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Predicting Intent to Install a Rain Garden to Protect a Local Lake: An Application of the Theory of Planned Behavior

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Abstract: Many lakes are degraded by urban stormwater runoff. One way to reduce these impacts is installing rain gardens that absorb water running off impervious surfaces. The study reported here explored how the Theory of Planned Behavior (TPB) can be used to inform storm water management outreach campaigns. Regression analyses of survey data were used to inform how Extension natural resource educators can more effectively encourage people to install rain gardens. Attitudes toward rain gardens and subjective norms were positively associated with behavioral intent. Perceived behavioral control was not significantly associated with behavioral intent. Implications for Extension educators are discussed.

Introduction

Storm water runoff from impervious surfaces in developed watersheds can negatively affect the quality of local bodies of water, contributing to erosion and increased loading of sediment, pollutants, and nutrients. Indeed, many lakes are already degraded by contaminants from urban stormwater runoff (Bannerman, Owens, Dodds, & Hornewer, 1993). Fortunately, there are also a variety of actions residents can take to contribute toward sound storm water management that helps infiltrate runoff onto their own property and protect nearby lakes.

One such strategy promoted by natural resource educators is the installation of rain gardens (Tornes, 2005). Rain gardens are shallow depressions planted with deep-rooted grasses, wildflowers, shrubs, or trees designed to capture, treat, and infiltrate storm water and the accompanying pollutants this runoff carries (Dietz, 2007; Obropta, DiNardo, & Rusciano, 2008). They also recharge aquifers and reduce peak flows (Dietz & Clausen, 2005). Water that washes off roofs, driveways, and other hard surfaces gets directed to the rain garden, where it is absorbed by the plants and soil, preventing it from washing into storm sewer systems and then nearby streams, rivers, and lakes.

The reasons why individuals living near lakes do or do not install rain gardens may vary and likely relate to a variety of psychological, behavioral, and social factors. It is clear that addressing non-point source pollution in watersheds requires understanding and influencing the behaviors of citizens who can implement practices on their property that can mitigate the deleterious effects of non-point source pollution (Prokopy et al., 2009).

Importantly, research suggests that classic education campaigns alone may not be sufficient to influence a sufficient number of people to adopt storm water management practices that protect or improve water quality (Dietz, Clausen, Warner, & Filchak, 2002). Indeed, outreach campaigns that depend on information alone are often insufficient to move people to adopt most environmentally friendly behaviors (Finger, 1994; Shaw, 2010; Stern, 2002) The study reported here explores the utility of the Theory of Planned Behavior (TPB) to offer a predictive and explanatory framework that can help Extension natural resource educators more effectively promote effective storm water management practices.

According to the TPB, behavioral intention is guided by three considerations (Ajzen, 1985):

- Attitude toward the behaviorâ beliefs about the likely outcomes of the behavior and the evaluations of these outcomes
- Subjective normsâ beliefs about the normative expectations of others and motivation to comply with these expectations (subjective norms), and
- Perceived behavioral controlâ self efficacy or beliefs about the presence of factors that may facilitate or impede performance of the behavior and the perceived power of these factors, which is an estimate of how easy or difficult it will be to perform a behavior (Perloff, 2008).

In combination, these considerations lead to the formation of behavioral intention, which is conceptualized as mediating between attitudes and action (Ajzen, 2008).

Previous studies have employed the TPB to predict a variety of behaviors. A significant body of past research has used the TPB to successfully explain and predict health behaviors, such as condom use (e.g., Chan & Fishbein, 1993; Libbus, 1995; Reinecke, Schmidt, & Ajzen, 1996; White, Terry, & Hogg, 1994), premarital sex (e.g., Chan & Cheung, 1998), attending health checks (e.g., Norman & Conner, 1993, 1996), and participating in regular exercise (e.g., Godin, Valois, & Lepage, 1993; Theodorakis, 1992, 1994; Van-Ryn, Lytle, & Kirscht, 1996). More relevant to this article, some studies have also used the TPB to explain and predict a range of ecological behaviors such as recycling (Boldero, 1995; Cheung, Chan & Wong, 1999; Kaiser & Gutscher, 2003; Oom Do Valle, Rebelo, Reis, & Menezes, 2005; Shaul & Katz-Gerro, 2006; Taylor & Todd, 1995), purchasing environmentally friendly products (Chan & Lau, 2001), improving riparian areas (Corbett, 2002), encouraging lower carbon modes of transportation (Wall, Devine-Wright & Mill, 2007), and using energy-saving light bulbs (Harland, Staats & Wilke, 1999).

Importantly, according to Fishbein and Ajzen (1975), underlying beliefs are likely to vary across behaviors and across populations and should be elicited from the target population to ensure the relevance of the beliefs used in the analysis. The study reported here is the first we are aware of that explores the potential utility of the TPB to predict behavioral intent of property owners to install rain gardens to protect or improve local lake water quality. It is our hope that exploring the value of the TPB for understanding the constructs associated with behavioral intent to install rain gardens may inform Extension outreach programs that can target these mechanisms to more effectively promote behaviors that protect local lakes.

The study reported here study focused on Lake Ripley, a 418-acre glacial kettle lake located in south central Wisconsin. Glacial kettle lakes were formed when slabs of ice broke off from glaciers, and, after the glaciers retreated and the climate continued to warm, the ice melted, leaving depressions in the landscape. The lake's watershed, or drainage basin, is about 5,100 acres (8 square miles). While Lake Ripley receives most of its water in the form of stream drainage from the surrounding watershed, groundwater accounts for at least 30% of the water being supplied to the lake. This groundwater input is critical for maintaining water quality. Because the Lake Ripley watershed is of considerable size, the lake receives a significant quantity of storm water runoff, which carries with it excess nutrients and sediments from non-point pollution sources in the basin.

Historically, wetlands comprised a large percentage of the watershed, but now represent only 15% of the total land area, including woodlands and open water. Much of the shoreline development is concentrated within a 1/2-mile area surrounding the lake. Due in part to the intensity of recreational usage on the lake and increasing development in the watershed, Lake Ripley has suffered ecological disturbances over time. Water quality has declined as a result of increased storm water runoff, transporting sediment and nutrients to Lake Ripley. An increase in impervious surfaces in developed areas has also reduced the amount of infiltration and groundwater recharge in the watershed.

Methods

Sample

Institutional Review Board (IRB) permission was obtained at the University of Wisconsin-Madison. Prior to creating the survey, focus groups were conducted in March 2007 to inform what indicators and scales would be most appropriate to represent the constructs specified in the TPB. Landowners within the lake's watershed were called by telephone and invited to provide feedback at a face-to-face focus group, and six individuals agreed to participate. The group was moderated by two of the authors, who asked a series of questions about perceived benefits and barriers, and beliefs and attitudes related to rain gardens. This feedback was used to inform development of the quantitative survey instrument organized around constructs specified in the TPB.

Mail surveys were sent in September 2007 to property owners living within the Lake Ripley watershed. Surveys were sent with a cover letter and postage paid return envelopes explaining the basic design properties and functions of a rain garden. Participants were encouraged to return the survey through an incentive drawing for a donated collection of native plants valued at $350. Using a random number generator, surveys were mailed to 350 households of the approximately 1,500 residences located in the most developed third of the Lake Ripley watershed, part of the Lake Ripley Management District (LRMD). Two weeks after the packages were mailed out, prospective respondents were called on the telephone and reminded to return their surveys.

Survey Measures

Personal Characteristics

To get a general understanding of the characteristics of our sample, respondents were asked whether they were full time or seasonal residents, how many years they had owned property on Lake Ripley, and their age.

TPB Components

Likert scales were developed to test whether variables specified by the TPB reliably predict intent to install rain gardens. Using 6-point multiple Likert scales to create composite scores or indices is a common and widely accepted practice in social science research (Babbie, 1989). The Likert scale is one of the most popular attitude scales because it is easy to prepare and to interpret, and simple for respondents to answer (Schiffman & Kanuk, 1997).

At its simplest, each of the composite variables in the TPB (except Behavioral Intentions) is created by mathematically combining a belief component (B) with an evaluation component (E) and then summing the products ($B_1xE_1 + B_2xE_2 + B_3xE_3$â ¦). The paragraphs below detail how these composite scores were produced. Table 1 summarizes the content of the survey questions used in creating these products.

Table 1.
Content of Likert-type Statements Used to Represent TPB

Item		**Likert Scale Response Anchors**	
		1	**6**
	Behavioral Expectations		
11.	If I build a rain garden in my yard, my property value will:	Definitely decrease	Definitely increase
13.	Building a rain garden on my property would improve the appearance of my property.	Very unlikely	Very likely
15.	If I build a rain garden, it will increase the amount of wildlife I attract to my yard.	Very unlikely	Very likely
17.	Building a rain garden in my yard would create standing water that could attract mosquitoes. R	Definitely no	Definitely yes

23.	If I build a rain garden on my property, it will improve the water quality of Lake Ripley.	Very unlikely	Very likely
12.	Increasing my property value is:	Not important to me	Very important to me
14.	The appearance of my property is:	Not important to me	Very important to me
16.	Increasing the wildlife habitat in my yard would be:	Very undesirable	Very desirable
18.	Preventing standing water that could breed mosquitoes in my yard is: R	Not important to me	Very important to me
24.	Improving the water quality of Lake Ripley is:	Not important to me	Very important to me
	Subjective Norms		
26.	If I build a rain garden in my yard, my neighbors would:	Strongly disapprove	Strongly approve
28.	If I build a rain garden in my yard, my family would:	Strongly disapprove	Strongly approve
30.	If I build a rain garden in my yard, my friends would:	Strongly disapprove	Strongly approve
27.	What my neighbors recommend is:	Not important to me	Very important to me
29.	What my family recommends is:	Not important to me	Very important to me
31.	What my friends recommend is:	Not important to me	Very important to me
	Perceived Behavioral Control		
7.	I have the physical ability to build a rain garden.	Definitely no	Definitely yes
8.	I have, or could easily acquire, the knowledge needed to build a rain garden.	Definitely no	Definitely yes
9.	I have the financial means to build a rain garden.	Definitely no	Definitely yes
39c.		Not at all	Very much

	The following are obstacles preventing me (or somebody in my household) from building a rain garden on my property: Cost/Expense		
39e.	The following are obstacles preventing me (or somebody in my household) from building a rain garden on my property: Too much work	Not at all	Very much
39f.	The following are obstacles preventing me (or somebody in my household) from building a rain garden on my property: Lack of knowledge	Not at all	Very much
Behavioral Intent			
32.	I (or somebody in my household) will build a rain garden on my property in the next two years.	Very unlikely	Very likely
34.	I (or somebody in my household) will build a rain garden on my property in the next two years if I am given detailed instructions how to do so.	Very unlikely	Very likely
35.	I (or somebody in my household) will build a rain garden on my property in the next two years if I received cost-sharing assistance.	Very unlikely	Very likely
36.	I (or somebody in my household) will build a rain garden on my property in the next two years if some of my friends and neighbors also build one.	Very unlikely	Very likely
37.	I (or somebody in my household) will build a rain garden on my property in the next two years if some of my friends and neighbors helped me.	Very unlikely	Very likely
38.	I would help my neighbors build a rain garden in the next two years if they asked for my help as part of a larger community event.	Very unlikely	Very likely
R = For statements that were negatively worded, scale values were reverse-coded. (The values of the scale are flipped so that the directional magnitude of component items is identical.)			

Including multiple and differently phrased statements for each TPB component results in a scale with a degree of reliability (i.e., the consistency of a set of measurements) far greater than that of a single measure or question. When multiple statements or attitude items are combined to represent a respondent's evaluation of one of the components of TPB, certain statistical tests can indicate how well the multiple statements or items measure what they are purported to measure, i.e., do they all measure the same conceptual construct? These statistics are known as internal consistency or reliability statistics (Eagly & Chaiken, 1993), the most appropriate measure for Likert scales being Cronbach's alpha coefficient (Cronbach, 1951). Cronbach's alpha coefficient is essentially the average correlation among the items in a particular composite score; correlations can range from 0.0 (non-existent correlation) to 1.0 (perfect correlation), with 0.8 being conventionally considered good reliability (Cohen, 1988). Reliability statistics measured with Cronbach's alpha were conducted on the TPB components. Table 2 presents Cronbach's alpha as well as means and standard deviations (SD) for the Belief and Evaluation components of each constructed score.

Table 2.
Descriptive Statistics of Constructed Score Variables

	Mean (SD)	**Cronbach's Alpha**
Behavioral Expectations		
- Belief	3.9 (1.0)	.69
- Evaluation	4.7 (0.8)	.54
Subjective Norms		
- Belief	4.2 (1.1)	.86
- Evaluation	3.8 (1.2)	.72
Perceived Behavioral Control		
- Belief	4.4 (1.3)	.76
- Evaluation	3.6 (1.4)	.74
Behavioral Intent	3.1 (1.5)	.91

Behavioral Expectations

Based on variables identified in the focus groups, a constructed score representing attitudes toward rain gardens was created by the researchers. The TPB postulates that attitudes toward a targeted behavior are the product of beliefs indicating that a behavior will produce particular outcomes multiplied by evaluations toward the behavior itself. Five six-point items gauged behavioral expectations; five corresponding six-point measures also gauged evaluations toward each of the respective behavioral expectations. Individual behavioral beliefs were multiplied by corresponding evaluations toward each behavior, and the sum of these products represented respondents' attitudes toward rain gardens.

Subjective Norms

According to the TPB, perceived behavioral expectations are another major predictor of behavioral intent. This constructed score was the product of normative beliefs among relevant reference groups (i.e., neighbors, family and friends) about the desirability of installing a rain garden multiplied by how much they care about what each of these reference thinks about whether they adopt the targeted behavior. Normative beliefs of each reference group were multiplied by the corresponding perceptions about the importance of that group's recommendations, and the sum of these products represented perceived behavioral expectations.

Perceived Behavioral Control

Control beliefs were constructed using three six-point items asking respondents about their perceived capability to install a rain garden. An index of three six-point questions asked whether specific obstacles prevented them (or somebody in their household) from building a rain garden on their property. The perceived behavioral control scoreâ the third key independent variable specified by the TPBâ was constructed by multiplying respondents' perceived ability to install a rain garden with the perceived factors that they expected might inhibit this behavior.

Behavioral Intent

The dependent variable of behavioral intent was constructed by rating various situations in which respondents might install a rain garden in the near-term future. Specifically, six six-item measures asked respondents how likely it was that they or somebody in their household would build a rain garden in a number of different scenarios in the following two years (Table 1). The sum of these six individual measures represented the behavioral intent dependent variable construct. Note that this constructed score did not multiply belief by evaluation as the other three components of TPB do. Rather, it is a straight composite measure of the likelihood the respondent will install a rain garden on their property.

Results

Of the 350 questionnaires mailed to Like Ripley property owners, 138 individuals returned their surveys, for a response rate of 39%. (One hundred ten individuals provided full information for inclusion in this analysis for an alternative response rate of 31%.) 67.2% of respondents were permanent full-time residents, while 32.8% were part-time or seasonal residents. Respondents reported their families have owned their properties for an average of 17.8 years, with a range of their families owning property from 1 to 100 years. The mean age of respondents was 56.4 and ranged from ages 28 to 87.

Interpretation of Means, Standard Deviations, and Cronbach's Alpha

The means, standard deviations, and Cronbach's alpha for the Belief and Evaluation components of each of the three constructed scores, as well as the Behavioral Intent score, are presented in Table 2. Average scores for each could range from 1 to 6, with 3.5 being the midpoint.

Looking at Behavioral Expectation, the Evaluation component had a higher mean and smaller standard deviation than the Belief component. This indicates that while respondents positively evaluated the potential results of installing rain gardens on their property, they were less positive about whether rain gardens could actually accomplish these results. Further, the standard deviation for the Evaluation component was quite small, indicating widespread agreement about the potential advantages rain gardens could confer.

Regarding Subjective Norms, the situation was reversed. Respondents had more positive ratings of whether their neighbors, friends, and family would approve of rain gardens, but less positive ratings of whether their opinions were important.

For Perceived Behavioral Control, respondents had high ratings of their own capabilities (i.e., believing that they had the money, knowledge, and time to build a rain garden), and they had substantially lower ratings of whether these were significant barriers to building a rain garden. The relatively higher standard deviations for the Belief and Evaluation components of Perceived Behavioral Control indicated that there was a wider distribution or dispersion of these ratings, and therefore relatively less agreement among the respondents' ratings. Finally, the average Behavioral Intent score (3.1) was less than the midpoint of the scale, indicating respondents had a generally negative likelihood to actually install a rain garden on their property, though the standard deviation indicated a substantial range of opinions on this topic.

Cronbach's alpha coefficients for all components except the Evaluation of Behavioral Expectations were .70 or above, with the Behavioral Intent score having the highest alpha coefficient of .91 (Table 2). Drawing on Cohen's (1988) guidance for judging reliability coefficients, these statistics provide evidence that our constructed scores are reasonable and reliable measures of the components of the TPB. A linear regression analysis was performed using Behavioral Intention as the dependent variable. The constructed scores of Behavioral Expectation, Subjective Norm, and Perceived Behavioral Control, were entered into the model simultaneously as predictor variables. Only those respondents with complete valid data on all four variables were included in the analysis.

Individually, the Behavioral Expectation and Subjective Norm variables were statistically significant predictors of Behavioral Intent; Perceived Behavioral Control was not a significant predictor. All predictor variables had positive regression coefficients indicating that as Behavioral Expectation and Subjective Norms increased in value, so did Behavioral Intent. The overall regression model had an R^2 of .36 meaning that the three independent variables explained 36% of the variance in behavioral intent towards adopting rain gardens.

Interpretation of Regression Results

Table 3 presents four numbers for each TPB component, the most important for present purposes being Î² beta and *t* score. The Î² is a standardized regression coefficient, computed so that the relative explanatory contribution of each constructed score can be compared to the others on the same scale. Further, the sign (positive or negative) of Î² indicates the direction of the constructed score to behavioral intent.

Table 3.
Summary of Linear Regression Analysis for Variables Predicting Behavioral Intent (N=110)

Variable	**B**	**SE B**	**Î²**	**t**
Behavioral Expectations	0.13	0.03	0.44	4.9**
Normative Beliefs	0.10	0.04	0.23	2.7*
Perceived Behavioral Control	0.02	0.03	0.06	0.71
Note. R^2 = .36 for entire model. *$p < .01$ ** $p < .001$				

Looking at Table 3, one can see that Behavioral Expectations has a Î² of .44, compared to .23 for Normative Beliefs, both of which are positive. This suggests that the explanatory power of the former is roughly twice that of the latter, and that both components work in the same direction, i.e., greater scores on Behavioral Expectations and Normative Beliefs indicate greater Behavioral Intent scores. The *p*-value indicates the probability of each components' effect relative to chance. A smaller p-value indicates that the result or relationship is not likely due to chance alone.

Discussion

The results of the study reported here indicate that two of the variables specified in the TPB were positively associated with intent to install a rain garden. First, attitudes toward the behavior were associated with behavioral intention, suggesting that Extension natural resource educators should work to enhance beliefs that rain gardens will contribute to positive outcomes they personally care about (e.g., water quality, aesthetics of their property) and refute beliefs that rain gardens will contribute to outcomes they do not want to occur (e.g., attracting mosquitoes or standing water).

Second, the use of promoting social norms as a program strategy to encourage adoption of rain gardens was supported. Given this finding, Extension natural resource educators should emphasize that others in their community support efforts to install rain gardens to improve the local environment (Griskevicius, Cialdini, & Goldstein, 2008). The use of models, case studies, and examples can help to create or redefine a social norm by communicating that the community accepts and applauds the targeted behavior (Monroe, 2003). Extension natural resource educators should also consider building demonstration rain gardens in highly visible places such as a public library, town hall, or schoolâ demonstration rain gardens can reinforce to the public the social desirability and public good associated with these landscape features and also offer convenient locations where public education programs can be held (Obropta, DiNardo, & Rusciano, 2008).

Our finding that perceived behavioral control was not associated with behavioral intention is consistent with the results of other researchers who have found that this construct does not always predict subsequent behavioral intention across all behavioral domains such as recycling waste paper (Cheung, Chan, & Wong, 1999), though others have found that perceived behavioral control is a significant predictor of intention to adopt ecological behaviors such as energy conservation and judicious use of automobiles (e.g., Kaiser & Gutscher, 2003).

Previous research suggests a number of possible explanations for why perceived behavioral control may not be always be associated with behavioral intentions. First, it is possible that perceived behavioral control is a significant predictor in some behavioral domains and not others so the construct is valuable in some contexts but perhaps is non-universally applicable and thus a non-generalizable part of the TPB (Kaiser & Gutscher, 2003). Indeed, part of the appeal of the TPB is its flexibility in weighting or prioritizing different components. For example, one behavior may be influenced primarily by behavioral expectations, while another may be primarily influenced by subjective norms or perceived behavioral control. In some contexts, it is possible that one or another of the three predictors is not relevant and makes no significant contribution to the prediction of intention. When this occurs, it may indicate that for the particular behavior or population under investigation, a particular factor in the TPB may not be an important consideration in the formation of intentions (Ajzen & Fishbein, 2008).

While our operationalization of the perceived behavioral control construct was based on formative research derived from focus groups and an-in-depth review of previous relevant studies, future research might test other survey scales for operationalizing and measuring this construct to more definitively conclude whether perceived behavioral control offers value in predicting whether people install rain gardens to protect local lakes.

On a related note, it is also worth reminding the reader that all of the variables in the study were constructed using scales that reflected information gathered during the focus group conversations that preceded development of the quantitative survey. As described above, the relative importance of different components of the TPB varies depending on the behavior and population being considered. Similarly, the composition of each of the variables would be expected to vary depending on the behavior and population being studied. Future research on the TPB will likely benefit from conducting context-specific focus groups or in-depth interviews to help construct variables that are most relevant to the unique population and behavior being studied.

One possible limitation of the study reported here is the limited response rate of 39% of prospective respondents. This raises the possibility that our sample was biased, possibly in such a way that those who responded were substantially different in some way compared to those who did not respond. While this possibility exists, the significant variance in both the independent and dependent variables of this study suggest that respondents had different levels of motivation to adopt the targeted behavior of installing rain gardens. That said, conducting similar studies with larger samples and higher response rates across multiple lakes and populations may increase the generalizability of our findings.

It is important to remind readers that the study examined how the variables specified by the TPB are associated with behavioral intention rather than behavioral outcomes. While behavioral intention is often associated with actual behavior (e.g., Kaiser & Gutscher, 2003), it is clear that measureable behavior changeâ and not just intentionâ is necessary to improve the quality of lakes.

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