in New York State.

3.3 Stimuli material

The one-minute PSA video was designed to encourage New York State residents to engage in proper recycling. The video first introduced the benefits of recycling and then pointed out the importance of proper recycling as well as the fact that successful recycling depended on community-based efforts. Throughout the video, a middle-aged male's voice narrated the following script:

> "New Yorkers understand why we recycle. It preserves our state's beautiful natural resources. It gives old items new life, and it creates jobs. But how and what we recycle matters too. The global market has forced changes here at home, and that means looking for the chasing green arrow isn't enough. Each community has different rules on what kinds of plastic, metal, glass, and paper can be recycled. So, it's more important than ever to check with your local program. We all need to do our best to put the right things in and keep the wrong things out. In New York, there are retail drop-off programs for items that cannot be recycled at home: things like plastic bags,

rechargeable batteries, and electronics. Recycling right makes a difference. Join your neighbors. Help the environment. Create a better New York."

3.4 Measures

All items were measured on a 5-point scale from 1 = strongly disagree to 5 = strongly agree unless otherwise noted.

3.4.1 Attitude toward recycling

Adapted from previous research (Guagnano et al., 1995; Hopper & Nielsen, 1991), five items were used to measure attitude toward recycling. These items included "Recycling helps conserve natural resources," "Recycling helps reduce litter," "Recycling helps save energy," "Recycling helps reduce the use of landfills/dumps," and "What I recycle will be made into new products." Overall, our respondents reported a positive attitude toward recycling ($M = 4.11$, $SD = 0.71$, $\alpha = 0.82$).

3.4.2 Subjective norms

Seven items were used to assess subjective norms, including three items that specifically tapped into moral norms. These items included "Most people who are important to me think I should recycle," "Most people who are important to me would approve of me recycling," "My household/family members think I should recycle," "My friends/colleagues think I ought to recycle," "I feel morally obliged to recycle materials/products regardless of what other people do," "I feel guilty when I do not recycle materials/products," and "I would consider myself a better person if I recycle materials/products." All items were adapted from Onel and Mukherjee (2017) ($M = 3.76$, $SD = 0.79$, $\alpha = 0.88$).[1]

3.4.3 Perceived behavioral control

Adapted from past research (Onel & Mukherjee, 2017), six items were used to measure perceived behavioral control—"I can recycle easily," "I have plenty of opportunities to recycle," "It is inconvenient to recycle (reverse coded)," "I have been provided satisfactory resources to recycle properly," "I know which materials/products are recyclable," and "I know when and where I can recycle materials/products." Respondents reported a relatively high level of perceived behavioral control toward recycling ($M = 3.89$, $SD = 0.77$, $\alpha = 0.81$).

3.4.4 Recycling intention

Recycling intention was assessed with four items adapted from Onel and Mukherjee (2017). These items include "I intend to recycle better in the next three months," "I will try to recycle better in the next three months," "I plan to recycle better in the next three

[1] Exploratory factor analysis showed that all seven items loaded on the same factor (KMO = .88, Bartlett's Test of Sphericity = 2570.73, $p < .001$). Confirmatory factor analysis also showed that a one-factor model provided the best fit to the data ($\chi^2 = 36.73$, $df = 10$, $\chi 2/df = 3.67$, RMSEA = 0.06, 90% CI: [0.04, 0.08], CFI = 0.99, TLI = 0.98, SRMR = 0.02).

Table 1 Standardized regression coefficients predicting recycling intention.

	Recycling intention
Block 1: Demographics	
Age	−.03
Female	**.13*****
Education	.03
White	.05
Employment	**.07***
Household income	**− .18*****
Political ideology (Conservative)	**− .09***
R^2	*.07*
Block 2: TPB variables	
Attitude	**.10****
Subjective norms	**.36*****
Perceived behavioral control	**.22*****
R2 change	*.27*
Adjusted R^2	*.33*
ANOVA	$F(10,673) = 34.15$

*$p < .05$, **$p < .01$, ***$p < .001$

months," and "How likely are you to recycle better in the next three months?" Overall, our participants reported a relatively high intention to recycle better in the near future ($M = 3.63$, $SD = 0.93$, $\alpha = 0.92$).

3.5 Analysis

All data were analyzed using SPSS 26. The first set of hypotheses was tested using hierarchical ordinary least squares regression. All individual demographic variables were entered in the first block, and all TPB variables were entered in the second block. The second set of hypotheses was tested using independent samples' t tests. We used PROCESS macro Model 4 (Hayes, 2018) using 5,000 bootstrap subsamples with a 95% confidence interval (CI) to test the third and fourth hypotheses. Lastly, we used PROCESS macro Model 7 (Hayes, 2018) to examine the research questions.

4 Results

We first proposed that attitude (**H1a**), subjective norms (**H1b**), and perceived behavioral control (**H1c**) would be positively related to recycling intention. As shown in Table 1, attitude ($\beta = 0.10$, $p = 0.006$), subjective norms ($\beta = 0.36$, $p < 0.001$), and perceived behavioral control ($\beta = 0.22$, $p < 0.001$) were positively related to recycling intention. Thus, **H1** was supported. Among the control variables, females and employed participants reported a stronger intention to recycle better in the near future. Those with higher income and conservative ideology reported a weaker intention to recycle better in the near future. Overall, the TPB variables accounted for 27% of the variance in recycling intention.

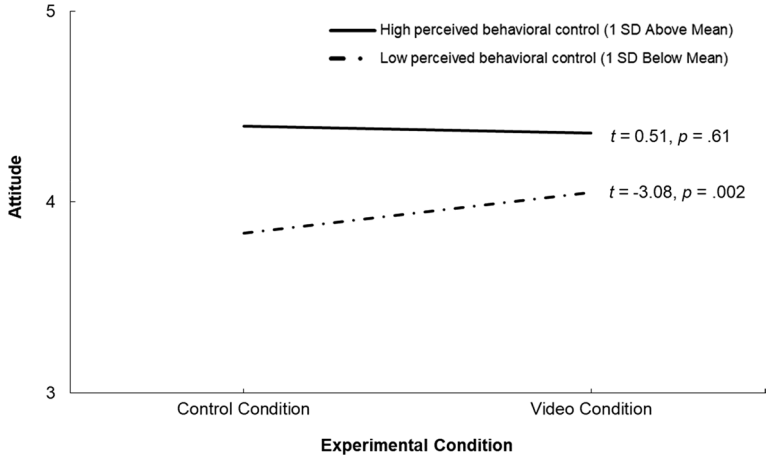

Fig. 1 Perceived behavioral control moderates the relationship between video exposure and attitude

The second set of hypotheses stated that compared to those in the control group, respondents in the video condition would report a more positive attitude toward recycling (**H2a**), perceive greater subjective norms (**H2b**), report higher perceived behavioral control (**H2c**), and express a stronger intention to recycle better (**H2d**). A series of independent samples' t tests were conducted to test these hypotheses. Results show that there was a significant mean difference between the video condition ($M = 4.19$, $SD = 0.67$) and the control condition ($M = 4.06$, $SD = 0.74$) for attitude, t (697) = 2.53, $p = 0.012$, Cohen's $d = 0.18$. Thus, **H2a** was supported. However, there were no significant between-condition differences in subjective norms, t (699) = 1.016, $p = 0.31$, and perceived behavior control, t (705) = 1.77, $p = 0.77$. Thus, **H2b** and **H2c** were not supported. There was a significant mean difference between the video condition ($M = 3.80$, $SD = 0.90$) and the control condition ($M = 3.48$, $SD = 0.92$) for recycling intention, t (695) = 4.68, $p < 0.001$, Cohen's $d = 0.35$. Thus, **H2d** was supported.

The third hypothesis stated that attitude would mediate the relationship between video exposure and recycling intention. Controlling for individual characteristics, results showed a significant mediation effect through attitude: $b = -0.02$, $SE = 0.01$, 95% CI: [− 0.0507, − 0.0008]. Thus, **H3** was supported. That is, attitude negatively mediated the relationship between video exposure (1 = video condition vs. 2 = control condition) and recycling intention. The fourth hypothesis stated that subjective norms would mediate the relationship between video exposure and recycling intention. Results indicated that the mediation effect through subjective norms was not significant: $b = -0.01$, $SE = 0.02$, 95% CI: [− 0.0378, 0.0217]. These relationships were consistent with or without covariates. Therefore, **H4** was not supported.

The first research question (**RQ1**) was focused on perceived behavioral control as a moderator in the mediation effect through attitude. Using PROCESS Model 7, results showed that perceived behavioral control moderated the relationship between video exposure and attitude ($b = 0.09$, $p = 0.01$). Specifically, respondents in the video condition reported a more favorable attitude toward recycling than those in the control condition, but this relationship was only significant among individuals with low perceived behavioral control ($b = -0.12$, $p = 0.002$) (Fig. 1). Based on the index of moderated mediation

(index of moderated mediation: 0.0398, BootLLCI: 0.0028, BootULCI: 0.0783), the mediated relationship through attitude was significantly different between those with high perceived behavioral control and those with low perceived behavioral control (Hayes, 2015). In particular, the mediation effect through attitude was stronger for those with low perceived behavioral control. The second research question (**RQ2**) was focused on the moderating role of perceived behavioral control in the mediation effect through subjective norms. Results indicated that there was no significant moderation effect on this relationship.

5 Discussion

Guided by the theory of planned behavior, this study examined the effectiveness of a PSA video in encouraging New York State residents to engage in better recycling in the near future. Consistent with the TPB, attitude, subjective norms, and perceived behavioral control were all positively related to recycling intention. Compared to the control group, the video was effective in improving participants' intention to recycle better by increasing positive attitude toward recycling. Lastly, perceived behavioral control moderated this mediation effect through attitude.

Overall, our findings evidenced the effectiveness of the TPB in predicting recycling intention, which is not surprising because the TPB has been widely supported in a variety of contexts. Among the three TPB variables, subjective norms accounted for the highest amount of variance in behavioral intention. The reason may be that we included moral norms to operationalize subjective norms. In other studies where only injunctive norms were measured, subjective norms were the weakest predictor (e.g., Knussen et al., 2004; Mannetti et al., 2004; Rhodes et al., 2015). The addition of moral norms seems to increase the predictive power of subjective norms because recycling intention is dependent on one's internalized moral responsibility to do the right thing, instead of avoiding social sanction (Botetzagias et al., 2015). Thus, moral norms may be particularly relevant to environmental behaviors. In fact, some scholars have demonstrated that framing environmental behaviors as a moral issue can motivate people to act (Chan & Bishop, 2013; Seabright, 2010). Since recycling is a prosocial behavior that is often classified in the moral domain, it is reasonable to believe that recycling intention is a function of individuals' moral beliefs concerning what is right and wrong (Thøgersen, 1996). Similar rationale can be found in other social psychology theories. For instance, the norm activation model suggests that moral norm is a primary predictor of prosocial behaviors (Schwartz, 1977). Over the years, an increasing number of TPB-based studies have included moral norm as an additional independent variable (Armitage & Conner, 2001; Bamberg & Möser, 2007). In this research, treating injunctive norm and moral norm as separate variables did not generate distinct findings. Nevertheless, future research should explore the unique contribution of different types of norms on environmental behaviors (Bamberg & Möser, 2007; Harland et al., 1999).

We found that the PSA video contributed to improved behavioral intention through attitude, but not subjective norms. In addition, although the video highlighted the benefit of recycling, the importance of community engagement, and the ease of action, it was only effective in engendering a more positive attitude toward recycling and did not influence subjective norms or perceived behavior control. These findings are consistent with Chatzisarantis and Hagger (2005), although these authors further argued that when all three antecedent variables were addressed in persuasive messages, they might cause confusion and reduce persuasive effect. Similarly, Parker et al. (1996) designed separate videos

featuring each TPB construct and found that only the video featuring normative beliefs led to behavioral change. Rosenthal and Linder (2021) found that recycling contamination was reduced when participants were presented with procedural information (i.e., how to perform recycling), but not with declarative information (i.e., why recycling is important). These authors further argued information that addressed people's attitude might be particularly useful when the target behavior was easy to perform (Rosenthal & Linder, 2021). Reflecting on these insights, future intervention based on the TPB should perhaps focus on each component separately to detect its respective influence on behavioral intention. Nevertheless, this study demonstrates that videos can be a powerful tool to influence people's intention to engage in environmental behaviors. Another possible reason is that in an individualistic society, attitude, rather than social norms, almost always exerts greater influence on people's behavior (Park & Yang, 2012). Future research should explore how each TPB variable influences behavioral formation across different cultural contexts.

The most theoretically interesting result is the moderating role of perceived behavioral control on the mediation effect through attitude. Specifically, attitude mediated the relationship between video exposure and recycling intention only among participants with low perceived behavioral control. This result is a little surprising because environmental messaging was shown to be more effective among people with high perceived behavioral control in other contexts such as climate change (Oh et al., 2020). Compared to climate change, recycling is a concrete action that requires lower self-efficacy; therefore, it makes sense that persuasive message about recycling works better among individuals with lower perceived behavioral control. In this research context, it is possible that people who perceive high behavioral control already hold crystalized beliefs about recycling, so it is difficult to modify their attitude and recycling intention. In contrast, the PSA video influences individuals with low perceived behavioral control by increasing their awareness of the importance of recycling in New York State, which then translates into a more positive attitude and stronger intention to recycle better in the future. This finding is particularly interesting because perceived behavioral control may serve as a segmentation strategy for recycling campaigns (Yzer, 2007). Specifically, PSA videos may be particularly effective among audiences who have limited knowledge about recycling or those who do not yet engage in proper recycling. Supporting this argument, Hine et al. (2014) found that audience segmentation and tailored messaging are effective tools to communicate about environmental issues such as climate change. Similarly, Kumar and Smith (2018) found that different audience groups tend to experience different levels of social pressure, which result in different intentions to purchase local food. Based on our findings, communication campaigns related to recycling can segment the target audience based on their perceived behavioral control (e.g., perceived self-efficacy, perceived barriers to engage in proper recycling). Even so, other variables may also moderate the key relationships proposed in the TPB. For instance, Wan et al. (2014) found that perceived policy effectiveness and subjective norms interacted to influence recycling intention. Wang et al. (2021) found that knowledge, personal involvement, and moral responsibility moderated the relationship between perceived behavioral control and waste sorting behavior. Therefore, future research should continue to explore other moderators based on the TPB framework.

While discussing our results, it is also important to point out limitations. First, we only assessed perceived behavioral control, not actual behavioral control, which may have a greater influence on recycling intention. For instance, the availability of household recycling service, proximity to recycling facilities, and whether local recycling program is single stream or dual stream may all influence actual behavioral control. Second, the video component that highlights benefit of recycling may have overshadowed the content

designed to highlight subjective norms (i.e., community effort) and perceived behavior control (i.e., ease of action). Future intervention should target each TPB component separately to evaluate its respective impact on recycling intention. Third, future research may further explore the impact of modality and delivery method on the PSA video's persuasive effect. Lastly, participants in the control group may have interpreted the measures of recycling intention (e.g., I intend to recycle better) in different ways. Future research may consider providing a brief definition when measuring this key variable.

In conclusion, this study reveals that attitude, subjective norms, and perceived behavioral control are significant predictors of recycling intention. In addition, the PSA video designed based on the TPB was effective in engendering recycling intention by elevating positive attitude toward recycling. More importantly, the moderation effect of perceived behavioral control suggests that strategic communication messaging delivered through a video format may be particularly effective among individuals who perceive themselves to have limited ability to recycle properly. Theoretically, this moderated mediation effect suggests that future research based on the TPB should not only examine the main effect of each predicting variable, but continue to assess the role of perceived behavior control as a moderating factor.

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Author contributions ZL contributed to writing—original draft, conceptualization, and methodology. JZY contributed to writing—reviewing and editing, methodology, and supervision. SSC performed writing—reviewing and editing. MAS administered the project.

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Availability of data and material Data can be requested from the corresponding author.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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