Predicting Recycling Behavior in New York State: an integrated model

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Abstract
Public participation in proper recycling is a crucial means to deal with the crisis in the U.S. recycling market. In this study, we combine the norm activation model (NAM; Schwartz 1977), the information-motivation-behavioral skills model (IMB; Fisher et al. 2003), and the theory of interpersonal behavior (TIB; Triandis 1977; 1979) to investigate recycling intention and behavior. Based on a longitudinal sample of New York state residents (N = 520), the results show that the integrated model fits the data well. Personal norm, habit, and recycling intention are three direct predictors of recycling behavior. Recycling intention is directly influenced by personal norm and behavioral skills, and indirectly influenced by personal motivation, social motivation, and ascription of responsibility. These findings suggest the importance of the normative approach in environmental campaigns to encourage recycling.

Keywords Recycling · Norm activation model · Information-motivation-behavioral skills model · Habit · Theory of interpersonal behavior

Introduction
Recycling in the U.S. has become an emerging environmental crisis since China’s National Sword Policy enacted in 2018, which restricted the import of secondary materials and imposed a strict contamination rate at 0.5% for imported recyclable materials (O’Donnell 2018). As a result, the recycling market in the U.S., which heavily relied on China to export its recyclables, is facing unprecedented challenges. For instance, recycling rules have been updated with fewer items accepted (Katz 2019)—being unaware of this can contaminate recycling batches and increasing recycling cost. Recycling carries crucial economic and environmental benefits by creating more job opportunities, reducing carbon emission, and conserving natural resources. In particular, recycling is a crucial solution to decreased landfill capacity and increased plastic waste in the U.S. (Di et al. 2021). Therefore, it is important to understand the American public’s recycling intention and behavior, specifically, what motivates them to recycle and what barriers deter them from recycling. These insights could inform effective campaign design at this crucial juncture.

Recycling behavior is determined by a combination of many internal and external variables. As some scholars pointed out, individuals’ decisions about recycling are so complicated that a single model cannot explain recycling behavior comprehensively (Phulwani et al. 2020). In recent years, researchers have increasingly connected different theoretical approaches to understand environmental behavior (see for example, Aboelmaged 2021; Lopes et al. 2019; Wan et al. 2021; Zhang et al. 2017). Steg and Vlek (2009) argue that there are three major perspectives in the literature that account for environmental behaviors: 1) perceived cost and benefit approach, which is represented by the theory of planned behavior (Ajzen 1991), which assumes that people make rational decisions about behavioral engagement; 2) moral and normative influence, which is captured by the norm activation model (NAM; Schwartz 1977); 3) affective and emotional factors (e.g., the model of goal-directed behavior; Perugini and Bagozzi 2001). Steg and Vlek argue...
that these theoretical perspectives are not mutually exclusive, but complement each other. They also note that in many cases, environmental behaviors are determined by habitual engagement rather than thoughtful elaboration.

Inspired by Steg and Vlek (2009), we combine the norm activation model (NAM; Schwartz 1977), the information-motivation-behavioral skills model (IMB; Fisher et al. 2003), and the theory of interpersonal behavior (TIB; Triandis 1977; 1979) to examine recycling intention and behavior. The NAM is particularly relevant to recycling behavior because recycling is often viewed as a moral and altruistic behavior (Thøgersen 1996). The IMB model includes individual and social motivations and behavioral skills, which include the main constructs of the theory of planned behavior, with the addition of information exposure. Similarly, Kaiser and Wilson (2004) also propose that individuals’ likelihood to engage in a behavior is determined by their commitment and the difficulty of the target behavior. Although the IMB has mainly been used in health domains, it may have utility in environmental research as well. In particular, de Young (1988) argued that recyclers and non-recycler were similar in their attitudes toward recycling, but they differed significantly in the information they possessed about recycling. Therefore, information may be an important determinant here. Lastly, the TIB is a rather complex model, but the inclusion of habit and emotion is particularly interesting for this research because recycling is a habitual behavior for many people.

In this study, we aim to test an integrated model that incorporates cognitive, affective, and information variables to better understand recycling intention and behavior. We believe the proposed model will help researchers achieve a more comprehensive understanding of determinants of recycling behavior. Results generated from this research will inform the design of public communication campaigns designed to engender more effective recycling behavior.

Literature Review

The Norm Activation Model

Most environmental behaviors are prosocial actions, including recycling. Because of its benefits to nature and society, many scholars have viewed recycling as a moral behavior (Thøgersen 1996). That is to say, people’s decision to engage in recycling is not dependent on elaborated cost vs. benefit calculations; rather, it is a result of moral beliefs (Thøgersen 1996). One of the most commonly used theories to explain prosocial actions is the norm activation model (de Groot and Steg 2009). The norm activation model (NAM; Schwartz 1977) posits that personal norm is the best determinant of prosocial behavior, and it is affected by individuals’ awareness of the consequences of their behavior and the acceptance of ascribed responsibility (Lopes et al. 2019). The basic premise of the NAM is that people engage in prosocial behaviors when their personal values are activated (Klöckner 2013). The NAM model has been successfully applied to a variety of environmental behaviors ranging from environmental complaint (Zhang et al. 2017), recycling (Davies et al. 2002; Hopper and Nielsen 1991; Park and Ha 2014), and reduction in car use (de Groot and Steg 2009).

According to de Groot and Steg (2009), there are three main interpretations of the relationships among NAM variables in the literature: (1) some scholars argue that the relationship between personal norm and behavior is moderated by awareness of consequences and ascription of responsibility (e.g., Vining and Ebreo 1992). It is also referred to as the NAM as a moderator model (de Groot and Steg 2009; Schwartz 1977); (2) both awareness of consequences and ascription of responsibility are direct predictors of personal norm, which further influences behavioral intentions or behaviors (e.g., Bamberg and Schmidt 2003), (3) awareness of consequences influence ascription of responsibility, which in turn influences personal norm and behavior, which is essentially a mediation model (Steg and de Groot 2010). For instance, de Groot and Steg (2009) applied the NAM to examine five types of prosocial behaviors and found consistent support for the NAM as a mediation model. In a subsequent study, Steg and de Groot (2010) further supported the NAM as a mediation model. In particular, to activate personal norm, people must be aware of the consequences of a certain behavior and feel responsible to perform the behavior, and personal norm is the only direct predictor of prosocial behaviors (Bamberg and Schmidt 2003). Based on this rationale, we posit the first series of hypotheses:

H1: Awareness of consequences is positively related to ascription of responsibility.
H2: Ascription of responsibility is positively related to personal norm.
H3: Personal norm is positively related to recycling intention.
H4: Ascription of responsibility will mediate the relationship between awareness of consequences and personal norm.
H5: Personal norm will mediate the relationship between ascription of responsibility and recycling intention.

Furthermore, the crucial role of personal norm in recycling behavior is a well-established finding in
environmental research. According to a meta-analysis, Miafodzyeva and Brandt (2013) found that personal/moral norm was one of the stronger determinants of recycling behavior. Synthesizing from 11 studies, Bamberg and Möser (2007) found a mean correlation of $r = 0.39$ of personal/moral norm and environmental behavior. Because of the strong effect of personal norm, we will also examine its direct influence on recycling behavior:

**H6:** Personal norm is positively related to recycling behavior.

However, the NAM only focuses on internal moral factors that affect individuals’ recycling intention, but external variables also need to be taken into account (He and Zhan 2018).

### The Information–Motivation–Behavioral Skills Model

The IMB model posits that information, motivation, and behavioral skills are fundamental determinants of behavioral adoption and adherence (Fisher et al. 2003). That is to say, when people are well informed about a problem, have enough motivation to act, and possess necessary skills to act, they are more likely to perform and maintain a behavior (Fisher et al. 2003). Despite the fact that the IMB was originally evaluated in health domains, there is a growing trend of applying health psychology theories to environmental contexts (Nisbet and Gick 2008; Seacat and Northrup 2010). Compared to other behavioral formation theories such as the theory of planned behavior (Ajzen 1991), the IMB emphasizes the importance of information exposure. Information is particularly important for recycling behavior because a lack of accurate information may result in wishful recycling (i.e., recycle items one deems to be recyclable, but are actually not) and contamination. This model has been applied successfully to environmental issues such as water conservation (Ehret et al. 2021) and recycling (Seacat and Northrup 2010).

The first construct of the IMB model is information. It has been recognized that behavioral change is more likely to happen when people have proper knowledge or information (Ehret et al. 2021). Although information exposure does not necessarily translate into actual behavior, a lack of information has been shown to be a barrier to recycling (Carmi et al. 2015; Schultz 2002; Rosenthal and Leung 2020; Vining and Ebreo 1992). According to the IMB, information is a prerequisite of acting properly and consistently, and accurate information can facilitate behavioral change, whereas inaccurate information impedes behavioral change (Fisher et al. 2006). In the IMB literature, information is often conceptualized as knowledge about a problem (Ehret et al. 2021). Related to recycling, knowledge can be categorized into procedural knowledge (knowledge about when, where, and how to recycle), impact knowledge (awareness of the consequences of recycling), and normative knowledge (perception of others’ behaviors) (Schultz 2002). Among the three, procedural knowledge is the most examined form of knowledge because it can reduce uncertainty about the recycling process and increase individuals’ self-efficacy, which is particularly useful for those who want to recycle better (Rosenthal and Leung 2020). In addition, in the IMB literature, information is often conceptualized and operationalized as information that facilitates or impedes the performance of a target behavior (Seacat and Northrup 2010). Specifically, related to recycling, such information may include knowledge about how to prepare recyclable items, knowledge about local recycling schedules, knowledge about what is recyclable or not in one’s area and so on (Seacat and Northrup 2010). Together, we limit our definition of information to individuals’ understanding of the recycling process (i.e., procedural knowledge).

Another determinant of behavioral adoption and adherence is motivation. According to the IMB model, there are two types of motivation: personal motivation and social motivation. Personal motivation refers to individuals’ attitudes toward behavior and the perceived outcomes of this behavior (Seacat and Northrup 2010). In addition to the IMB model, attitude is also a key component of other social psychology theories such as the theory of planned behavior, and it has been identified as a consistent determinant of behavioral intention (Armitage and Conner 2001). Social motivation refers to perceived social support from referent others (Fisher et al. 2006), which is often conceptualized and operationalized as social norms in IMB-based study (e.g., Ehret et al. 2021; Seacat and Northrup 2010). We argue that if individuals perceive recycling as a popular behavior among their referent others, including their family members, friends, or colleagues, or if their referent others approve of them engaging in recycling, they are more likely to recycle.

Behavioral skills concern individuals’ objective and perceived ability to perform a behavior, and these skills determine whether informed and motivated individuals are capable to act (Fisher et al. 2006). This construct is similar to perceived behavioral control or self-efficacy, and it is commonly measured by the self-efficacy scale in the IMB literature (Ehret et al. 2021). Depending on the difficulty of the target behavior, information and motivation influence behavioral intention directly or indirectly: when the target behavior is not difficult to perform, information and motivation tend to influence behavioral
intention directly; when the target behavior is complex and requires multiple steps, information and motivation are more likely to influence behavioral intention through behavioral skills (Fisher et al. 2006; Seacat and Northrub 2010). In the context of recycling, Seacat and Northrub (2010) found that information and motivation influence recycling behavior through behavioral skills and they attributed this indirect effect to the fact that recycling requires skills to perform. Consistent with Seacat and Northrub (2010), we posit that:

H7: Information is positively related to behavioral skills.

H8: Personal motivation is positively related to behavioral skills.

H9: Social motivation is positively related to behavioral skills.

H10: Behavioral skills is positively related to behavioral intention.

H11: Behavioral skills mediate the relationship between information and behavioral intention.

H12: Behavioral skills mediate the relationship between personal motivation and behavioral intention.

H13: Behavioral skills mediate the relationship between social motivation and behavioral intention.

Social norms, which are also termed as social motivation in this study, directly influence the development of personal norms because it offers a benchmark as to what behaviors are socially popular and acceptable. Based on social norms, individuals internalize these standards and form personal norm (Bamberg and Möser 2007). Widely shared social norms are generally accepted by individuals and internalized as self-evaluation and self-expectations, even when they are not consciously learned (Schwartz 1977). Through a meta-analysis, Klöckner (2013) found that social norms influence personal norms. Similarly, if individuals hold positive attitude toward recycling, they may feel a sense of responsibility to recycle because they view it as a beneficial and responsible behavior to both the environment and society. Some scholars maintain that individuals’ attitudes toward a behavior reflect their evaluations of the environmental, social, and moral implications of the behavior (Floress et al. 2017). Thus, ascription of responsibility should be associated with attitude (Floress et al. 2017; Thompson et al. 2015). Therefore, we further posit that:

H14: Social motivation is positively related to personal norm.

H15: Personal motivation is positively related to ascription of responsibility.

The Theory of Interpersonal Behavior

The theory of interpersonal behavior (TIB) (Triandis 1977; 1979) is very similar to the theory of planned behavior in that both theories include expectancy-value and normative influence constructs (Bamberg and Schmidt 2003; Lopes et al. 2019). However, the TIB is less frequently used compared to the theory of planned behavior and the NAM due to its complexity (Lopes et al. 2019). The basic assumption of the TIB is that individuals’ rationality decreases as the target behavior becomes habitual (Bamberg and Schmidt 2003). Most research on environmental behaviors has focused on cognitive variables such as attitude and subjective norm, but non-cognitive factors such as habit and emotion deserve more attention (Russell et al. 2017). Some scholars have argued that a lot of environmental behaviors are not the result of rational choice, but are shaped by affective processes (Carrus et al. 2008; Russell et al. 2017; Steg and Vlek 2009). Therefore, in this research, we also incorporate habit and emotion from the TIB into our model.

Triandis (1977; 1979) argues that past behavior and habit play a crucial role in predicting current behavior. Habitual behavior is triggered by a learned cognitive structure that is stored in memory and can be retrieved easily when individuals are in a particular situation (Steg and Vlek 2009), and people have a natural inclination to act in line with their past behavior (Ouellette and Wood 1998). In particular, environmental behaviors like recycling are often guided by automatic cognitive processes rather than rational reasoning (Steg and Vlek 2009). According to Ouellette and Wood (1998), habit is more likely to be formed when behaviors are performed on a regular basis (e.g., daily or weekly) in a stable context. It is also worth noting that although past behavior and habit are conceptually distinct, they are often measured the same way (Conner and Armitage 1998). Thus, we use them interchangeably in this research. Given the frequency and repetitiveness of recycling behavior, we argue that it involves a strong habitual tendency (Russell et al. 2017): individuals need to collect their recyclable items perhaps multiple times a day, put their recycling bin on the curbside weekly or biweekly, and go to recycling center to recycle specific items such as electronic devices or batteries occasionally. Empirical evidence supports this conjecture in that past behavior or habit is a significant predictor of behavioral intentions and behaviors (Klöckner
In addition, Ouellette and Wood (1998) suggest that for behaviors that are performed in a stable and predictable context, past behavior is a stronger determinant of future behavior than behavioral intention. Therefore, rather than hypothesizing a direct association between habit and recycling intention, we propose that:

**H16:** Habit is positively related to recycling behavior.

Another highlight of the TIB is the inclusion of emotion. Because recycling is a type of moral and altruistic behavior, individuals’ affective responses may outweigh cognitive factors in influencing behavioral intention (Smith et al. 1994; Vining and Ebreo 2002). The effect of emotion on people’s attitude, judgment, and behaviors has been documented in several psychological theories. For instance, the affect heuristic hypothesis suggests that people rely on affect when making decisions (Finucane et al. 2000). That is to say, affect serves as a kind of “heuristic” in people’s decision-making process. Further, Slovic and colleagues (2004) propose that there are two systems that people employ when evaluating risks: the “analytic system” refers to the rational assessment of a risk, whereas the “experiential system” depicts the intuitive and quick way of judging a risk. The latter relies on the images and associations of a stimuli, which can evoke people’s positive or negative affective responses, and thus influence their decision-making. For example, when thinking of recycling, people may think of a green environment and new products made of recycled materials and experience good feelings such as hope and pride, which can further motivate them to recycle. In addition, cognitive dissonance theory suggests that it is emotionally unpleasant to have inconsistent attitude and behavior—therefore, people have a tendency to avoid inconsistencies by acting in line with their attitude (Festinger 1957; Thøgersen 2004). When people maintain pro-environmental attitude, but do not engage in environmentally friendly behaviors, a dissonant state will arise along with negative emotions (Vining and Ebreo 2002).

Environmental studies have shown that when people derive pleasure or satisfaction from environmental behaviors, they are more likely to perform these behaviors (Lindenberg and Steg 2007; Pelletier et al. 1998). Vining and Ebreo (2002) also argue that self-evaluative emotions like pride, which result from compliance with a socially desired standard, could motivate environmental behaviors. Additionally, Carrus et al. (2008) found that emotions associated with a behavior can serve as a specific cue to act. Indeed, Carmi et al. (2015) found that having enough knowledge did not lead to environmental behavior directly, rather, emotions fully mediated the relationship between knowledge and behavior. Thus, we hypothesize that:

**H17:** Emotion toward recycling is positively related to recycling intention.

It is widely recognized that behavioral intention does not equate behavior (Sheeran and Webb 2016), but behavioral intention is a proximal determinant of actual behavior (Ajzen 1991; Conner and Armitage 1998). Also, behavioral intention is typically associated with future behavior, not current behavior (Ajzen 1985). Furthermore, behavioral intention and actual behavior may be affected by different variables. Through a meta-analysis, Klöckner (2013) found that behavioral intention, perceived behavioral control, and habit were direct determinants of behavior, whereas factors like attitude only predict behavioral intention. Similarly, Geiger et al. (2019) suggested that individual factors like emotion may better predict behavioral intention rather than behavior. Therefore, our last hypothesis is:

**H18:** Behavioral intention is positively related to recycling behavior.

Figure 1 shows the theoretical model with hypotheses.

**Method**

**Sample**

Upon IRB approval, two waves of survey were conducted. We contracted Ipsos Public Affairs to recruit a representative sample of New York state residents. Ipsos Knowledge Panel® is the largest online research panel that is representative of the entire U.S. population. It uses probability-based sampling to randomly recruit panel members, with the capability to include hard-to-reach populations by providing them internet and hardware access. Selected panel members received email invitations and were requested to complete the survey at their earliest convenience. The questionnaire was pre-tested among a small group of participants (n = 38) recruited by Ipsos first. After finalizing the questionnaire, wave 1 survey began on May 26, 2020 and ended on June 3, 2020 (N = 1010). After seven months, wave 2 survey was conducted from January 14, 2021 to January 29, 2021 (N = 1037). In this study, we focused on the subsample of respondents that participated in both surveys (n = 520). We used the same set of questions in both surveys. The median survey completion time for both surveys was 20 min. In this subsample, we had slightly more females (52.2%) than males (47.8%), and the average age was 49.53 (SD = 17.88). The majority of our sample was White (58.7%). Among the respondents, 36.9% (n = 192) received bachelor’s degree or higher, followed by high school (n = 169, 32.4%), some college (n = 136, 26.2%), and less than high...
school education \((n = 24, 4.5\%)\). The median household income was in the bracket of \$85,000–\$99,999, and most of our respondents \((64.1\%)\) were employed. In terms of political ideology, respondents reported middle-of-the-road political ideology \((M = 3.87, SD = 1.51, 1 = \text{extremely liberal}, 7 = \text{extremely conservative})\). Overall, our sample was comparable to the 2019 American community survey on gender and education distribution, but we overrepresented younger, non-White, and more educated populations, and those have higher incomes \((\text{Table 1})\).

**Measures**

Table 2 shows individual items’ wording and descriptive statistics of all variables \((\text{except for information items, which are shown in Tables 3 and 4})\). Unless otherwise noted, all items were measured on a 5-point scale.

**Personal motivation**

Three items adapted from Guagnano et al. \((1995)\) were used to measure personal motivation toward recycling \((\text{survey 1: } M = 3.51, SD = 0.89, \alpha = 0.66; \text{survey 2: } M = 3.44, SD = 0.91, \alpha = 0.70)\).

**Social motivation**

Four items adapted from previous research \((\text{Onel and Mukherjee 2017})\) were used to measure social motivation \((\text{survey 1: } M = 3.67, SD = 0.82, \alpha = 0.86; \text{survey 2: } M = 3.65, SD = 0.87, \alpha = 0.88)\).

**Information**

In line with the original theory \((\text{Fisher et al. 2003})\), we consulted with two experts from the New York Department of Environmental Conservation to develop 18 yes-or-no questions about whether certain items are recyclable in home recycling bins in New York state. We recoded the responses into 0 = incorrect and 1 = correct, and “not sure”
Table 2 Descriptive data for key variables

| Concept                        | Measures                                                                 | Wave 1 M | Wave 1 SD | Wave 2 M | Wave 2 SD |
|--------------------------------|--------------------------------------------------------------------------|----------|-----------|----------|-----------|
| Personal Motivation (1-5 scale)| Finding room to store recyclable materials is a problem (Reversed).     | 3.19     | 1.31      | 3.02     | 1.27      |
|                                | The problem with recycling is finding time to do it (Reversed).          | 3.86     | 1.01      | 3.87     | 1.04      |
|                                | Storing recyclable materials at home is unsanitary (Reversed).           | 3.45     | 1.12      | 3.46     | 1.16      |
|                                | Averaged scale                                                           | 3.51     | 0.89      | 3.44     | 0.91      |
|                                | Cronbach’s alpha                                                         | 0.66     | 0.70      |           |           |
| Social Motivation (1-5 scale)  | Most people who are important to me think I should recycle.             | 3.57     | 0.97      | 3.60     | 1.00      |
|                                | Most people who are important to me would approve of me recycling.      | 3.96     | 0.96      | 3.96     | 0.95      |
|                                | My household/family members think I should recycle.                     | 3.71     | 1.03      | 3.69     | 1.08      |
|                                | My friends/colleagues think I ought to recycle.                         | 3.42     | 0.96      | 3.36     | 1.05      |
|                                | Averaged scale                                                           | 3.67     | 0.82      | 3.65     | 0.87      |
|                                | Cronbach’s alpha                                                         | 0.86     | 0.88      |           |           |
| Behavioral Skills (1-5 scale)  | I can recycle easily.                                                    | 3.93     | 0.95      | 3.98     | 1.04      |
|                                | I have plenty of opportunities to recycle.                              | 3.99     | 0.95      | 4.02     | 1.00      |
|                                | I have been provided satisfactory resources to recycle properly.        | 3.59     | 1.02      | 3.75     | 1.08      |
|                                | I know which materials/products are recyclable.                         | 3.69     | 0.92      | 3.89     | 0.90      |
|                                | I know when and where I can recycle materials/products.                  | 3.72     | 0.97      | 3.78     | 1.03      |
|                                | Averaged scale                                                           | 3.78     | 0.74      | 3.89     | 0.81      |
|                                | Cronbach’s alpha                                                         | 0.83     | 0.86      |           |           |
| Awareness of Consequences (1-5 scale) | Recycling helps conserve natural resources.                             | 3.96     | 0.96      | 4.20     | 0.87      |
|                                | Recycling helps reduce litter.                                           | 4.16     | 1.00      | 4.31     | 0.93      |
|                                | Recycling helps save energy.                                             | 3.81     | 0.94      | 3.93     | 0.98      |
|                                | Recycling helps reduce use of landfills/dumps.                           | 4.12     | 0.93      | 4.27     | 0.88      |
|                                | Averaged scale                                                           | 4.02     | 0.74      | 4.18     | 0.73      |
|                                | Cronbach’s alpha                                                         | 0.78     | 0.81      |           |           |
| Ascription of Responsibility (1-5 scale) | I am responsible for recycling properly.                               | 4.08     | 0.96      | 4.23     | 0.95      |
| Personal Norm (1-5 scale)      | I feel morally obliged to recycle materials/products regardless of what other people do. | 4.07     | 1.04      | 4.08     | 0.97      |
|                                | I feel guilty when I do not recycle materials/products.                  | 3.83     | 1.06      | 3.75     | 1.15      |
|                                | I would consider myself a better person if I recycle materials/products. | 3.70     | 1.06      | 3.71     | 1.10      |
|                                | Averaged scale                                                           | 3.87     | 0.89      | 3.85     | 0.92      |
|                                | Cronbach’s alpha                                                         | 0.81     | 0.82      |           |           |
| Emotion (1-5 scale)            | *Please indicate how true each statement is of you.*                     |          |           |           |           |
|                                | When I recycle, I feel happy.                                           | 2.88     | 1.28      | 2.95     | 1.32      |
|                                | When I recycle, I feel hopeful.                                         | 2.75     | 1.26      | 2.87     | 1.33      |
|                                | When I recycle, I feel proud of myself.                                 | 2.90     | 1.33      | 3.08     | 1.37      |
|                                | When I can't recycle, I feel anxious.                                   | 2.05     | 1.17      | 2.03     | 1.18      |
|                                | When I can't recycle, I feel upset.                                     | 2.30     | 1.25      | 2.28     | 1.22      |
|                                | When I can't recycle, I feel frustrated.                                | 2.40     | 1.33      | 2.41     | 1.28      |
|                                | Averaged scale                                                          | 2.54     | 1.05      | 2.60     | 1.09      |
|                                | Cronbach’s alpha                                                        | 0.91     | 0.92      |           |           |
| Habit (1-4 scale)              | *Before the coronavirus pandemic, how often did you recycle the following materials at home?* |          |           |           |           |
|                                | Glass bottles                                                           | 3.44     | 0.99      |           |           |
|                                | Newspaper/Magazines                                                     | 3.33     | 1.08      |           |           |
|                                | Metal containers                                                        | 3.32     | 1.05      |           |           |
|                                | Junk mail                                                               | 2.85     | 1.27      |           |           |
|                                | Cardboard                                                               | 3.46     | 0.96      |           |           |
|                                | Plastic bottles and jugs                                                | 3.58     | 0.83      |           |           |
|                                | Averaged scale                                                          | 3.50     | 0.76      |           |           |
responses were coded as incorrect. Overall score was calculated based on the number of correct answers (survey 1: $M = 0.59$, SD = 0.23, $\alpha = 0.82$; survey 2: $M = 0.58$, SD = 0.23, $\alpha = 0.82$). Tables 3 and 4 show percentages of correct answers for each item in both surveys.

Behavioral skills

We measured behavioral skills with five items adapted from previous research (Onel and Mukherjee 2017) (survey 1: $M = 3.78$, SD = 0.74, $\alpha = 0.83$; survey 2: $M = 3.89$, SD = 0.81, $\alpha = 0.86$).

Awareness of consequences

We measured awareness of consequences with four items adapted from Hopper and Nielsen (1991) (survey 1: $M = 4.02$, SD = 0.74, $\alpha = 0.78$; survey 2: $M = 4.18$, SD = 0.73, $\alpha = 0.81$).

Ascription of responsibility

One item adapted from Steg et al. (2005) was used to measure ascription of responsibility (survey 1: $M = 4.08$, SD = 0.96; survey 2: $M = 4.23$, SD = 0.73, $\alpha = 0.95$).

Personal norm

Three items adapted from previous research (Onel and Mukherjee 2017) were used to measure personal norm (survey 1: $M = 3.87$, SD = 0.89, $\alpha = 0.81$; survey 2: $M = 3.85$, SD = 0.92, $\alpha = 0.82$).

Emotion

To assess affective responses, we employed six discrete emotions that are frequently used in emotion research (e.g., Nabi et al. 2018). We assessed three positive emotions (happy, hope, and pride) and three negative emotions (anxiety, upset, and frustration). It is worth noting that although we measured both positive and negative emotions, all items were coded so that higher values indicate more positive emotions toward recycling (survey 1: $M = 2.54$, SD = 1.05, $\alpha = 0.91$; survey 2: $M = 2.60$, SD = 1.09, $\alpha = 0.92$).

Recycling behavior and habit

We measured respondents’ recycling behavior by asking how often they recycled glass bottles, newspaper/magazines, metal containers, junk mail, cardboard, plastic bottles, and jugs before the lockdown due to the COVID-19 pandemic in both wave 1 and wave 2 survey. We treated respondents’ recycling behavior at wave 2 survey as recycling behavior, and their recycling behavior at wave 1 survey as habit/past behavior. Overall, our respondents reported a high level of engagement in recycling behavior (survey 1: $M = 3.50$, SD = 0.76, $\alpha = 0.90$; survey 2: $M = 3.49$, SD = 0.75, $\alpha = 0.89$).
Table 3 Descriptive data for information items in wave 1 survey

| Are the following items recyclable in your home recycling bin? | Yes | No | Not Sure |
|---------------------------------------------------------------|-----|----|---------|
| Plastic shopping bags (No)                                    | 33.9% | 55.8% | 10.3% |
| Styrofoam (No)                                                | 22.0% | 65.5% | 12.5% |
| Milk jugs (Yes)                                               | 81.5% | 11.5% | 7.0% |
| Drinking glasses (No)                                         | 50.8% | 36.2% | 13.0% |
| Ceramics (plates, bowls, and flower pots) (No)                | 27.1% | 50.5% | 22.4% |
| Store receipts (No)                                           | 47.6% | 39.3% | 13.1% |
| Candy bar wrappers and chip bags (No)                         | 18.8% | 64.8% | 16.4% |
| Clean aluminum foil (Yes)                                     | 54.1% | 30.8% | 15.1% |
| Metal cans (Yes)                                              | 87.0% | 9.6%  | 3.4%  |
| Batteries (No)                                                | 23.5% | 61.5% | 15.0% |
| Electronics (No)                                              | 25.6% | 60.7% | 13.8% |
| Textiles like clothing, blankets, and bedding (No)            | 14.3% | 67.8% | 17.9% |
| Wine bottles (Yes)                                            | 77.6% | 15.1% | 7.2%  |
| Napkins, paper towels, and tissues (No)                       | 26.0% | 62.5% | 11.5% |
| Disposable coffee cups (No)                                   | 32.2% | 51.8% | 16.0% |
| Diapers (No)                                                  | 4.5%  | 79.9% | 15.6% |
| Plastic beverage pouches (No)                                 | 35.0% | 45.9% | 19.2% |
| Anything that contains plastic, metal, glass, or paper (No)   | 59.4% | 19.9% | 20.7% |

Table 4 Descriptive data for information items in wave 2 survey

| Are the following items recyclable in your home recycling bin? | Yes | No | Not Sure |
|---------------------------------------------------------------|-----|----|---------|
| Plastic shopping bags (No)                                    | 32.5% | 52.3% | 15.2% |
| Styrofoam (No)                                                | 20.2% | 62.3% | 17.5% |
| Milk jugs (Yes)                                               | 84.3% | 9.0%  | 6.8%  |
| Drinking glasses (No)                                         | 58.0% | 25.9% | 16.1% |
| Ceramics (plates, bowls, and flower pots) (No)                | 26.5% | 46.3% | 27.2% |
| Store receipts (No)                                           | 49.6% | 30.3% | 20.1% |
| Candy bar wrappers and chip bags (No)                         | 20.0% | 59.2% | 20.8% |
| Clean aluminum foil (Yes)                                     | 55.2% | 26.4% | 18.4% |
| Metal cans (Yes)                                              | 87.3% | 8.2%  | 4.5%  |
| Batteries (No)                                                | 25.3% | 62.8% | 11.9% |
| Electronics (No)                                              | 23.3% | 64.5% | 12.2% |
| Textiles like clothing, blankets, and bedding (No)            | 16.7% | 63.4% | 19.8% |
| Wine bottles (Yes)                                            | 80.3% | 12.5% | 7.2%  |
| Napkins, paper towels, and tissues (No)                       | 26.1% | 54.8% | 19.1% |
| Disposable coffee cups (No)                                   | 30.0% | 47.9% | 22.1% |
| Diapers (No)                                                  | 7.5%  | 71.7% | 20.8% |
| Plastic beverage pouches (No)                                 | 34.6% | 42.3% | 23.1% |
| Anything that contains plastic, metal, glass, or paper (No)   | 51.4% | 24.4% | 24.2% |

Recycling intention

Adapted from Onel and Mukherjee (2017), we measured recycling intention with four items. In both surveys, our respondents reported a relatively strong intention to recycle in the future (survey 1: $M = 3.46$, $SD = 0.90$, $\alpha = 0.91$; survey 2: $M = 3.60$, $SD = 0.95$, $\alpha = 0.92$).

Analysis

We used path analysis in Mplus 8 to test our hypotheses and the integrated model. To document potential changes in recycling behavior over time, given the recent change in the recycling system, we employed a residual approach (Fung et al. 2018; Moyer et al. 2019) to remove the variance accounted for by wave 1 variables. Specifically, all variables except for recycling behavior and habit at wave 1 were entered into regression along with demographic variables as predictors of the corresponding variables at wave 2, and the predicted values were saved as unstandardized residuals. The unstandardized residuals were used in the path analysis.

Results

The model fit the data well: $\chi^2(27) = 74.54$, $\chi^2/df = 2.76$, $p$-close = 0.00, RMSEA = 0.06, 90% CI: [0.05, 0.08], CFI = 0.95, TLI = 0.92, SRMR = 0.06. Table 5 summarizes the results of all hypotheses. Path analysis showed that awareness of consequences was positively related to ascription of responsibility ($\beta = 0.41$, $p < 0.001$), supporting H1. Ascription of responsibility was positively related to personal norm ($\beta = 0.15$, $p < 0.001$), supporting H2. Personal norm was positively related to recycling intention ($\beta = 0.15$, $p = 0.002$), supporting H3. Mediation analysis indicated that ascription of responsibility mediated the relationship between awareness of consequences and personal norm ($b = 0.06$, $p < 0.001$, 95% confidence interval (CI): [0.03, 0.10]), and personal norm mediated the relationship between ascription of responsibility and recycling intention ($b = 0.02$, $p = 0.02$, 95% CI: [0.00, 0.04]), supporting H4 and H5 respectively. The results also showed that personal norm was positively related to recycling behavior ($\beta = 0.09$, $p < 0.001$), supporting H6.

Related to the IMB model, information was not related to behavioral skills ($\beta = 0.06$, $p = 0.19$), thus, H7 was not supported. Personal motivation was positively related to behavioral skills ($\beta = 0.13$, $p = 0.006$), supporting H8. Social motivation was also positively related to behavioral skills ($\beta = 0.14$, $p = 0.003$), supporting H9. Behavioral skills was positively related to behavioral intention ($\beta = 0.15$, $p = 0.002$), supporting H10. Mediation analysis showed that behavioral skills mediated the relationship...
between personal motivation and recycling intention ($b = 0.02$, $p = 0.04$, 95% confidence interval (CI): [0.00, 0.04]), as well as the relationship between social motivation and recycling intention ($b = 0.02$, $p = 0.03$, 95% confidence interval (CI): [0.00, 0.04]). However, behavioral skills did not mediate the relationship between information and behavioral intention ($b = 0.01$, $p = 0.23$, 95% confidence interval (CI): [−0.00, 0.02]). Thus, $H_{11}$ was not supported, but $H_{12}$ and $H_{13}$ were supported.

Lastly, social motivation was positively related to personal norm ($\beta = 0.52$, $p < 0.001$), supporting $H_{14}$. Personal motivation was positively related to ascription of responsibility ($\beta = 0.14$, $p < 0.001$). Thus, $H_{15}$ was supported. Habit was positively related to recycling behavior ($\beta = 0.81$, $p < 0.001$), supporting $H_{16}$. Interestingly, emotion was not related to recycling intention ($\beta = 0.08$, $p = 0.09$). Thus, $H_{17}$ was not supported. Behavioral intention was positively related to recycling behavior ($\beta = 0.07$, $p = 0.01$), supporting $H_{18}$.

Overall, the path model accounted for 20% of the variance in ascription of responsibility, 31% of the variance in personal norm, 5% of the variance in behavioral skills, 6% of the variance in recycling intention, and 69% of the variance in recycling behavior. Figure 2 illustrates the main findings, along with fit indices of the model.

### Discussion

To our knowledge, this study is the first to combine the norm activation model (NAM; Schwartz 1977), the information-motivation-behavioral skills model (IMB; Fisher et al. 2003), and the theory of interpersonal behavior (TIB; Triandis 1977; 1979) to examine individuals’ recycling intention and recycling behavior. Employing a longitudinal design, the integrated model delineates the relative contribution of important socio-psychological variables that collectively account for almost 70% of the variance in recycling behavior. Specifically, recycling behavior is predicted by personal norm, habit, and recycling intention, and recycling intention is directly influenced by personal norm and behavioral skills, and indirectly influenced by personal motivation, social motivation, and ascription of responsibility.
Since recycling is an altruistic behavior that brings few immediate individual rewards (Hopper and Nielsen 1991), the NAM provides a suitable framework because it is particularly effective in predicting prosocial behaviors. In line with past research (de Groot and Steg 2009), our finding supports the NAM as a mediation model. Specifically, ascription of responsibility mediates the relationship between awareness of consequences and personal norm, and ascription of responsibility influences behavioral intention through personal norm. That is to say, individuals need to be aware of the consequences of recycling first and then perceive a sense of responsibility to recycle, which in turn heightens their sense of moral obligation, which further motivates them to engage in recycling eventually. This finding is theoretically sound because moral obligation often originates from problem awareness and feelings of responsibility—only when these conditions are met can personal norm affect behavioral intention (de Groot and Steg 2009). Similarly, Hopper and Nielsen (1991) state that personal norm translates into recycling behavior only when problem awareness is high. Moreover, personal norm has been identified as one of the most crucial determinants of many environmental behaviors (Bamberg and Möser 2007), including recycling (Hopper and Nielsen 1991) and environmental complaint (Zhang et al. 2017). Thus, for communication practitioners, future campaigns can benefit from highlighting moral obligation and personal norm to encourage citizens to adopt environmental behaviors such as recycling.

Regarding the IMB model, personal and social motivation influence recycling intention through behavioral skills. That is, personal and social motivation work through behavioral skills to influence recycling intention. As Seacet and Northrub (2010) suggest, certain knowledge and skills are required to engage in proper recycling, such as understanding the updated recycling rules in one’s town or county. In other words, people need to have proper knowledge in order to feel confident that they can recycle properly. This finding is also in line with other behavior theories such as the theory of planned behavior in that people’s likelihood to engage in a behavior will increase if they possess both the motivation and the ability (Ajzen 1991). Furthermore, we also found that social motivation is positively associated with personal norm. People’s perception of what is socially desirable shapes their attitude toward the behavior and helps them develop moral perceptions (Park and Ha 2014). Therefore, creating a social environment that favors proper recycling may foster personal norm toward recycling, which is a direct and strong predictor of recycling behavior. However, according to a survey by the Pew Research Center (2016), only three in ten Americans report that their community’s social norms strongly encourage recycling. This contrast reveals an opportunity for communication campaigns, which is to adopt a social norm approach to encourage better recycling. For instance, communication practitioners can tell residents that “join your neighbors to recycle” or “our community cares about
recycling” to make them perceive a norm that favors recycling in the community. Community leaders can also create recycling clubs for residents to share their experience and skills related to recycling and thus form social norms that favor recycling in their community.

Integrating the NAM and the IMB, our results also indicate that personal motivation is related to ascription of responsibility. That is, a sense of responsibility can shape people’s attitude toward recycling and vice versa. Linking to the social norm approach mentioned above, highlighting individual responsibility to recycle properly is also crucial because once people see themselves as being responsible, they are more likely to maintain favorable attitude toward recycling, despite the fact that it may not always be convenient to recycle.

Inconsistent with previous research (Seacat and Northrub 2010), we did not find a significant relationship between information and behavioral skills. In the IMB literature, information is measured inconsistently. Some scholars use self-report measures to assess information level (e.g., Seacat and Northrub 2010), while others use more objective measures such as true-or-false questions (e.g., Cornman et al. 2007; Fisher et al. 2003). In this study, we opted to use the latter approach in order to get a more accurate sense of objective knowledge, which may explain the contradictory result from Seacat and Northrub (2010). Future research should continue to explore proper conceptualization and operationalization of the information construct of the IMB. For instance, incorporating other types of knowledge about recycling, such as impact and normative information (Schultz 2002), may be a useful strategy. In addition, a more precise measure of behavioral skills may better capture this relationship. Future research may further explore more refined ways to assess behavioral skills. On the other hand, although no significant relationship between information and behavioral skills was found in the current research, it is crucial to provide residents accessible and accurate information because copious research (e.g., Rosenthal and Leung 2020; Seacat and Northrub 2010) has documented the importance of information or knowledge in recycling behavior; lacking proper knowledge can frustrate people’s willingness to engage in recycling (Rosenthal and Leung 2020) or even harm collective recycling efforts.

Thus, at the policy level, policymakers should offer consistent and easy-to-understand recycling guidelines; for private sectors, they can provide clear recycling labels on consumer products to guide people to recycle properly.

Against our expectation, although emotion is typically a strong predictor of behavior (Carmi et al. 2015; Vining and Ebreo 2002), we did not find any significant association between emotion and recycling intention. Kollmuss and Agyeman (2002) argue that emotional involvement in environmental topics is a “learned” ability because it requires a certain level of environmental knowledge and problem awareness to respond to environmental issues. In this case, our respondents probably have not developed sufficient understanding of the recycling problem to experience any emotional reaction to this topic. Indeed, all the emotions are rated around the middle point of the scale. Future research should offer more context to inquire individuals’ emotional reaction to the outlook of recycling, instead of the recycling behavior per se. To this end, it is also urgent to raise people’s awareness of the recycling problem. Policymakers and communication practitioners should inform citizens of the benefits of recycling, as well as the challenges we face as a nation. Another possible reason is that the emotion component has already been captured in other attitudinal constructs such as personal motivation (Davies et al. 2002). It is also likely that people may not possess strong emotions toward a habitual behavior that they perform regularly. Future research may want to explore how to tease out the variance of attitude and habit from emotion. Lastly, previous research has shown that self-interested emotions such as joy, pride, and amusement often do not predict environmental behavior, whereas self-transcendent emotions such as awe and compassion are more strongly associated with sustainable behaviors (Jacobs and McConnell 2022). Additionally, for the parsimony of the analysis, we did not analyze negative and positive emotions separately, but future research should examine the impact of discrete emotions on environmental behaviors.

Unsurprisingly, recycling intention and habit are direct predictors of recycling behavior. Recycling intention is positively associated with recycling behavior because it implies the efforts people are planning to exert to perform the behavior (Ajzen 1991). However, as mentioned before, several caveats need to be taken into account. For instance, there are many measurement issues regarding behavioral intention (see for a review, Sutton 1998). For instance, the recycling intention reported in the survey might be provisional. Moreover, although the intention is a proximal predictor, other factors may exert stronger effects on behavior. Future studies should continue to explore effective ways to capture people’s recycling intention and how it translates into behavior. Conner and Armitage (1998) argue that habit or past behavior is the best predictor of current or future behavior, which is reflected in this study. A meta-analysis (Klöckner 2013) also supports incorporating habit into behavioral models because of its strong influence on behavior. Recycling is the type of behavior that is frequently repeated, as a result, people naturally learn it and habitually perform it once triggered by environmental stimulus (Knussen and Yule 2008). In terms of practical implication, environmental campaigns may consider including signage at various points of contact (i.e., cue to action) and increasing access to recycling facilities to ease the formation of habit.
There are three limitations within this research. First, although we used techniques such as forced-choice items (Nederhof 1985) to reduce social desirability, we rely on self-report data in this study, which may still be subject to social desirability issues. Future research should incorporate direct observations of recycling behavior such as tracking recycling rate in a given municipality. Moreover, we assessed all constructs in the same survey, which might lead to common method bias (see for details, Podsakoff et al. 2003). Although we employed several techniques such as counterbalancing question to reduce common method bias, future research should employ other solutions to achieve higher validity. For example, researchers can assess the predictors by survey and assess the outcome variable (i.e., recycling behavior) by observation or experiments. Second, due to survey length, we only used one item to measure ascription of reliability. Multi-item measure strategy should be used consistently in future studies. Third, this subsample is not completely representative of New York state residents, which limits the generalizability of the results. Lastly, some variables such as personal motivation only achieved limited reliability, so future research should explore more reliable measures for personal motivation.

To conclude, this research shows that integrating theories with discrete yet complementary factors can help develop a more comprehensive model to predict recycling behavior (Park and Ha 2014). In general, our model fits the data well and it reveals interesting results such as the mediated relationship between awareness of consequences and personal norm through ascription of responsibility. The strong influence of habit on recycling behavior suggests that it is important to educate the public to keep abreast of new changes in recycling rules in their local community because once the habit is formed, it will influence future maintenance of recycling behavior.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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