

Climate Change, Food Choices, and the Theory of Behavioral Choice

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Research Article

Keywords: Theory of planned behavior, theory of behavioral choice, dietary choices, pro-environmental behavior, climate change, models

Posted Date: June 7th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1513250/v1>

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Abstract

Food choices are an important aspect of climate change mitigation. How best to account for them? The dietary change intentions of 454 adults in the United States and Canada were predicted from the theory of planned behavior (TPB) and the recently proposed theory of behavioral choice (TBC), using an online survey. The TBC accounted for a statistically significant greater proportion of variance than the TPB (83 versus 61 percent) in explaining the respondents' intentions. The strongest TBC predictor of intention was felt obligation, followed by social norms, affect, and habitual behavior. Three interactions among the TBC predictors also contributed, in small but significant ways, in accounting for the food choice intentions. Translational policy implications are discussed.

1. Introduction

Climate change is driven in large part by the use of fossil fuels, and this has increased the level of greenhouse gases to historic levels of over 400 parts per million. In multiple ways, climate change will affect every person and animal on the planet. Addressing the vast and varied environmental, social, and economic consequences of climate change is one of the great challenges the world faces in the 21st century (Swim et al. 2009). An overwhelming majority of scientists agree that global warming is occurring, and that it is predominantly caused by human activities (Cook et al. 2016; Pachauri and Meyer 2014). Unsurprisingly, therefore, many researchers have focused their efforts on understanding the significant effect that altering human behavior can have on strategies to reduce the negative effects of climate change (e.g. Schultz and Kaiser 2012).

Despite efforts in many quarters that have led to increased environmental awareness and education (Steg and Gifford 2005), greenhouse gas emissions still trend upward. One often-overlooked area where human behavior change can have an important impact on climate change is food consumption (Rees et al. 2018). Food consumption – particularly of animal-based products – accounts for a significant amount of both global water use and greenhouse gas (GHG) emissions (Reisch et al. 2013). In an analysis of over 60 studies, Aleksandrowicz et al. (2016) found a median decrease in GHG emissions across all sustainable diets, with the strongest effect observed in the diets that most reduced meat consumption. Furthermore, reducing meat consumption is a particularly useful area of sustainability to focus on when studying behavioral change, because it has an especially high potential for reducing GHG emissions on an individual and household level (Lacroix and Gifford 2020; Stehfest et al. 2009). To help address this threat, the present study's goal is to improve understanding of the gap between harboring good environmental intentions and weak mitigative action within the food-choice domain.

The disparity between choosing climate-negative behaviors despite awareness of long-term consequence, is a significant challenge (Joireman et al. 2004). Pro-environmental values do not necessarily translate into employed, actionable strategies (e.g. Aitken et al. 2016; Gifford 2011). An important step toward mitigation is the development of a theory that can provide a sound basis for effective policy. The theory of planned behavior (TPB; Ajzen 1991, 2011) has been widely used in other areas of psychology and has

served as a reasonable framework for addressing pro-environmental behavior (PEB). It was developed as an enhancement of theory of reasoned action (TRA), adding perceived behavioral control as a direct, and indirect, mediator of behavior. This helped to make the TPB appropriate for studying PEB and, indeed, it has been shown to be a stronger predictor of pro-environmental behavior achievement than the original TRA (Rossi and Armstrong 1999).

In the TPB, intentions are said to be influenced by three factors: attitude toward the behavior, subjective norms, and perceived control over one's behavior, each of which is further divided into sub-categories (Ajzen 1991).

Successful attempts to expand the TPB have been made, for example, to help account for transportation choices (e.g. Heath and Gifford 2002). However, given the ubiquitous gulf between intentions and behavior, the time has come specifically deal with the intention = behavior gap. To do so, the recently proposed theory of behavioral choice (TBC; Gifford Lacroix and Chen 2018) suggests accounting for the gap by adding structural and psychological barriers as potential explanations of the intention-behavior chasm, as well as three added antecedent predictors (Figure 2).

Some of the intention-behavior gap can be explained by structural barriers – those that individuals truly are unable to overcome themselves, such as a physical disability, low income, or the non-existence of local public transportation. However, many individuals are objectively capable of making pro-environmental changes to their behavior, but do not, or not as much as they can, because of what might be called psychological barriers, justifications, or rationalizations (Gifford 2011). Understanding the psychological barriers that prevent people from achieving their pro-environmental intentions is necessary to develop the interventions needed to effect meaningful and successful behavioral change.

In order to better explain the remaining gap between pro-environmental intentions and actually completed actions, a taxonomy of psychological barriers called the “dragons of inaction” was proposed (Gifford 2011). Subsequent empirical research has resulted in the development of the Dragons of Inaction Psychological Barrier (DIPB) scale, comprised of five scales that incorporate about two dozen of the dragon species: Change Unnecessary, Conflicting Goals and Aspirations, Interpersonal Relations, Lacking Knowledge, and Tokenism (Lacroix Gifford Chen 2019).

More recently, to incorporate these barriers into a model, the theory of behavioral choice (TBC; see Figure 2; Gifford Lacroix Chen 2018) was proposed. The TBC shares some elements with the theory of planned behavior (TPB) but adds the following elements: values (as an enhancement to the TPB's attitude toward the behavior), affect, habit, and felt obligation (as predictors of intention), psychological barriers and structural barriers (as moderators of the success or failure of intentions), and reported behavior (as distinct from observed behavior). The new predictors emerged from a preliminary qualitative study in which 65 respondents were asked to freely suggest reasons why they would consider making an important new choice in their lives. The TBC aims to improve the prediction of behavior by adding these constructs, with the aim of striking a productive balance between comprehensiveness and parsimony.

The TBC strives to answer the often-asked question of why, if individuals profess to care about the environment, they do not more actively change their behavior to reflect that concern. Developing a clearer understanding of the influences that encourage or discourage pro-environmental intentions, including the barriers that prevent those intentions from coming to fruition, is important for achieving success in changing behavior.

The primary purpose of this study was to evaluate the relative strength of the well-established TPB versus the newly-developed TBC as competing models for predicting pro-environmental intention and behavior. The domain for their comparison of the models in this study is one's choice to choose a climate-positive food diet (or not). To be specific, the main hypothesis was that the TBC model will fit the data better than the TPB model. Another aim of the study was to investigate whether the interaction effects among the predictors would improve the predictive power. Predictor interactions have recently been examined for TPB (Kothe Mullan 2015; La Barbera and Ajzen 2020; La Barbera and Ajzen 2021; Steinmetz Davidov and Schmidt 2011).

2. Method

2.1 Participants

Using the Turk Prime platform, 664 participants from the United States and Canada completed the online survey. Some were removed from the sample for a number of reasons: 50 failed the validated questions and 160 "speeders" completed the survey unreasonably quickly. Thus, the final sample size included 454 validated participants. Their mean age was 42.63 years ($SD = 12.56$ years), and the sample included 191 males (42 %) and 262 (57.7 %) females. A few participants ($n = 8$, 1.8 %) chose not to disclose their level of education, 110 participants had a high school diploma (24.2 %), 104 had a college diploma (22.9 %), 163 had a bachelor's degree (25.9 %), and the rest had a Master's degree ($n = 59$ or 13%) or a doctorate degree ($n = 9$ or 2 %). Their political ideology was slightly left leaning on average ($M = 2.76$ on a 5-point scale from "strong left" to "strong right").

2.2 Materials

The three predictors of intention in the TPB model were measured on a 7-point "strongly disagree" to "strongly agree" scale: attitude toward the behavior, using three items (e.g. "Making this change would be good for the environment"); social norms, using four items (e.g. "Most people who are important to me think that I should eat a more plant-based diet"); and perceived behavioral control, using four items (e.g. "If I really want to, I can change my diet to include fewer animal products").

The six predictors of the TBC model were assessed as follows:

Attitude Plus: This predictor aims to improve the TPB's attitude predictor by adding questions about values. Therefore, it was named "Attitude Plus" to differentiate between these two scales. Eight items were

used to measure attitude plus, the five items from the TBC attitude scale plus, on a scale of 1 ("strongly disagree") to 7 ("strongly agree"): "My values require me to change my consumption towards more plant-based foods," "I believe this dietary change is the right thing to do," and "Eating fewer animal products is one of my principles."

Social Norms: As in the TPB, four items were used: "Most people who are important to me think that I should eat a more plant-based diet." Respondents were asked to rate these items on scales indicating strongly disagree (= 1) to strongly agree (= 7).

Perceived Behavioral Control: As in the TPB, four items were used to measure perceived behavioral control: "If I really want to, I can change my diet to include fewer animal products?", and "Whether or not I change my eating behavior is up to me." On a scale of 1 ("strongly disagree") to 7 ("strongly agree"), respondents were asked to rate these items.

Habitual Behavior: For assessing habitual behavior, a TBC addition, four items were used: "I have been eating animal products for such a long time that I'm not sure how I will make this change," and "I am too much of a creature of habit to actually reduce my consumption of animal products." A 7-point response-option scale of 1 to 7 from strongly disagree (= 1) to strongly agree (= 7) was asked to measure these items.

Felt Obligation: Four items were used in this TBC addition. Respondents were asked to rate the following statements about the obligation they may perceive on a 7-point scale, from 1 = strongly disagree, to 7 = strongly agree: "I feel obligated to change my eating behavior for the duration of this study", and "For this study, I ought to change my dietary choices."

Affect: Five items were used in this third TBC addition, to assess emotions about the behavior. Respondents were asked to rate the following statements about their desire to change their behavior on a 7-point scale, with 1 = strongly disagree, and 7 = strongly agree such as: "I would feel delighted to eat a more plant-based diet.", and "I am excited to make this dietary change."

Intention was measured using six items (e.g. "Moving toward a plant-based diet over the next two weeks is something that I intend to do"). Respondents were asked to rate these items on a scale from 1 = strongly disagree, to 7 = strongly agree.

Without positing specific hypotheses, we were also interested in examining whether demographic variables such as age, gender, level of education, income, and political position might be related to behavioral intention. The coding of these variables is shown in Table 4.

3. Results

3.1 Means, Standard Deviations, and Reliabilities

On average, responses to the intention items were in mid- to high- levels of their 7-point scale ($m = 4.43$, $sd = 1.51$). Among the predictors of intention, respondents reported high levels of the 7-point scale for attitude ($m = 5.07$, $sd = 1.32$) and perceived behavioral control ($m = 5.73$, $sd = .93$). The participants reported mid- to high-levels of attitude plus values ($m = 4.70$, $sd = 1.28$), social norms ($m = 4.29$, $sd = 1.29$), affect ($m = 4.27$, $sd = 1.45$) and obligation ($m = 4.32$, $sd = 1.54$). However, participants reported mid-levels of the 7-point scale for habitual behavior ($m = 3.54$, $sd = 1.47$). The internal consistency reliability of the predictor scales was assessed using Cronbach's alpha. They ranged from $\alpha = .76$ to $.91$ (see Table 5). The social norm and perceived behavioral control factors in TBC were identical to those of the TPB.

Table 1 *Predictors of behavioral intention in the TPB model*

Attitude	Mean	SD	Response range
1. I believe eating a more plant-based diet would be...	5.41	1.47	Extremely bad (1) to Extremely good (2)
2. I want to make this dietary change because the alternative, eating more animal products, is worse.	4.60	1.67	
3. Making this change would be good for the environment.	5.20	1.51	
4. On a scale of Bad to Good, to make this behavior change would be...	5.37	1.46	
5. I will move to a plant-based diet simply because it seems like a good idea.	4.65	1.65	
Social Norms			
1. I will be reducing my consumption of animal products because others strongly encouraged me to.	4.46	2.01	Strongly disagree (1) to
2. Most people who are important to me think that I should eat a more plant-based diet.	4.09	1.65	Strongly agree (7)
3. I am going to make this change because people around me would criticize me if I did not try.	4.20	2.24	
4. I have been strongly influenced by other people to eat fewer animal products.	4.41	1.85	
Perceived Behavioral Control			
1. If I really want to, I can change my diet to include fewer animal products.	5.71	1.20	
2. I am confident that I will be able to eat fewer animal products.	5.43	1.34	
3. I can choose to change my dietary behavior, at least for this study.	5.46	1.45	
4. Whether or not I change my eating behavior is up to me.	6.34	.83	

Table 2 *Predictors of behavioral intention in the TBC model*

Items	Mean	SD	Response range
Attitude Plus			
1. I believe that making this dietary change would be...	5.41	1.47	Extremely useless (1) to Extremely useful (7)
2. I want to make this dietary change because the alternative, eating more animal products, is worse.	4.60	1.67	
3. On a scale of Bad to Good, to make this behavior change would be...	5.37	1.46	Extremely bad (1) to Extremely (7) good
4. Making this change would be good for the environment.	5.20	1.51	
5. Eating fewer animal products is one of my principles.	3.85	1.69	
6. My values require me to change my consumption towards more plant-based foods.	3.68	1.80	
7. I believe this dietary change is the right thing to do.	4.88	1.62	Strongly disagree (1) to
8. I will move to a plant-based diet simply because it seems like a good idea.	4.65	1.65	Strongly agree (7)
Social Norms			
1. I will be reducing my consumption of animal products because others strongly encouraged me to.	4.46	2.01	
2. Most people who are important to me think that I should eat a more plant-based diet.	4.09	1.65	Strongly disagree (1) to
3. I am going to make this change because people around me would criticize me if I did not try.	4.20	2.24	Strongly agree (7)
4. I have been strongly influenced by other people to eat fewer animal products.	4.41	1.85	
Perceived Behavioral Control			
1. If I really want to, I can change my diet to include fewer animal products.	5.71	1.20	
2. I am confident that I will be able to eat fewer animal products.	5.43	1.34	Strongly disagree (1) to
3. I can choose to change my dietary behavior, at least for this study.	5.46	1.45	Strongly agree (7)
4. Whether or not I change my eating behavior is up to me.	6.34	.83	
Habitual Behavior			
1. I have been eating animal products for such a long time that I'm not sure how I will make this change.	3.66	1.76	

2. I am set in my ways, so it's difficult to consider changing my dietary habits.	3.32	1.62	
3. I have to admit that I am so used to my current eating pattern that this could be a difficult change to make.	3.86	1.72	Strongly disagree (1) to
4. I am too much of a creature of habit to actually reduce my consumption of animal products.	3.43	1.68	Strongly agree (7)
Felt Obligation			
1. I feel obligated to change my eating behavior for the duration of this study.	3.86	1.87	
2. I really must change my eating behavior, at least for this study	4.26	1.85	Strongly disagree (1) to
3. For this study, I ought to change my dietary choices	4.75	1.67	Strongly agree (7)
4. Really, I don't believe that I should change my eating choices during this study (<i>reversed</i>)	4.43	1.18	
Affect			
1. I would feel delighted to eat a more plant-based diet	4.25	1.79	
2. I really don't think I would enjoy changing my current eating choices (Reversed)	3.94	1.69	
3. I am excited to make this dietary change.	4.23	1.76	Strongly disagree (1) to
4. Attempting to make this change will feel good.	4.81	1.65	Strongly agree (7)
5. Changing my diet towards a plant-based diet would be...	5.16	1.63	Extremely unappetizing (1) to Extremely appetizing (7)

Table 3 *Intention items*

Table 4 *Demographic variables*

	Mean	SD	Response range
1. Moving toward a plant-based diet over the next two weeks is something that I intend to do.	4.08	1.97	Strongly disagree (1) to Strongly agree (7)
2. To see how it goes, my intention is to try to eat a more plant-based diet for the length of this study.	4.48	1.86	
3. I definitely plan to eat more plant-based foods.	4.66	1.76	
4. I don't expect that I will be changing my dietary choices (<i>reversed</i>)	4.18	1.85	
5. My aim, honestly, is to switch toward a more plant-oriented diet.	4.39	1.78	
6. I just can't see myself trying to change my food choices (<i>reversed</i>)	4.84	1.83	

Response range	
Age	-
Gender	Male (1), Female (2), Other (3)
Level of education	1 = high school graduate, 2 = diploma/technical training, 3 = bachelor degree, 4 = master's or equivalent degree, 5 = PhD, 6 = other
Income	-
Political stands	1 = Strong left, 2 = Somewhat left, 3 = Moderate, 4 = Somewhat right, 5 = Strong right

Table 5 *Descriptive statistics (N = 454)*

		<i>M</i>	<i>SD</i>	α
	Attitude (1-7)	5.04	1.30	.89
TPB	Social norms (1-7)	4.29	1.55	.81
	Perceived behavioral control (1-7)	5.73	.93	.76
	Attitude plus values (1-7)	4.70	1.28	.92
	Social norms (1-7)	4.29	1.55	.81
	Perceived behavioral control (1-7)	5.73	.93	.76
TBC	Habitual behavior (1-7)	3.56	1.47	.89
	Obligation (1-7)	4.32	1.54	.88
	Affect (1-7)	4.27	1.45	.89
	Intention (1-7)	4.43	1.51	.91
	Recent dietary behavior	12.75	5.75	-

3.2. Relations among the Predictors and Intention

All the predictors were significantly related to intention

(see Table 6). A significant positive relation was observed between attitude and intention ($r = .72, p < .001$). Social norm was significantly negatively related to intention ($r = -.46, p < .001$). Respondents who perceived greater control over their dietary behaviors, tended to report stronger intentions to take precautionary actions in the future ($r = .51, p < .001$). Participants with positive attitude and values towards changing their diet to more plant-based diets expressed stronger intentions ($r = .75, p < .001$).

Respondents who had been eating meat for a long time have developed a habit that they found it hard to break; they expressed weaker intentions to change their behavior ($r = -.52, p < .001$). The more that respondents believed that they were obligated to change their behavior, the stronger their intentions to take action in the near future ($r = .82, p < .001$). Those with greater more positive affect about towards changing their behavior intended more to change toward a plant-based diet ($r = .80, p < .001$). Finally, respondents who had recently consumed more animal-based food reported weaker intention to adopt plant-based diets.

Table 6 *Correlations among the predictors and intention*

	Attitude	Social norms	Perceived behavioral control	Attitude plus	Habitual behavior	Obligation	Affect	Recent dietary behavior
Intention	.72**	-.46**	.51**	.75**	-.52**	.82**	.80**	-.10*

**Significant at the .01 level *Significant at the .05 level.

The main hypothesis was that the TBC model predictors would account for more variance in intention than would the predictors of TPB model. Linear regression using the Enter method in three steps was employed to test this assumption. In the first step, recent dietary behavior was entered as a control variable; a change from eating little (or much) meat recently could importantly affect one's intention to change to a plant-based diet. For example, those who were already eating little meat would have less "room" (intention) to change. In the second step, the TPB predictors were added as a second block, and in the third step the TBC predictors were entered as a final block.

The results were that the TBC accounted for a significantly greater proportion of the variance in intention [$F(6, 455) = 255.45, p < .001, R^2_{Adjusted} = .82$] than that of the TBC [$F(3, 449) = 202.31, p < .001, R^2_{Adjusted} = .61$]. Thus, the main hypothesis was supported (see Table 7).

Among TPB predictors, attitude was the most important predictor of intention [$\beta = .56, p < .001$]. The second-most important predictor was social norms; it had a negative relation to intention [$\beta = -.30, p < .001$]. The least important predictor was perceived behavioral control [$\beta = .18, p < .001$], which was positively correlated with intention.

In the TBC model, the most important predictor was felt obligation [$\beta = .41, p < .001$]. The more participants felt obligated to change their behavior towards a plant-based diet, the stronger intention they reported. Affect was the second-most important predictor [$\beta = .22, p < .001$]; it was positively related to intention. The third-most important predictor was social norms [$\beta = -.16, p < .001$]; its correlation was negative. Participants tended to deny that adoption of a more plant-based diet would occur under the influence of their social circle [$\beta = -.16, p < .001$]. The fourth-most important variable was habit [$\beta = -.11, p < .001$]. Those who felt trapped in their behavior pattern of consuming meat-based diets were less likely to change their behavior towards a plant-based diet. Finally, the least-important predictor was perceived behavioral control [$\beta = .05, p < .001$]. Participants who reported being in greater control of their dietary behaviors reported stronger intentions to change. Interestingly, attitude (TPB) and attitude plus (TBC) were not significantly related to intention ($p > .05$; see Table 7).

Table 7 *The prediction of intention*

Model		Standardized Coefficients β	t	p
1	<i>Constant</i>		27.68	.00
	Recent dietary behavior	-.10	-2.16	.03
2	(Constant)		2.14	.03
	Recent dietary behavior	-.02	-.81	.41
	Attitude	.56	17.44	.00
	Social norms	-.30	-10.34	.00
	Perceived behavioral control	.18	5.70	.00
3	(Constant)		4.43	.00
	Recent dietary behavior	-.01	-.60	.54
	Attitude	.03	.42	.67
	Social norm	-.16	-7.18	.00
	Perceived behavioral control	.05	2.19	.02
	Habitual	-.11	-4.81	.00
	Obligation	.41	13.21	.00
	Affect	.22	5.91	.00
	Attitude plus values	.14	1.75	.08

3.3. The Role of Interactions among the Predictors

All possible interactions of the predictors were then computed and their effects on intention were examined independently with structural equation modeling. Social norms, in conjunction with (each of) perceived behavioral control, felt obligation, and affect, significantly predicted intention. Affect, interacting with felt obligation, significantly predicted intention. Finally, the interaction of perceived behavioral control and habitual behavior predicted intention.

Therefore, these five interactions were included in the model-comparison analyses reported earlier. Recent dietary behavior, as a control variable, was again entered as a first block. The three TPB predictors were entered in the second block, followed by the six TBC predictors were entered as the third block. Finally, the five aforementioned TBC interactions were entered in the fourth block. The resulting model was significant and it accounted for an adjusted 83 percent of the variance in intention [$F(13, 440) = 168.69, p < .001, R^2_{Adjusted} = .83$]. The variance accounted for by the interactions was small (added $R^2 = .01$, but this was statistically significant [$F(5, 440) = 6.16, p < .001$]).

This new analysis shifted the overall results slightly. Attitude plus significantly predicted intention once the interactions had been entered into the analysis, but attitude (TPB) and social norms were no longer significant. Once they were entered into the full analysis, three of the five interactions (habitual behavior \times perceived behavioral control, affect \times felt obligation, and social norms \times perceived behavioral control) significantly predicted intention.

Felt obligation [$\beta = .52, p < .001$] remained the most important predictor of food choice intentions. However, perceived behavioral control, which had been the least important predictor in the earlier analysis, now became the second-most important predictor of intention [$\beta = .41, p < .001$]. The third-most important predictor of intention [$\beta = .36, p < .001$] was affect. Next, participants who were more in the habit of consuming plant-based food reported stronger intentions in the future [$\beta = .25, p < .001$]. Attitude plus was also a significant predictor [$\beta = .16, p < .001$]; it was positively related to intention (see Table 8).

Table 8 *The prediction of intention including interaction terms*

Model		Standardized Coefficients β	t	p
1	(Constant)		27.68	<.01
	Recent dietary behavior	-.10	-2.16	.03
2	(Constant)		2.14	.03
	Recent dietary behavior	-.02	-.81	.41
	Attitude	.56	17.44	<.01
	Social norms	-.30	-10.34	<.01
	Perceived behavioral control	.18	5.70	<.01
3	(Constant)		4.43	<.01
	Recent dietary behavior	-.01	-.60	.54
	Attitude	.03	.42	.67
	Social norms	-.16	-7.18	<.01
	Perceived behavioral control	.05	2.19	.02
	Attitude plus	.14	1.75	.08
	Habitual behavior	-.11	-4.81	<.01
	Felt obligation	.41	13.21	<.01
	Affect	.22	5.91	<.01
4	(Constant)		-2.47	.01
	Recent dietary behavior	.00	-.01	.99
	Attitude	.02	.38	.70
	Social norms	.12	.96	.33
	Perceived behavioral control	.41	4.71	<.01
	Attitude plus	.16	1.93	.05
	Habitual behavior	.25	2.48	.01
	Felt obligation	.52	4.70	<.01
	Affect	.36	3.22	<.01
	Habitual behavior × Perceived behavioral control	-.36	-3.80	<.01
	Social norms × Felt obligation	.10	1.13	.25

Social norms × Perceived behavioral control	-0.42	-2.76	<.01
Affect × Felt obligation	-0.37	-3.27	<.01
Social norms × Affect	.04	.45	.65

3.3.1. Inside the Significant Interactions

Simple slopes analyses were conducted to examine the nature of the three significant TBC interactions. All were based on creating three groups: respondents with scores lower than one standard deviation from the mean, those with scores between minus one and plus one standard deviations from the mean, and those with scores higher than one standard deviation from the mean.

The first interaction, between perceived behavioral control and habitual behavior, is shown in . Intention weakened for all three groups as respondents believed less that they could not change their habits. Second, those who believed that they had greatest control expressed the strongest intentions to adopt plant-based diets. Third, those who believed they had the least control reduced their intention to change their behavior the least; this is the heart of the interaction.

The second interaction was between affect and felt obligation. First, as respondents felt more delighted and excited about the idea of changing their behaviors, their intention to take those steps became stronger. Second, those with the strongest sense of obligation reported stronger intentions to change their behavior. However, this tendency was slightly flatter among respondents who reported the strongest sense of obligation; this is the heart of the interaction (see Figure 4).

The third significant interaction involved social norms and perceived behavioral control.

First, intention declined for all groups with stronger perceived norms. This is consistent with the earlier finding of a strong negative correlation between social norms and intention. Second, intention was strongest for those who perceived greater perceived behavioral control. However, intention declined faster for those who perceived greater perceived behavioral control than for others; that is the heart of this interaction (see Figure 5).

3.4. Demographic Variables

The respondents' intentions to adopt plant-based diets was examined for the five demographic variables. Females ($r = .24, p < .01$) and those with more left political positions ($r = -.13, p < .01$) expressed stronger intentions to change their behavior towards a plant-based diet in the future. The other demographic variables were not significantly related and intention ($ps > .05$; see Table 8).

Table 8 *Correlations between demographic variables and intention*

	Age	Gender	Academic standing	Income	Political ideology
Intention	.05	.24**	.04	.04	-.13**

Note: ** Significant at the .01 level; * Significant at the .05 level.

4. Discussion

This study's results show that the theory of behavioral choice (TBC) predicts a significantly greater proportion of variance in the intention to adopt plant-based behaviors than does the theory of planned behavior, as hypothesized. The 21 percent increase is partly caused by the TBC's additional predictor variables including felt obligation, affect, and habitual behavior. The findings also confirm the small but significant value of considering interactions between TBC components.

Several previous studies have considered adding constructs in order to enhance the TPB model (e.g. Conner and Abraham 2001; Conner and Armitage 1998; Gifford Lacroix and Chen, 2018; Richard van der Pligt and Vries 1996; Zhang et al. 2020). Most focused on extending the original model by including one or two additional predictors. The theory of behavioral choice is a more comprehensive framework for successfully gathering the most important predictors.

In particular, felt obligation played an essential role in determining individuals' food-choice intentions. Previous studies have also reported a positive and significant relation between a sense of obligation to engage in pro-environmental intentions or behavior (Doran and Larsen 2016; Han Lee and Kim 2018; Harland Staats and Wilke 1999; Onwezen et al. 2013; Stern 2000).

In accordance with the TPB model and other studies' findings (Croker et al. 2009; Huang et al. 2020; Zhang et al. 2020; Ong et al. 2021; Rees et al. 2018; Richard, van der Pligt and Vries 1996) social norms also play a key role in influencing on the intention of individuals to prepare, at least in our first analysis (that did not include predictor interactions). Social norms and intention were negatively related. Perhaps this was because participants wished to deny that they were under the influence of others in their social circles. Many of us would like to think that our decisions are our own. Alternatively, some authors attribute the absence of a connection between intention and social influence to lack of awareness (Croker et al. 2009).

As for affect, many studies find it to be one of most important factors in predicting intention (Ajzen 2011; Rapaport and Orbell 2000; Richard van der Pligt and Vries, 1996; Wolff et al. 2011).

Although breaking one's habits is often considered the most difficult part of behavior change to overcome, many climate-relevant behaviors are associated with habit. The results of this study confirmed the importance of breaking habits for increasing one's pro-environmental intentions, which is consistent with other studies (Gifford Lacroix and Chen, 2018; Rees et al. 2018; Verplanken and Whitmarsh 2021).

In the present study's second analysis, the variance accounted for by the interactions between constructs within the TBC was small but significant. Previous studies have estimated interaction effects in the TPB. These mostly focused on the moderator impact of perceived behavioral control (e.g. La Barbera and Ajzen 2020; La Barbera and Ajzen 2021; Steinmetz Davidov and Schmidt 2011). The present investigated the interaction effects of the TBC intention constructs, which is consistent with Kothe and Mullan's (2015) conclusion that considering interactions between constructs is essential for a complete understanding of outcomes.

Although the TBC predictor attitude plus was not significantly related to intention in the first analysis, it was when the interaction effects were added to the model. Therefore, the inclusion of values and emotions to the TPB's attitude construct was confirmed in this work. To the best of our knowledge this construct, attitude plus, was used first in the present study, although the idea of adding principles to the TPB model was introduced by Gifford, Lacroix and Chen (2020).

Perceived behavioral control moved from being the least to the second-most important predictor of intention when the interaction effects were added to the TBC. That greater PBC tends to weaken the relative importance of social norm is consistent with the results of other studies (La Barbera and Ajzen 2020).

Three demographic variables (age, income, and educational level) were not significantly related to intention, but females and those with stronger left political positions did express stronger intentions than males and those with stronger right political stands. Thus, efforts to shift toward encouraging more plant-based dietary choices might best be focused on men and those who hold stronger right political positions. Which sorts of messages appeal to these groups might well be discovered by reviewing the literature on masculinity and conservatism.

This study focused on dietary intentions. Of course, future studies based on the TBC should enhance this research by including food behaviors. And, of course, other important climate-related intentions and behaviors should be investigated. Also, future work should continue the search for the value of examining the import of predictor interactions. As is very often the case, we note that participants' reports of their recent dietary behavior relied on their memories, which may not be perfect.

Policymakers who are engaged in designing pro-environment messages should give greater consideration to the strongest influences on intention. For instance, we found that having a sense of obligation was the most important factor predicting the intention to adopt plant-based behavior in the near future. Adopting plant-based food was also said by the participants to be negatively influenced by their social circle. Social norms influence individuals' dietary decisions and they should be taken into account by awareness campaigns and policymakers.

Furthermore, anticipating positive effect, such as enjoying engaging in pro-environmental behavior or having a good feeling about it strongly motivates individuals to undertake action in the future. Breaking a habit is the most difficult challenge that individuals encounter and can act as a barrier through the

effectiveness of interventions. Therefore, providing information for people and educating them how to overcome it is vital. In addition, based on the results of interaction effects, policy makers need also emphasize on perceived control over dietary decisions and attitude plus values toward behavior. However, they should be aware that the importance of social norm weakens with greater PBC.

In conclusion, the present work suggests that adding three important constructs to the theory of planned behavior (felt obligation, perceived behavioral control, affect, habit, and attitude plus), as part of the new theory of behavioral choice, is an important advance.

Declarations

Competing interests The authors declare no competing interests

Funding We are grateful for the support from the Social Sciences and Humanities Research Council of Canada, grant number 435-2020-1295.

Author contributions Robert Gifford: conceptualization; writing; revising; editing Karine Lacroix: data gathering; writing Zahra Asgarizadeh: data analysis; methodology; visualization; writing; editing Emily Ashford Anderson: data gathering; writing Madison Milne-Ives: writing Peter Sugrue: data analysis; methodology

Data Availability The data generated during and analyzed during the current study are available from the corresponding author upon reasonable request.

Consent to Publish All authors gave their consent to publish and our university encourages us to publish scientific articles, so the University's consent is assumed.

Ethics approval Ethics approval was granted by University's Research Ethics Board.

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Figures

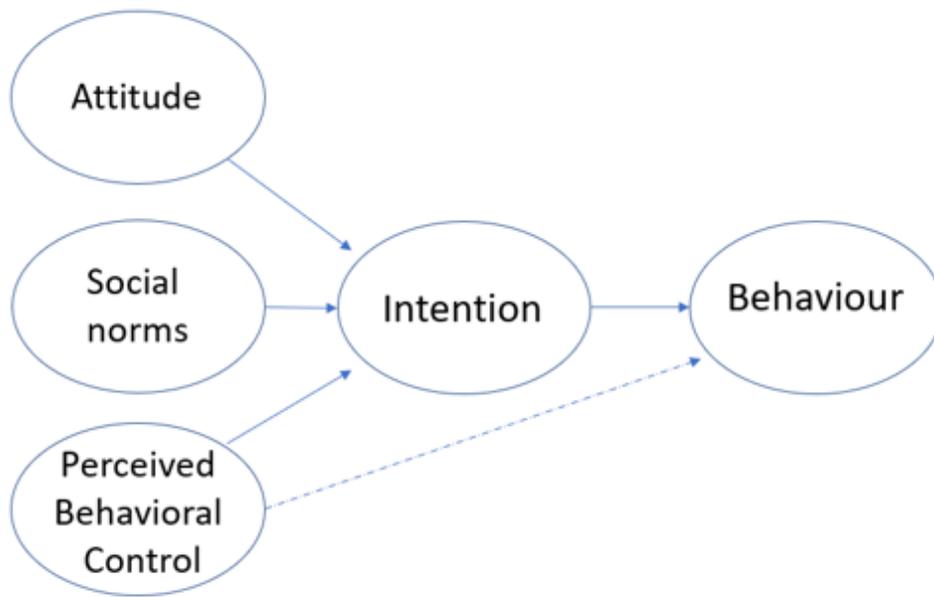


Figure 1

The theory of planned behavior

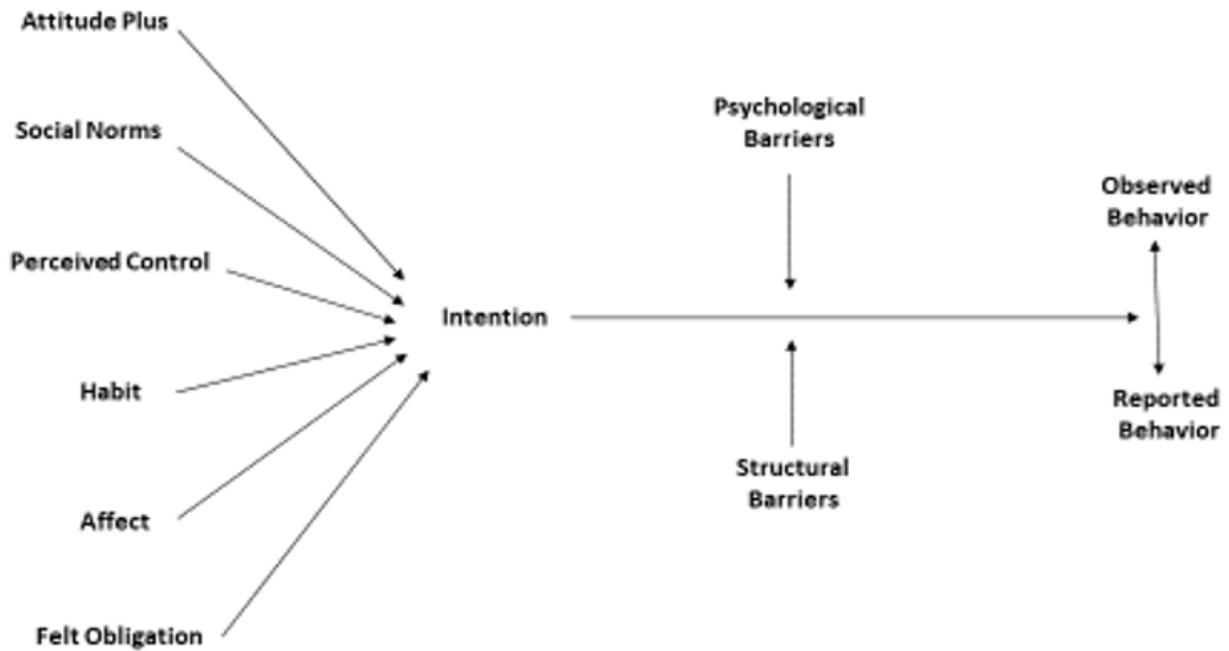


Figure 2

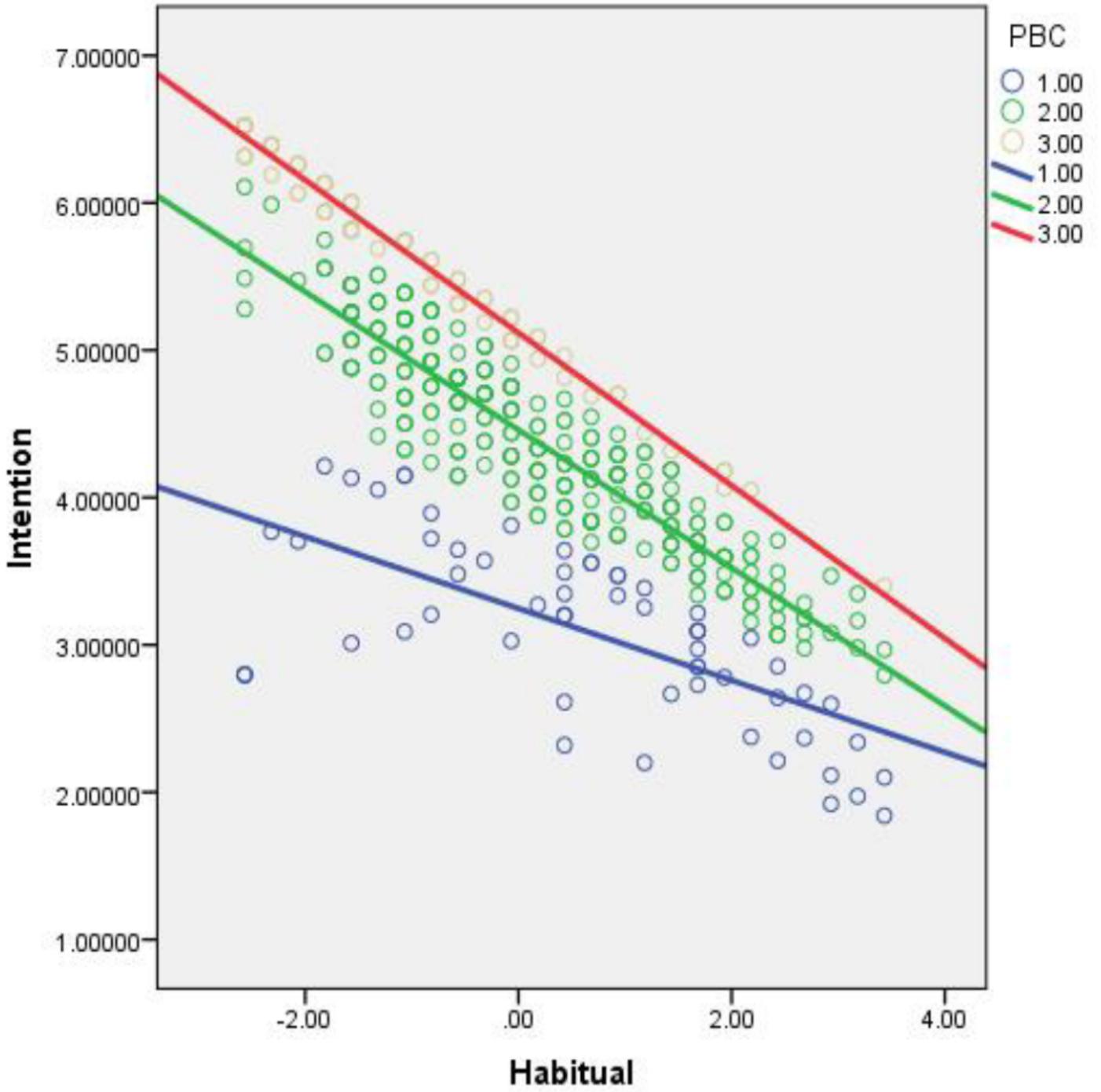


Figure 3

Intention and the habitual behavior x perceived behavioral control interaction

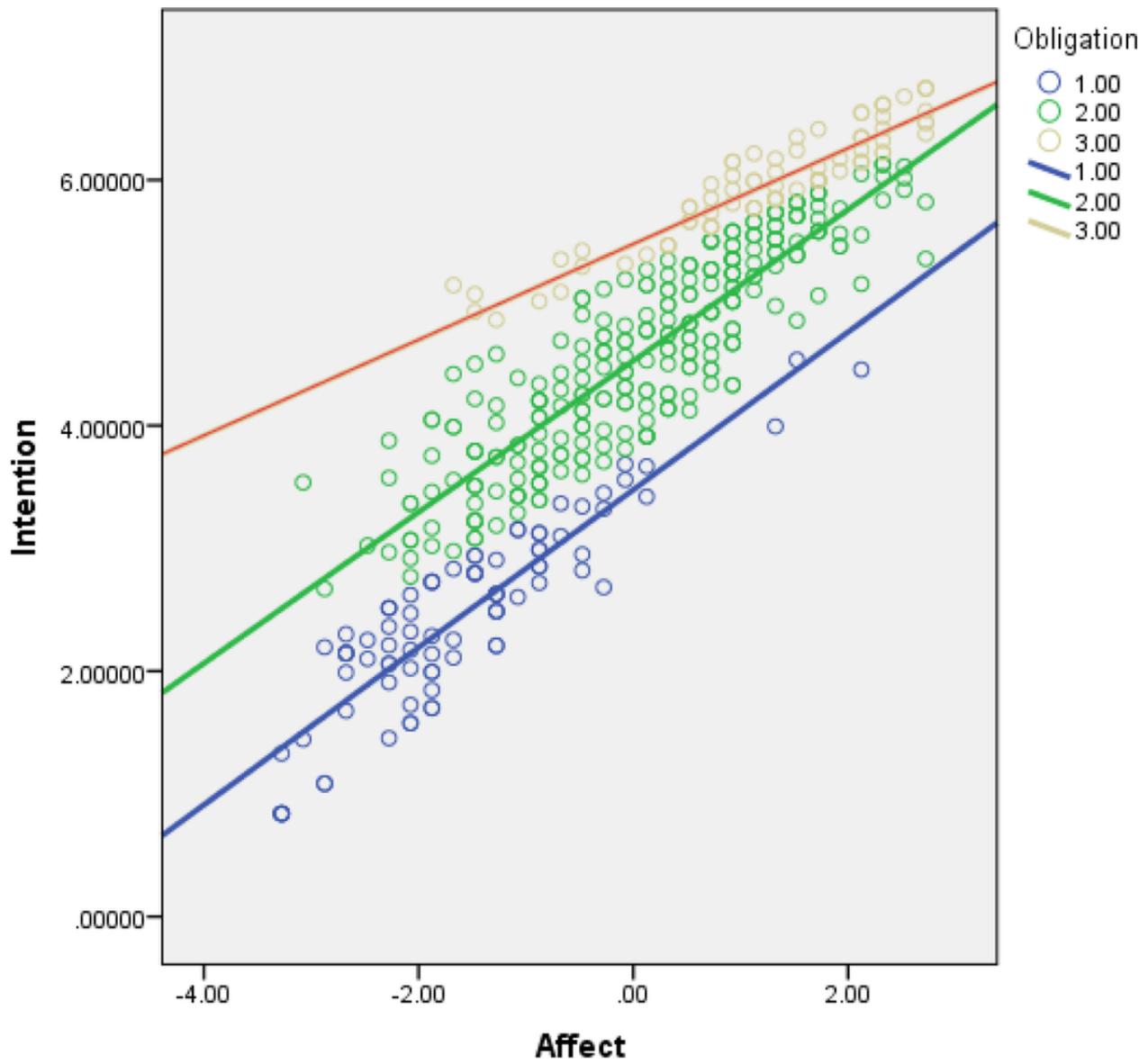


Figure 4

Intention and the interaction between affect and felt obligation

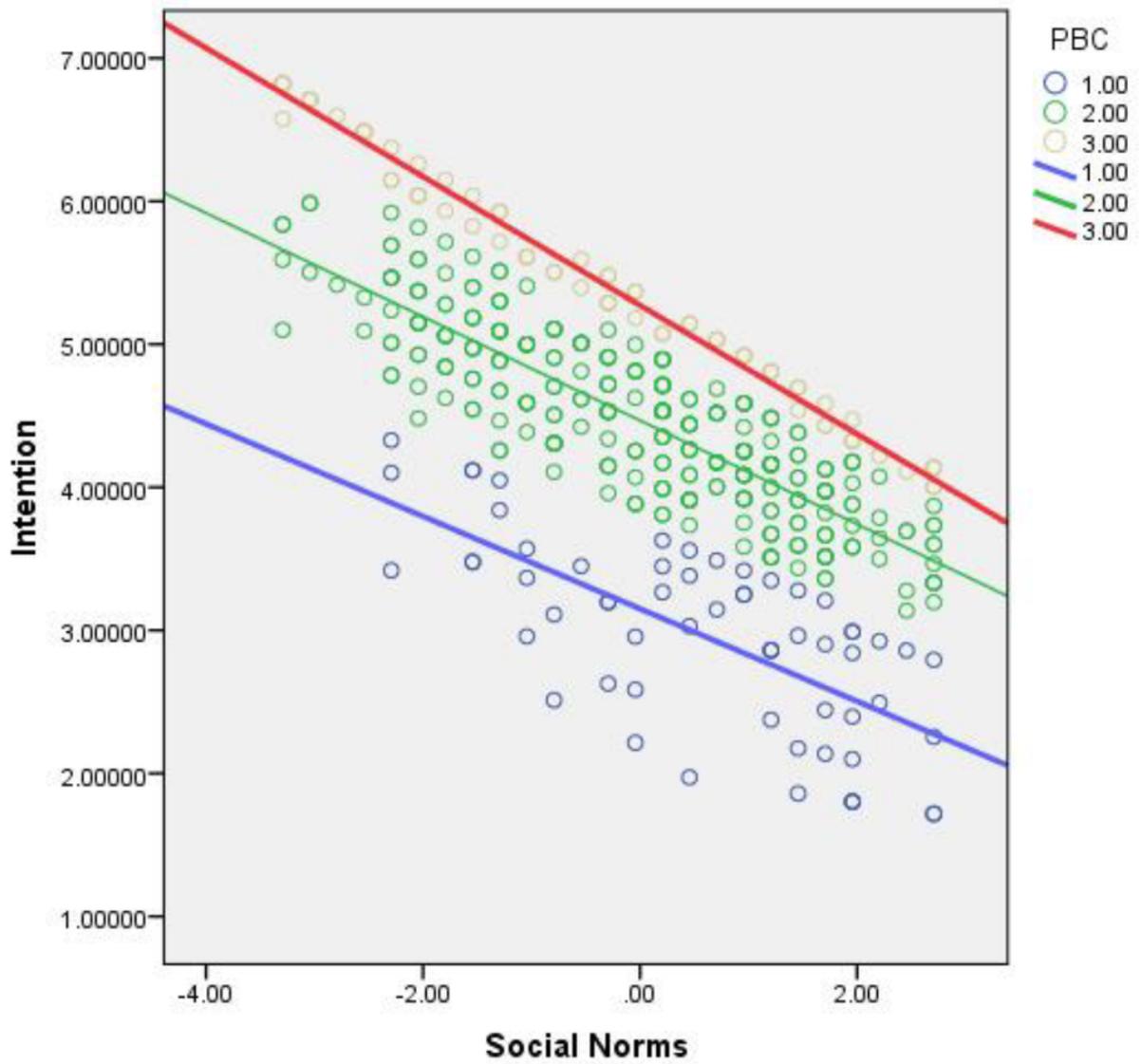


Figure 5

Intention and the interaction between social norms and perceived behavioral control