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Habit in the Physical Activity Domain: Integration With Intention Temporal Stability and Action Control

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The purpose of this study was to explore the role of habit in predicting physical activity with the theory of planned behavior (TPB). The study extended previous research by (a) including a measure of temporal intention stability in the regression equation, and (b) unpacking the intention × behavior × habit relationship. Participants were 153 undergraduate students who completed a habit measure and measures of the TPB at Time 1 followed by measures of intention and behavior 2 weeks later. Results using regression analysis demonstrated that habit explained 7% additional variance after accounting for the TPB and temporal stability of intention and its interaction with intention. Follow-up analyses showed considerable asymmetry in the three-way relationship between intention, behavior, and habit, where high habit participants were composed primarily of intenders (i.e., intended to be active >3 times/week at 30 min) who engaged in regular physical activity (70%, $n = 28$) and low habit participants were inactive nonintenders (i.e., did not intend to be active >3 times/week at 30 min and were subsequently not active; 69%, $n = 25$). The results support the notion that some properties of physical activity may have an automatic component and that habits may be important to physical activity action control.

Keywords: theory of planned behavior, automaticity, intention stability, exercise

Regular weekly physical activity at a moderate intensity has numerous health benefits, yet participation is low (Warburton, Katzmarzyk, Rhodes, & Shephard, 2007; Warburton, Nicol, & Bredin, 2006). Therefore, the promotion of physical activity is important to public health. A sound theoretical understanding of physical activity has been postulated as the best way to move forward with promotion initiatives (Baranowski, Anderson, & Carmack, 1998). Specifically, if the foundations of physical activity initiation and maintenance are well understood, then intervention initiatives targeting these foundations should meet with success.

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Most leading behavioral theories suggest that the proximal construct predicting behavioral action is the intention to act or a related behavioral goal (Ajzen, 1991; Bandura, 1998; Fishbein et al., 2001; Noar & Zimmerman, 2005; Rogers, 1983). This construct represents motivation and the conscious plan to enact behavior, and theorizing for this intention-behavior relationship has been supported reliably in the physical activity domain (Symons Downs & Hausenblas, 2005). Still, intention-behavior discordance is high. Research on the topic suggests that the behavioral translation of physical activity intentions is around 50% (e.g., Canadian Fitness and Lifestyle Research Institute, 2004; Rhodes & Plotnikoff, 2006). Researchers and theorists have thus postulated that (a) either additional variables other than intention explain behavior or (b) intermediary variables moderate the intention-behavior relationship (Norman & Conner, 2005; Rhodes, Plotnikoff, & Courneya, 2008; Schwarzer, 1992; Sheeran, 2002).

Over 30 years ago, Triandis (1977) suggested that habit may provide an independent role in explaining behavior from intention and interact with the intention-behavior relationship. According to Triandis's theory of interpersonal behavior, when a particular behavior has been frequently performed in the past, it increases in habit strength. As a result, these strongly habitual behaviors are not set in motion by planned intentions. This assertion has created a tumultuous debate among social cognitive theorists ever since, and its utility in the physical activity domain has been no less controversial (Maddux, 1997). Current theorists define habit as goal-directed automaticity marked by elements of repetition and low awareness (Aarts & Dijksterhuis, 2000; Aarts, Paulussen, & Schaalma, 1997; Ouellette & Wood, 1998; Verplanken & Aarts, 1999). That is, the behavior was once performed via deliberative processes (attitudes, expectancy value, etc.) and subsequent motivation, but it is now performed via external cues to the behavior. It has been postulated that habits are formed from practiced behaviors that have become efficient to perform and are likely highly reinforcing (Verplanken & Aarts, 1999).

The concept of habit, however, has been debated and much of the criticism of the habit construct has been methodological. Most tests of the construct have used a measure of past behavior as a proxy of habit. Past behavior is an omnibus of all reasons for prior behavioral performance and thus both proponents (Verplanken, 2006) and opponents (Ajzen, 2002c) of the habit construct have suggested that past behavior is not an appropriate measure of habit. Residual variance between past and future behavior after controlling for social cognitive constructs could be from unmodeled conscious processes as much as automatic processes (Ajzen, 2002c). Recently, however, this methodological limitation has been improved upon with specific habit indices. For example, the self-report index of habit strength (Verplanken & Orbell, 2003) contains several items that measure history of behavioral repetition, automaticity, and identity. Studies in the physical activity domain that have used this index have generally shown some discriminant validity from past behavior (Verplanken & Melkevik, 2008) and supportive findings (Chatzisarantis & Hagger, 2007; De Bruijn, Kremers, Singh, Van den Putte, & Van Mechelen, 2009) in terms of its prediction of behavior independent of intention and an interaction with intention on behavior. For instance, De Bruijn and colleagues (2009) reported that among Dutch adolescents, intention to use a bicycle was more than six times stronger when cycling habits were weak than when cycling habits were strong. Although similar findings have been reported elsewhere (Gardner, in press),

there is a lack of studies focusing on generalized physical activity. Because active transportation and cycling modes are commonly done in stable situational contexts, these behaviors may be more prone to become habitual. Research on more generalized measures of physical activity may reveal whether findings from the active transportation literature can be transferred to other physical activity modes (Gardner, in press; Lally, Chipperfield, & Wardle, 2008).

Another major methodological concern has been that intention stability, the waxing and waning of intentions across the prediction time, may account for the low intention-behavior relationship and not automaticity (Ajzen, 2002c). Specifically, temporal instability of intention across time may add error to the intention-behavior relationship. People either have changed their intentions or did not construe their initial responses with the distal outcome; this explanation still suggests that motivational variables may guide behavioral action but it suggests that error in prediction occurs from the administration measures across time. Intention temporal stability has been established as the most powerful moderator in the intention-behavior relationship and arguably the best measure of intention strength (Conner, Sheeran, Norman, & Armitage, 2000; Sheeran & Abraham, 2003). No studies, to our knowledge, have tested whether habit can predict behavior after accounting for intention stability. Tests of this effect are needed to confirm the suggestions made by Ajzen (2002c).

From a physical activity standpoint, habit is also controversial when considering current knowledge about behavioral performance. As Maddux (1997) has suggested, regular physical activity is a potentially aversive physical experience that brings people out of resting homeostasis, requires effort and planning/scheduling, and takes considerable time. The behavior is plagued by barriers to motivation (time, fatigue, social support) (Canadian Fitness and Lifestyle Research Institute, 2002), and does not have considerable evidence that forgetfulness is responsible for low adherence. This would seemingly be a key link with automaticity (Gollwitzer & Sheeran, 2006). Verplanken and Melkevik (2008), however, have suggested that the potential habit component in physical activity behavior is during its initiation and not in the act itself. Thus, automaticity may have a partial role (e.g., acting within a certain time of the day, putting-on exercise apparel, or driving to the facility) in the complex act of physical activity behavior but it is unlikely to supplant motivation and social cognition (organizing and maintaining the physical activity schedule and/or equipment, determination in the face of constraints). Regular physical activity is also a practiced behavior with high frequency of performance, often at similar settings; thus it is possible that habit may play a role in behavioral continuation. Perhaps more important, habit may have an impact on action control (i.e., translating intention into behavior). Discrepancy between initial positive intention and resulting behavior is important in the physical activity domain because most of the populace has positive intentions but at least half often fail to act (Canadian Fitness and Lifestyle Research Institute, 2004; Rhodes & Plotnikoff, 2006; Rhodes, Plotnikoff et al., 2008; Sheeran, 2002). Habitual patterns (same routine) seem apt for helping with the seamless transition of motivation to behavior without considerable deliberation and social cognition. Research is needed to test this conjecture.

Therefore, the purpose of this study was to explore habit in the physical activity domain. First, the predictive capability of habit and a habit × intention interaction on behavior was evaluated after accounting for the temporal stability of intention, its interaction with intention, and using social cognitive variables from Ajzen's

(1991) theory of planned behavior (TPB). It was hypothesized that habit and its interaction with intention may predict behavior independent of these other constructs based on the theorizing of Triandis and others (Triandis, 1977; Verplanken & Aarts, 1999). Similar to previous work, habit was expected to demonstrate a positive relationship with behavior, and those participants who reported higher physical activity habit were expected to show a lower intention-behavior relationship compared with those who report low habit (Chatzisarantis & Hagger, 2007). This is based on the assumption that volitional intention may be less relevant to behavioral enactment as the behavior becomes habitual. Nevertheless, it was also hypothesized that intention and intention strength would have an effect on physical activity given the above-noted rationale that the behavior is still highly motivation dependent.

Second, it was hypothesized that habit would be linked with action control (Rhodes & Plotnikoff, 2006; Rhodes, Plotnikoff et al., 2008); that is, habit would differentiate those with physical activity intentions who successfully engaged in physical activity from those who were unsuccessful. This hypothesis was based on theorizing that habit represents goal-driven (high intent) automaticity (Verplanken & Aarts, 1999). The intention-behavior relationship is asymmetrical, with participants falling into only three of the four possible quadrants: nonintenders who do not act, intenders who fail to act (unsuccessful intenders), and intenders who act (successful intenders). Traditional regression approaches may not be as disposed to understanding action control (i.e., separating these three profiles in analyses) based on the outlined asymmetry of the intention-behavior relationship (Sheeran, 2002).

Method

Participants and Procedure

One hundred and ninety students volunteered to participate in the study from introductory psychology and health psychology courses at a Canadian University-College. Informed consent was obtained from the participants. Participants attended large group sessions during October and November 2006, completing self-report measures of the TPB and automaticity. One hundred and fifty-three participants returned to complete a 2-week follow-up measure of intention and physical activity behavior. All students provided informed consent and the study was approved by the Institution Ethics and Review Board (2006–039-MUCF). No differences ($p > .05$) between those who did not return for the follow-up and those who did were identified on all of the variables of interest. Thus the total sample for the prospective study was 153 participants. The relatively small 2-week time lag was chosen to reflect optimal predictive accuracy, given the dynamic nature of social cognitions and the TPB tenets of time, context, target, and action (Ajzen, 1991, 2002a). The mean age of participants was 22.17 ($SD = 6.51$ years), 74% were female, and the mean year in university for the sample was 1.99 ($SD = 1.22$).

Instruments

The definition of physical activity was chosen to reflect Health Canada's position stand for recommended weekly exercise among adults (Health Canada, 2002).

Physical activity was defined as activities performed *at least* at a moderate intensity, four or more times per week, accumulating at least 30 min each time.

Attitude toward regular physical activity was measured using 7-point bipolar adjective items as suggested by Ajzen and Fishbein (1980). Three items were used to tap the instrumental (e.g., useful-useless, wise-unwise, beneficial-harmful), and three items were used to tap the affective (enjoyable-unenjoyable, pleasant-unpleasant, exciting-boring) aspect of attitude as suggested by Ajzen (2002a). Affective and instrumental attitude were measured as separate components, given considerable research that has supported their discriminant validity (Courneya, Conner, & Rhodes, 2006; French et al., 2005; Lawton, Conner, & McEachan, 2009; Rhodes, Blanchard, & Matheson, 2006). The statement that preceded the adjectives was "For me, regular physical activity over the next two weeks would be. . . ." Internal consistencies for the two measures were acceptable (affective attitude α = .75; instrumental attitude α = .71).

Subjective norm was measured by three items on 7-point scales. Two items measured the injunctive component of subjective norm and one item measured the descriptive component of subjective norm based on the recommendation of Ajzen (2002a). These components were aggregated to form a scale based on the findings of Rhodes and colleagues (Rhodes, Blanchard, & Matheson, 2006; Rhodes & Courneya, 2003a). The items were (1) "Most people who are important to me would want me to engage in regular physical activity over the next 2 weeks" (from 1 [*strongly disagree*] to 7 [*strongly agree*]), (2) "Most people whose opinions I value would approve of me to engaging in regular physical activity over the next 2 weeks" (from 1 [*completely disapprove*] to 7 [*completely approve*]), and (3) "Most people who are important to me will engage in regular physical activity over the next 2 weeks themselves" (from 1 [*completely untrue*] to 7 [*completely true*]). The measure showed borderline adequate internal consistency (α = .67).

Perceived behavioral control was measured by three questions recommended by Rhodes and Courneya (2003b; 2004) and standard to the TPB (Ajzen, 2002b). The three PBC items were (1) "In the next 2 weeks, I have complete personal control over doing regular physical activity if I really wanted to do so," (2) "Engaging in regular physical activity is mostly up to me in the next 2 weeks if I wanted to do so," and (3) "Engaging in regular physical activity over the next 2 weeks if I wanted to do so would be. . . ." Items 1 and 2 were scored on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*), whereas Item 3 was scored from *extremely difficult* (1) to *extremely easy* (7). Internal consistency for the measure was acceptable (α = .73).

Intention was assessed by items recommended by Courneya (1994) and Rhodes and colleagues (Rhodes, Blanchard, Matheson, & Coble, 2006). The items were (1) "I intend to engage in regular physical activity ____ times per week over the next 2 weeks" (open scaled), (2) "I am motivated to engage in regular physical activity over the next 2 weeks" (from 1 [*completely unmotivated*] to 7 [*completely motivated*]), and (3) "I am determined to engage in regular physical activity over the next 2 weeks" (from 1 [*completely undetermined*] to 7 [*completely determined*]). The items were standardized and then aggregated to create an intention measure for the correlation-based analyses (α = .82). Item 1, however, was used to create the intention-behavior profiles because it has perfect scale correspondence with the behavior measure and it has repeatedly demonstrated excellent reliability and

predictive validity as a single-item measure of intention (Courneya & McAuley, 1994; Rhodes & Courneya, 2003a; Rhodes, Courneya, & Jones, 2003). The correspondence of intention and behavior with this measure allows for grouping of the profiles using a common metric (i.e., frequency of physical activity). The other two intention items do not use this common metric and would make it more difficult to split profiles.

Intention stability followed the procedures of Conner et al. (2000) and Sheeran and Abraham (2003). Specifically, items were created by (1) the sum of the absolute differences between intention items at Times 1 and 2, (2) the within-participant correlation between intention items at the two time points, (3) the number of items that exhibited change, and (4) the absolute difference between the sum of intention items at both time points. Reliability was $\alpha = .85$.

Physical activity behavior was measured using the Godin Leisure Time Exercise Questionnaire (Godin, Jobin, & Bouillon, 1986; Godin & Shephard, 1985). The instrument contains three open-ended questions covering the frequency of mild (e.g., easy walking), moderate (e.g., fast walking), and strenuous (e.g., jogging) exercise completed during free time for at least 30 min duration in a typical week. Our adaptation included substituting "physical activity" for "exercise" and "two weeks" for "one week." Strenuous and moderate physical activity frequencies were aggregated to produce a total activity frequency at or above moderate intensity. Mild activity was not included as an indicator due to its incongruence with our definition of regular physical activity.

Habit was assessed with the 12 SRHI items from the measure developed by Verplanken and Orbell (2003) and adapted to physical activity by Chatzisarantis and Hagger (2007). The measure contains 12 items that span assessments of uncontrollability, lack of awareness, and efficiency as recommended by Bargh (1994). Regular physical activity was defined as per Health Canada's guidelines (2002) and the 12 items were scored on a 7-point scale from 0 (*strongly disagree*) to 6 (*strongly agree*). Exploratory factor analysis (principal components) identified a single-factor solution similar to previous research (Chatzisarantis & Hagger, 2007) and the reliability of the measure was excellent ($\alpha = .97$).

Analysis Plan

Following basic descriptives and intercorrelations among the relevant constructs of interest, hierarchical ordinary least squares regression analyses were employed to predict future physical activity and examine whether habit could explain behavior after controlling for the TPB and intention stability. To predict behavior, intention and PBC were entered in Block 1, followed by TPB constructs of affective and instrumental attitude and subjective norm in Block 2 as per the tenets of the TPB (Ajzen, 1991). Intention stability was entered in Block 3, followed by the intention stability $\times$ intention interaction in Block 4. Habit was entered into the equation in Block 5, followed by the habit $\times$ intention interaction in Block 6. Intention, habit, and intention stability were mean centered to reduce potential multicollinearity in the interaction terms (Aiken & West, 1991).

Next, habit's role in action control was assessed with two related methods. First, the symmetry/asymmetry of future behavior and initial intention relationships by habit was achieved via chi-square analyses and was divided into low advocacy

(<2; disagreement response options), ambivalence (>1.9 and <3.9; neither disagreement nor agreement response options), and high advocacy (>4; agreement response options) and compared in proportion to inactive (<4 bouts of activity per week) / active (>3 bouts of activity per week) individuals and nonintenders (<4 intended bouts of activity per week) / intenders (>3 intended bouts of activity per week) as per Health Canada's guidelines for regular physical activity (2002). These variable categorizations were done purposefully using absolute values (i.e., not simple median splits) to examine symmetry across scale responses. Second, intention-behavior profiles were created in an identical manner to Rhodes et al. (2003). Specifically, the classification corrected for scale correspondence in the social-cognitive/automaticity measures by categorizing those participants who initially intended to be active four or more times per week from those participants who did not initially intend to be active at least four times per week. The behavior measure was similarly categorized to correspond with the measures as a dichotomy of (1) less than four bouts of physical activity and (2) four or more bouts of future physical activity. This results in classifications of (1) nonintenders, (2) nonintenders exceeding intentions, (3) unsuccessful intenders, and (4) successful intenders. Power analysis for detecting at least a medium effect size ($F = .35$) suggested that the minimum cell size per profile needed to retain in the analyses was $n = 23$. Identifying whether habit was different by profile membership was then achieved using analyses of variance tests and Tukey post hoc comparison if the finding was significant. All tests were performed at $p < .05$.

Results

Descriptives and correlations for the sample can be found in Table 1. As can be seen in Table 1, habit significantly positively correlated with affective attitude, subjective norm, PBC, intention, and physical activity. The largest correlations were between habit and both intention and behavior. In terms of descriptives, habit had a mean of around the center of the scale (i.e., suggesting ambivalence), intention

Table 1 Descriptives and Correlations of Physical Activity, Habit, Intention Stability, and Theory of Planned Behavior Constructs

	2	3	4	5	6	7	8	*M*	*SD*
1. Affective Attitude	.32**	.31**	.19**	.55**	.17*	.50**	.31**	5.18	1.10
2. Instrumental Attitude		.35**	.15*	.26**	.03	.10	.11	6.28	0.70
3. Subjective Norm			.19*	.33**	.03	.27**	.17*	5.63	.097
4. PBC				.45**	.06	.32**	.26*	5.72	1.15
5. Intention					.17*	.59**	.44**	0.00	0.87
6. Intention Stability						.15*	.09	–0.02	0.95
7. Habit							.55**	2.98	1.54
8. Follow-up Physical Activity Behavior								3.13	2.47

Note. PBC = perceived behavioral control. Scores ranged between 1 and 7 for theory of planned behavior constructs and between 0 and 6 for habit. Intention is presented as a standardized *Z* score.
*$p < .05$, **$p < .01$.

had medium-strong mean score, and physical activity behavior had a mean of 3.13 bouts per week. These variables all had a normal distribution from skewness and kurtosis results.

Table 2 highlights the findings for predicting physical activity with habit, the TPB, and intention stability. For the prediction of physical activity, intention, but not PBC, was a significant predictor in Block 1, explaining 17% of the variance. The inclusion of the other TPB constructs and intention temporal stability was not significant in Blocks 2 and 3 respectively; however, intention temporal stability × intention predicted behavior in Block 4 and explained an additional 6% variance. Figure 1details this relationship in simple slopes analysis and shows that the intention-behavior relationship is larger for those with high intention stability compared with low stability. Habit explained an additional 7% variance in Block 5, but the habit × intention interaction was not significant in Block 6. (We also examined the habit measure with the behavioral items stripped from it based on criticism that past behavior is not habit. The findings did not differ from those reported with the complete SRHI.) This interaction was also not significant when explored without intention stability and TPB variables as covariates.

As one might expect from the bivariate correlations found in Table 1, habit across the intention, $\chi^2(2) = 38.308$; $p < .01$, and behavior, $\chi^2(2) = 26.19$; $p < .01$, variables was asymmetrical with those high in habit reporting as intenders or active than those low in habit respectively. Table 3 highlights the full habit × intention × physical activity relationship, which demonstrates further asymmetry. Among those low in habit, 69% ($n = 25$) were nonintenders who did not follow up with behavior.

Table 2 The Theory of Planned Behavior, Intention Stability, and Habit Predicting Physical Activity

	F_{change}	*df*	R^2_{change}	β^1	β^2	β^3	β^4	β^5	β^6
Block 1	14.16**	2,138	.17						
Intention				.38**	.29**	.29**	.31**	.14	.18
PBC				.08	.10	.09	.06	.05	.06
Block 2	1.34	3,135	.02						
Affective attitude					.18	.18	.15	.06	.09
Instrumental attitude					–.06	.04	–.01	.02	.00
Subjective norm					.02	.02	.01	–.01	–.02
Block 3	0.18	1,134	.00						
Intention stability						–.03	.01	–.03	–.06
Block 4	11.08**	1,133	.06						
Intention × intention stability							.26**	.21**	.21**
Block 5	13.85**	1,132	.07						
Habit								.35**	.34**
Block 6	2.10	1,131	.01						
Habit × intention									.12

Note. β^{1-4} = standardized regression coefficients for Equations 1–4.
*$p < .05$, **$p < .01$.

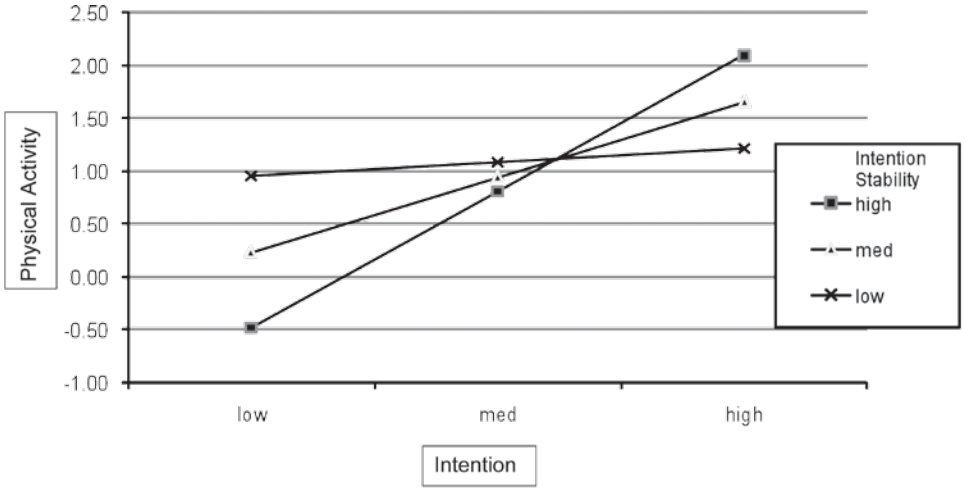

Figure 1 — Interaction between intention temporal stability and intention when predicting physical activity behavior.

Table 3 Intention × Physical Activity × Habit Relationship in Number of Cases

	Physical Activity Behavior	
	Inactive	**Active**
Low Habit		
Nonintenders	25	3
Intenders	6	2
Ambivalence		
Nonintenders	19	6
Intenders	13	25
High Habit		
Nonintenders	7	2
Intenders	7	28

Among those who reported ambivalence in their physical activity habit, however, the results showed that 30% (n = 19) were nonintenders who did not engage in physical activity, 40% (n = 25) were intenders who were subsequently active, and 21% (13) were intenders who did not result in physical activity. Thus, the results showed more diversity across the intention-behavior quadrants. Finally, 70% (n = 28) of those reporting high habit were intenders who successfully engaged in physical activity, thus demonstrating considerable asymmetry.

Separation of intention-behavior profiles yielded three of the four possible combinations. Participants could be grouped as nonintenders (n = 53), unsuccessful intenders (n = 32), or successful intenders (n = 57). Only 11 participants could

be grouped as nonintenders exceeding intentions, and these participants were subsequently not used in the analysis of variance. Among the three viable profiles, however, habit was significantly different ($F_{2,139} = 28.22$, $p < .01$; $\eta^2_{partial} = .29$) and homogeneity of variance was supported. Post hoc tests showed that habit was not different for nonintenders ($M = 1.93$, $SD = 1.41$) and unsuccessful intenders (M = 2.64, $SD = 1.43$), but successful intenders ($M = 3.88$, $SD = 1.25$) were significantly higher on habit than both the other groups.

Discussion

The purpose of this study was to extend the limited research that has applied a habit measure with the TPB in the physical activity domain (Chatzisarantis & Hagger, 2007; De Bruijn et al., 2009; Gardner, in press). Earlier research has commonly been done with cross-sectional samples (De Bruijn, 2009) and has failed to control the effect of habit strength on health behavior for known important moderator variables, such as intention stability. This was achieved through a more rigorous test of its role in predicting behavior by (a) including a measure of temporal intention stability in the regression equation and (b) unpacking the intention × behavior × habit relationship. The results demonstrate that habit may play a role in physical activity behavior independent of initial intention.

First, it was hypothesized that habit and its interaction with intention would predict behavior independent of intention, constructs of the TPB (i.e., PBC, affective and instrumental attitude, subjective norm), and intention temporal stability (i.e., intention strength) based on the theorizing of Triandis and others (Triandis, 1977; Verplanken & Aarts, 1999). It should be noted that our measure of intention temporal stability used the 2-week time span between measures, and thus it represents a relatively liberal measure in comparison with some recent research that used two prior time spans to predict a third time point in behavior (Conner et al., 2000; Sheeran & Abraham, 2003). This procedure combined with the short prospective time frame (2 weeks) and matched time-frame compatibility among TPB constructs and behavior make for a particularly rigorous test for the habit construct. Ajzen (2002c) has criticized the absence of these methodological properties as one of the main reasons for a habit-behavior relationship in previous research.

Nevertheless, the results demonstrated that habit could account for a significant 7% of the variance in physical activity after controlling for the TPB and intention temporal stability. Similar to previous research in physical activity (Sheeran & Abraham, 2003), intention temporal stability had a significant interaction with intention in predicting behavior. Participants with higher intention stability had a larger intention-behavior relationship than those with lower intention stability. This measure of motivational flux, however, could not discount the relationship of physical activity and habit. The results support theorizing from previous habit researchers (Aarts et al., 1997; Verplanken & Melkevik, 2008) and suggest that automatic behavioral initiation may be a component of physical activity behavior. Still, it is also important to note that motivation—both in terms of a main effect of intention on behavior and an interaction of intention × intention temporal stability—were also key predictors of physical activity. Indeed, in this study, habit represented 7% of the total 32% variance explained by the model in the final equation. This

finding supports the conjecture that physical activity has a strong and dominant motivational component in terms of its antecedents (Maddux, 1997).

A division of the intention × behavior × habit relationship also proved interesting. It has been shown repeatedly that habit moderates the intention-behavior relationship in that those with high habit have a weaker relationship than those with low habit (Aarts & Dijksterhuis, 2000; Verplanken & Aarts, 1999) and this has been replicated with physical activity behavior (Chatzisarantis & Hagger, 2007; De Bruijn et al., 2009). The argument put forward is that the behavior is no longer under motivational control when habits have been established; rather, individuals perform the behavior based on environmental cues without awareness.

The finding did not have support in the current study, but a division of the interaction showed considerable asymmetry in this three-way relationship. Specifically, those with high habits were almost exclusively intenders of physical activity while those with low habits were almost exclusive nonintenders of physical activity. By contrast, those who were ambivalent in their self-reported habit showed more symmetry with respondents in the nonintention (did not intend, did not perform behavior), successful intention (intend, performed behavior), and unsuccessful intention quadrants (intend, did not perform behavior). This veers away from Bargh's (1994) notion of automaticity, in which habit is marked by unintentionality. Indeed, our results refute this notion and previous research has established that almost no participants engage in physical activity without the intention to do so (Rhodes et al., 2003; Rhodes & Plotnikoff, 2006; Rhodes, Plotnikoff et al., 2008; Sheeran, 2002).

The results, however, are commensurate with the theorizing of Verplanken and Aarts (1999), in which habits may characterize low awareness and efficiency of previously established executive goals. It seems logical to suggest that habit, that is, the partial automaticity of initiation, may be of consequence to the translation of intentions into action. This theorizing had considerable support when intention behavior profiles of nonintenders, unsuccessful intenders, and successful intenders were used to differentiate the habit construct. Participants in the successful intenders group reported significantly higher habit than both other groups, but nonintenders were no different on habit from unsuccessful intenders. We interpret this finding to highlight the potential importance of habituating physical activity if one wishes to make the successful move from intention to behavior.

Given the support for the habit construct in these data, the practical application of the findings needs consideration. When habit is conceived merely as past behavioral frequency, one could rightly criticize it as an empty construct in terms of promotion opportunities (Verplanken & Aarts, 1999). How could one prescribe or intervene on prior experiences? The creation of habits, however, may be based on more than simple practice effects and repetition. Verplanken, Aarts and colleagues (Aarts & Dijksterhuis, 2000; Verplanken & Aarts, 1999; Verplanken & Melkevik, 2008) suggest that environmental aspects should play a key role. Habits are conceived as behavioral responses brought on by environmental cues. Having a highly salient environment for physical activity (a specific workout room/place, a specific piece of equipment, apparel, etc.) may be important for habit formation. Habits are also conceptualized as occurring from behaviors with strong reinforcing properties and ease of access (Verplanken & Aarts, 1999). The large relationship that habit had with affective attitude ($r = .50$) supports this conjecture; it would appear

that enjoyable activities may be important during habit creation (Custers & Aarts, 2005). We also theorize that routine (same time, same place, etc.) and protected time may be essential for habit formation. Specifically, these would seem helpful to ease the cognitive burden of constant scheduling/rescheduling and overcoming related physical activity barriers. Still, more research is needed to test this theorizing.

Despite the useful extensions to this limited literature, there are some limitations to the work that need consideration. First, the measure of behavior was obtained through self-report. Self-reported physical activity may contain considerable measurement error from recall bias (Prince et al., 2008). This error, however, may not impact the overall findings of this study unless it affects intention or habit differently. Second, the measures of motivation (intention, intention temporal stability) used in this study may not represent the spectrum of volitional physical activity motivation and thus different measures could yield other results. These measures employed, however, represent the standard for the TPB at this present time and temporal intention stability is considered the best measure of intention strength (Sheeran & Abraham, 2003). Finally, the convenience sample of primarily female undergraduate students in this study may not generalize to the population at large and replication of these findings would be prudent. It should be noted, however, that the TPB has been found generally invariant to age and gender as well as population subgroups in the physical activity domain (Hagger, Chatzisarantis, & Biddle, 2002; Rhodes, Blanchard, & Blacklock, 2008; Symons Downs & Hausenblas, 2005; Wankel & Mummery, 1993; Wankel, Mummery, Stephens, & Craig, 1994). We are unaware of any compelling evidence that would suggest that these results would not generalize to other populations.

In summary, habit accounted for significant variance in physical activity after controlling for intention, the TPB, and intention temporal stability. Habit was also shown to differentiate nonintenders and unsuccessful intenders from those successful in translating their intentions into behavior. The results support the notion that some properties of physical activity may have an automatic component and that habits may be important to physical activity action control.

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