

# Predicting Decisional Determinants of Physical Activity Among Older Adults: An Integrated Behavior Approach

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## Abstract

**Objectives:** The present study applied the Integrated Behavior Change Model to investigate how behavioral decisions are predicted, namely, intention, planning, and habits, with respect to physical activity. **Methods:** Participants were older adults (ages 65+) residing in the U.S. ( $N = 667$ ) who completed online measures of behavioral determinants (autonomous motivation, perceived behavioral control, subjective norms, attitudes, intention, habit, and consistency), in addition to past behavior. **Results:** A structural equation model revealed that intention was predicted by past behavior and social-cognitive determinants. Social cognitive determinants mediated between past behavior and habit, as well as between autonomous motivation and habit. Intention mediated between past behavior and planning. **Discussion:** This study highlights the importance of multiple processes (social cognitive, habit/automatic, and post-intentional/planning) that formulate physical activity intentions. Mediation pathways revealed the importance of autonomous motivation for establishing intentions and habit. Facilitating these processes among older adults could be effective for promoting physical activity.

## Keywords

habit, integrated behavior change model, older adults, physical activity

## Introduction

Engaging in regular physical activity has been shown to reduce the risk of developing common chronic conditions and disease among older adults, such as cognitive decline, major mobility disability, and osteoporosis (Barnes et al., 2003; McMillan et al., 2017; Pahor et al., 2014). Further, participating in regular physical activity in middle age or older adulthood is associated with improvements in physical and cognitive health (Falck et al., 2019; Lautenschlager et al., 2008; Sabia et al., 2012). Despite the documented benefits and awareness of these benefits among older adults (Goggin & Morrow, 2001), physical activity participation has been shown to decline with age (Hallal et al., 2012). This is a great concern given that older adults are being recognized as the fastest growing age group globally (United Nations, Department of Economic and Social Affairs, Population Division, 2019). Older adults may encounter unique challenges in the uptake of physical activity and its maintenance such as changes to mobility and functioning, fear of injury or pain, and the complexity of program contents (Chase, 2013; Fleig et al., 2016). Thus, identifying decisional determinants (i.e., individual and environmental

factors that influence the decision to adopt a behavior) of physical activity is critical to successfully promote this behavior among this demographic.

## Theoretical Approaches to Physical Activity Behavior

A variety of theoretical models and concepts have been utilized to explain the adoption of health behaviors such as physical activity (de Vries et al., 2018). Nonetheless, interventions focused on promoting physical activity in older adults vary considerably in their use of theoretical models (Stolte et al., 2017; Webb et al., 2010), and the proposed relationships between theoretical components and behavioral outcomes are often inadequately described (Chase, 2015; Senkowski et al., 2019). In studies that have applied theoretical frameworks to the topic, primarily social-

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cognitive models have been used to describe physical activity (e.g., the Theory of Planned Behavior; Ajzen, 1991) (Gourlan et al., 2016; McEwan et al., 2019; White et al., 2012). These studies were formative in identifying relevant social-cognitive predictors of physical activity; however, the application of theories specifically developed for physical activity may be more suitable to better understand the mechanisms behind this behavior. Currently, the multitude of determinants of behavior (change) is reduced to a limited number of theoretical elements (de Vries, 2017). Thus, the integration and critical testing of further decisional predictors of physical activity, such as automatic and self-regulatory skills (e.g., habit formation and planning), may allow for a more accurate depiction of the relation and interplay of variables (e.g., psychosocial factors, automatic processes, and motivational factors) (de Vries, 2017). To describe and study complex health behaviors (such as physical activity), the use and integration of multiple theoretical frameworks can increase the predictive validity (Kosma et al., 2006). Such a multi-theoretical approach can in turn support the development of tailored programs to encourage older adults with various degrees of physical activity engagement (Grodesky et al., 2006). A contemporary model that integrates hypotheses from various theories is the Integrated Behavior Change Model (IBC; Hagger & Chatzisarantis, 2014).

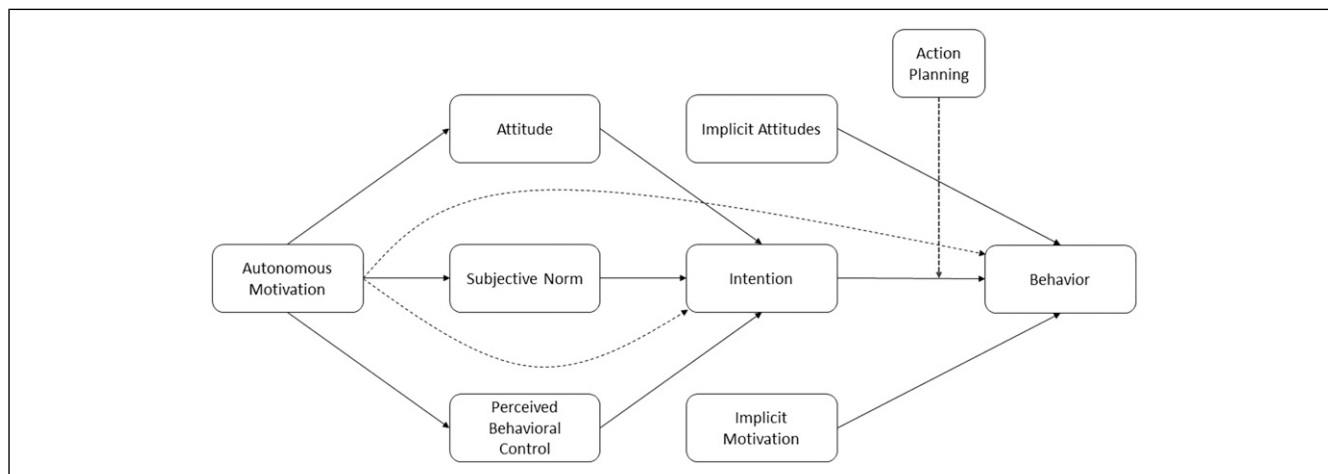
### *The Integrated Behavior Change Model*

The IBC was designed to understand physical activity behavior by including evidence from reviews and meta-analyses (Chatzisarantis & Hagger, 2009; Hagger & Chatzisarantis, 2009; Sniehotta et al., 2005). As displayed in Figure 1, the model carries forward relevant social-cognitive constructs identified from the Theory of Planned Behavior (TPB; Ajzen, 1991), action planning theories (Hagger & Luszczynska, 2014), Self-Determination Theory (Deci & Ryan, 1985), in addition to non-conscious (Strack & Deutsch, 2004; Zhang et al., 2019) and post-intention processes such as planning (Schwarzer & Luszczynska, 2008). Predictive validity for the IBC model has previously been demonstrated (Hagger et al., 2017; Hamilton et al., 2017; Kaushal, Keith, et al., 2020). Based on the TPB, the IBC includes beliefs-based constructs about the participation in the respective health behavior, including attitudes toward the target behavior (i.e., perceived advantages and disadvantages of engaging in the behavior), perceived behavioral control (PBC), and subjective norms (Hagger et al., 2019). While subjective norms describe beliefs about the influence of a person's social environment, PBC regards beliefs of personal capacities to engage in the respective behavior. According to the TPB, these belief constructs predict intention,

which is considered the most proximal predictor of behavior (Hagger et al., 2019). The IBC model also includes autonomous motivation (Deci & Ryan, 2008) as the core pillar that facilitates the development of conscious motivational processes. Autonomous motivation refers to the degree to which individuals perceive that their actions stem from free choice and reflect their true self. In the IBC, autonomous motivation is theorized to predict attitudes, PBC, and subjective norms (Hagger et al., 2006). Further, autonomous motivation is proposed to predict intention via total indirect effects of determinants of intention as supported by findings in a meta-analysis (Hagger & Chatzisarantis, 2009). In light of the complexity of physical activity behavior (Nelson et al., 2007), the necessity of planning for translating intention into behavior has been well documented (Bélanger-Gravel et al., 2013; Carraro & Gaudreau, 2013; Norman et al., 2019; Pfeffer & Strobach, 2019).

Finally, the IBC model accounts for automatic processes, which have been acknowledged as relevant determinants for predicting health behaviors such as physical activity (Gardner, 2015; Rebar et al., 2016). In the context of physical activity, habit has been shown to demonstrate validity for predicting behavior (Gardner et al., 2012; Hagger, 2019). Habit is defined as an automatic component that is established from repeatedly associating context with behavior, which eventually allows behavior to become cued or guided from associated contexts (Gardner et al., 2012; Wood & Rünger, 2016). An antecedent of physical activity habit is consistency (Kaushal et al., 2017; Kaushal & Rhodes, 2015). The familiarity of the context allows a portion of the behavior to be carried out automatically, while the behavior is still guided by conscious intention. This functionality is recognized as a dual process approach (Evans, 2008). As such, habit is an additional psychological variable with distinct characteristics from past behavioral frequency (van Bree et al., 2015). Whereas the role of habits in physical activity has been recognized across general population samples, its examination among older adults is limited (Rebar et al., 2016). This is problematic, because sustained activity is known to benefit cognitive and physical functioning (Denkinger et al., 2012; de Vries et al., 2012). Habits that promote a physically active lifestyle are desired in this target group as they may ease behavioral performance by lowering demands on cognitive resources (e.g., memory and attention; Danner et al., 2007; Fleig et al., 2016; Wood & Rünger, 2016).

Emerging evidence supports the importance of habit strength in older adults. For example, Peng et al. (2021) reported that long-term users of activity trackers aged 65+ used consistent temporal, locational, and contextual cues to facilitate habitual tracker use. Similarly, findings from a feasibility study for encouraging older adults to embed activities into daily life suggest the importance of activity and



**Figure 1.** Schematic of the Integrated Behavior Change (IBC) model for physical activity, following Hagger & Chatzisarantis, 2014.

object-based cues for establishing action and behavioral automaticity (Fleig et al., 2016). Past research has also found habits to mediate between prior and later physical activity behavior within the frameworks of theoretical models for behavior change (Kaushal, Preissner, et al., 2020; van Bree et al., 2015). This construct may thus be valuable for physical activity promotion among older adults (van Bree et al., 2015). The IBC incorporates the dual process approach by placing habit as a proximal predictor of behavior, parallel to intention.

### The Present Study

The present study aimed to examine the role of belief-based and automaticity-related variables in the prediction of older adults' intention to engage in physical activity using the IBC model. Our extended model includes non-conscious decision-making (habit) and its antecedent (consistency). In alignment with the TPB, we first hypothesized that intention would be predicted by attitudes, PBC, and subjective norms ( $H_1$ ). Secondly, we expected that TPB constructs (attitudes, subjective norms, and PBC) would mediate the relationship between autonomous motivation and intention ( $H_2$ ). Because past behavior may affect decision making and model habitual effects (Hagger, 2019), we included previous engagement in physical activity as a predictor in the present model. We expected social-cognitive constructs to mediate between past physical activity behavior and intention ( $H_3$ ). Further, in light of findings that support the importance of planning for engaging in physical activity, we also expected that past intention and behavior would predict the planning of future subsequent behavior ( $H_4$ ). To investigate the role of automaticity, we hypothesized that the degree of habit formation would be predicted by consistency, past behavior, and the aforementioned social-cognitive constructs ( $H_5$ ).

## Methods

In the following, a summary of the study methodology relevant for the present aims and hypotheses is provided. The full study methodology has been previously described (Kaushal, Preissner, et al., 2020).

### Study Design and Setting

Older adults were recruited through the online research platform Prime Panels (CloudResearch, formerly TurkPrime) that enables researchers to sample individuals according to specific characteristics (Chandler et al., 2019; Davidai, 2018). For the present study, individuals were recruited solely based on their age group. Currently, 75% of adults aged 65+ are suggested to use the Internet (Perrin & Atske, 2021), with differences in demographic characteristics and health-related knowledge between users and non-users (Arcury et al., 2020). Though concerns prevail about the demographic representativeness of older adult samples obtained via online crowdsourcing (Follmer et al., 2017; McRobert et al., 2018), it is unclear whether the potential sampling bias also extends to behavioral outcomes (Ogletree & Katz, 2021). For the present research, we chose online crowdsourcing to recruit a large sample of older adults with varying degrees of automaticity in their physical activity.

### Participants

Participants were older adults ( $M = 70.36$ ,  $SD = 4.70$ , range = 65–92 years, females: 56.7%) living in the United States. Individuals were mostly retired, Caucasian, and had attained a bachelor's degree. Table 1 provides a detailed overview of the demographic characteristics of the sample. In addition to being over the age of 65, participants were required to have proficiency in English as well as basic computer literacy to

**Table 1.** Summary of Respondents' (N = 667) Sociodemographic Characteristics.

Variable	Total Sample (N = 667)
<b>Age</b>	
Min–Max	65–92
Mean ± SD	70.36 ± 4.70
<b>Gender (n, %)</b>	
Male	281 (42.2)
Female	378 (56.7)
Other	8 (1.1)
<b>Ethnicity (n, %)</b>	
Caucasian	596 (89.4)
Black	41 (6.1)
Asian	8 (1.2)
Hispanic	9 (1.3)
First Nations	2 (0.3)
Mixed	7 (1.0)
Other	4 (0.5)
<b>Weight (lbs.)</b>	
N (N missing)	658 (9)
Min–Max	77–428
Mean ± SD	182.64 ± 45.73
<b>BMI</b>	
N (N missing)	653 (14)
Min–Max	16.06–60.55
Mean ± SD	28.91 ± 6.46
<b>Household income (n, %)</b>	
35,000 or less	255 (38.2)
35,001–50,000	129 (19.3)
50,001–75,000	143 (21.4)
75,001–100,000	58 (8.7)
100,001–150,000	56 (8.4)
150,001–200,000	14 (2.1)
More than 200,000	9 (1.3)
Missing	3 (0.4)
<b>Marital status (n, %)</b>	
Never married	82 (12.3)
Married/common law marriage	334 (50.1)
Separated/divorced/widowed	244 (36.6)
Missing	7 (1.0)
<b>Occupation (n, %)</b>	
Full-time employment	45 (5.4)
Part-time employment	57 (8.4)
Unemployed	13 (3.0)
Retired	528 (81.3)
Other	24 (3.5)
<b>Education (n, %)</b>	
Less than high school	2 (0.3)
High school diploma	155 (23.2)
Bachelor's or college degree	413 (61.9)
Masters' degree	82 (12.3)
Obtained a PhD	13 (1.9)
Missing	2 (0.3)

answer the survey. Participants provided informed consent and were redirected to the online questionnaire. To ensure a high data quality, we excluded responses associated with non-U.S. Internet protocol (IP) addresses, improbable reading or completion speed, and individuals who provided non-matching basic demographic data on an implemented control item. In total, 667 met the criteria for inclusion.

## Measures

The following measures were used to assess the constructs of interest and control variables in this study. Prior to answering to physical activity-related items, participants were provided with a definition of what is defined as regular physical activity (in line with Nelson et al., 2007). Descriptive information for all relevant variables can be found in Tables 1 and 2.

**Demographics.** Demographic information collected included age, gender, ethnicity, height, weight, marital status, annual household income, level of education, and employment status.

**Intention.** Intention to engage in physical activity was measured using a scale developed in line with Ajzen (2002) and Arnautovska et al. (2017). Three items were scored on a 7-point Likert-type scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

**Habit strength.** Habit strength within the context of physical activity was assessed using the four-item Self-Report Habit Index (SRHI; Gardner et al., 2012). The measure indicates the perceived extent to which physical activity is experienced as automatic and performed without thought. Answers are scored on a 5-point Likert-type scale from 1 (*totally disagree*) to 5 (*totally agree*). The SRHI has previously been used to assess habit strength in older adults (van Bree et al., 2017).

**Planning.** Planning for physical activity was assessed using a multi-item measure in line with Sniehotta et al. (2005). Three items assessed whether participants made specific plans for when and where to be physically active, and whether they set short-term goals for their activity behavior. Items were scored on a 5-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

**Consistency.** Consistency in physical activity was assessed using a multi-item scale in line with Kaushal and Rhodes (2015) and Kaushal et al. (2017). Three items measured the perceived consistency in location, time and performance consistency using a 5-point Likert-type scale from 1 (*not consistently*) to 5 (*very consistently*).

**Table 2.** Means, Ranges (Minimum, Maximum), Cronbach's Alphas, and Standard Deviations (SD) of Variables Included in the Structural Equation Model for  $N = 667$ .

Variables	Means (SD)	Minimum	Maximum	Internal Consistencies (Cronbach's Alpha)
Attitude	5.30 (1.29)	1	7	.89
Consistency	3.23 (1.32)	1	5	.91
Habit	3.20 (1.13)	1	5	.93
Intention	5.08 (1.78)	1	7	.98
Perceived behavioral control	5.73 (1.51)	1	7	.81
Planning	3.11 (1.10)	1	5	.87
Physical activity behavior	128.00 (73.69)	0	511	-
Subjective norm	4.85 (1.39)	1	7	.69
Autonomous motivation	5.84 (4.39)	-4.25	18	.72 (external), .69 (introjected), .95 (identified), and .88 (intrinsic)

Note. Dashes signify "not applicable."

**Social cognition constructs.** Attitude, subjective norms, and PBC regarding physical activity were assessed using multi-item measures developed in line with prior recommendations (Ajzen, 2002; Armitage et al., 1999; Fishbein & Ajzen, 1980; Rhodes et al., 2006). All items were scored using a 7-point Likert-type rating scale. Attitude was measured by six items, asking participants to indicate how, for example, enjoyable/unenjoyable or beneficial/harmful they perceived moderate physical activity over the next week to be. Injunctive and descriptive components of subjective norms were assessed using four items, assessing whether participants perceived important individuals in their social environment to want them to engage in physical activity and whether they will also engage in the behavior. PBC was measured using three items, asking individuals to rate the extent to which they believed themselves to have control over regular physical exercise.

**Motivation.** Self-regulatory styles regarding physical activity were assessed using the Self-Regulation Questionnaire (Ryan & Connell, 1989). Each of the four motivational regulation styles from the Self-Determination Theory were addressed by four specific subscales made up of four items within the overall 16-item scale: external regulation, intrinsic or internal regulation, introjected regulation, and identified regulation. Participants' responses on these subscales were scored according to the Relative Autonomy Index (RAI) formula to form a total score of relative autonomous motivation (Nurmi et al., 2016), with higher and positive scores indicating greater relative autonomous motivation, while negative scores indicated less relative autonomous motivation. The Self-Regulation Questionnaire for physical activity has previously demonstrated adequate construct validity in a study by Nurmi et al. (2016).

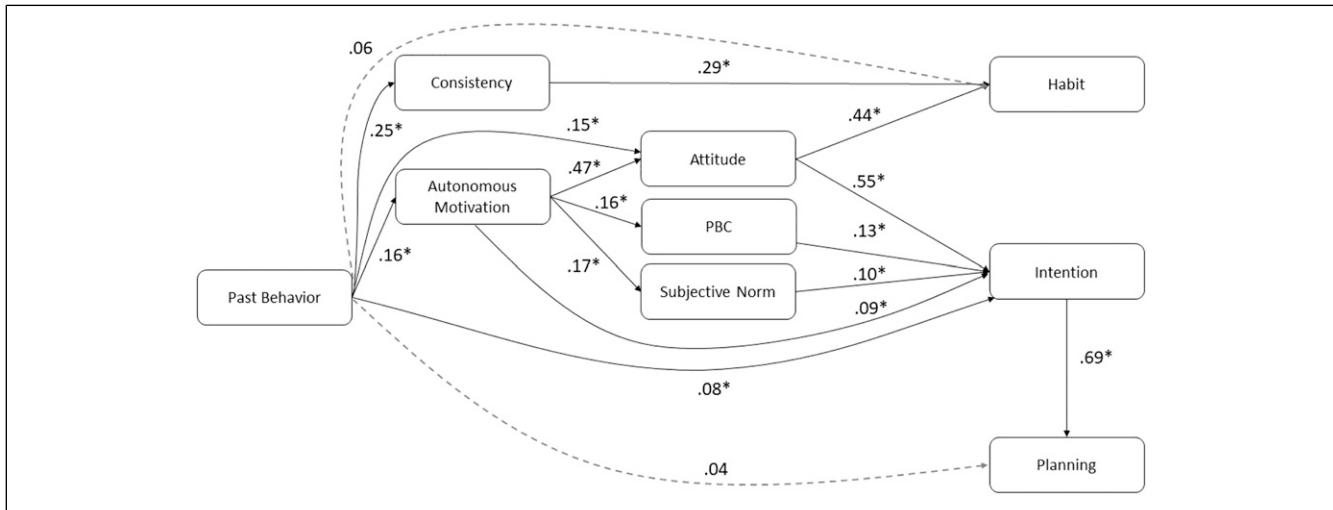
**Physical activity behavior.** Physical activity behavior was assessed using the Physical Activity Scale for the Elderly (PASE; Washburn et al., 1993). The PASE is composed of questions about household activities, recreational activities,

and occupational or work-related activities. Response options correspond to weekly frequencies (*never, 1–2 days, 3–4 days, and 5–7 days*) and daily frequencies (*less than 1 hr, 1 but less than 2 hr, 2–4 hr, and more than 4 hr*). Based on the PASE scoring manual (Washburn et al., 1993), frequencies were multiplied by a weight specific to the type of physical activity. Responses from activity type were added to form a total PASE score, with higher scores indicating greater levels of physical activity.

**Health status.** The Medical Outcome Study (MOS) 12-item Short Form Health Survey (SF-12 version 1) was used to measure physical and mental health status among participants. This questionnaire presents participants with questions about their general health, how their physical or mental health interferes with their work or other daily activities as well as questions regarding bodily pain and energy levels. The scores on these questions were then used to calculate the overall physical component summary score (PCS) and mental component summary score (MCS) which were used as a control variable in the present model. Responses from this questionnaire were scored according to scoring instructions provided by Ware et al. (1998) and entered as control variables.

### Analysis Plan

Demographics were calculated using SPSS v. 24.0 (IBM, 2016). The number of missing values was below 1% for all measures. In light of the distinct weights associated with the combination of a weekly and daily frequency in the PASE, missing values (<1%) on PASE subscales were not replaced, and the respective subscales not included in participants' total score. To test the proposed model (Figure 2), structural equation modeling in AMOS was employed by using a maximum-likelihood estimation method (Enders, 2011). We followed Wolf et al.'s (2013) estimation criteria to confirm that the sample size was sufficient for conducting the structural equation model. Goodness of fit was assessed using



**Figure 2.** Structural equation model predicting older adults' ( $N = 667$ ) physical activity habit, intention, and planning to be physically active. Note. Control variables and indirect effects have been omitted for clarity. Dashed lines indicate hypothesized pathways that were found to be statistically insignificant.  $*p < .01$ .

cut off indices specified by Hu and Bentler's (1999) Two-Index Presentation strategy for the Comparative Fit Index (CFI) (equal to or greater than 0.90) and other specifications for the root mean square error of approximation (RMSEA) (less than or equal to 0.08 with a 95% confidence interval), and TLI (greater than or equal to 0.90) reported in AMOS (Bentler, 1990). In the following, we present standardized regression coefficients as effect-size indices. Lastly, we expected the effects from the predictive model to hold after accounting for participants' health status.

## Results

### Model Effects

Latent correlations found all constructs to significantly correlate with each other (see Table 3). Model fit indices were found to fall within an acceptable range ( $\chi^2 = 1220.988$ ,  $df = 245$ ,  $p = .000$ , RMSEA = .077, 90% CI (.073, .082), CFI = .927, TLI = .910). Descriptive statistics and factor loadings for all model constructs can be found in Tables 2 and 4.

### Hypotheses Tests

**Predictors of intention.** As can be seen from Figure 2, intention was predicted by attitudes, PBC, and subjective norm. Autonomous motivation was found to predict intention via direct and indirect effects from attitudes, PBC, and subjective norms at a higher magnitude ( $\beta = .30$ ,  $p = .013$ , CI 95%, .25 to .35). Similar patterns were observed with past behavior having a direct effect on intention, and a larger effect via TPB constructs ( $\beta = .15$ ,  $p = .012$ , CI 95%, .09 to .19).

**Predictors of TPB constructs.** Autonomous motivation proximally predicted attitudes, PBC, and subjective norms. Past behavior predicted autonomous motivation and attitudes (see Figure 2).

**Predictors of habit.** Habit was directly predicted by consistency and attitude. Further, past behavior directly predicted consistency but not habit. Attitude and autonomous motivation also mediated between past behavior and habit ( $\beta = .17$ ,  $p = .004$ , CI 95%, .14 to .22). Similarly, attitude mediated between autonomous motivation and habit ( $\beta = .20$ ,  $p = .006$ , CI 95%, .17 to .26).

**Predictors of planning.** Planning was directly predicted by intention but not past behavior. Intention mediated between past behavior and planning ( $\beta = .16$ ,  $p = .007$ , CI 95%, .11 to .20).

## Discussion

The present study investigated decisional determinants of physical activity, namely, intentions, planning, and habit among older adults. We utilized the IBC model, a multi-theoretical approach, that included past behavior to test decisional determinants to enact in future PA. Congruent with TPB theorizing, results showed that attitudes, subjective norms, and PBC positively predicted physical activity intentions ( $H_1$ ). Among these determinants, attitude was found to explain the most variance of intention. These findings suggest that it may be beneficial for health practitioners to build on existing awareness of the benefits of physical activity and reframe perceived negative outcomes. In this regard, behavior change techniques such as self-reevaluation (i.e.,

**Table 3.** Latent Correlations for Model Constructs (N = 667).

	1	2	3	4	5	6	7	8	9
Intention (1)	—								
RAI (2)	.44*	—							
Attitude (3)	.42*	.41*	—						
Subjective norm (4)	.60*	.20*	.31*	—					
PBC (5)	.39*	.29*	.22*	.29*	—				
Consistency (6)	.55*	.39*	.36*	.54*	.33*	—			
Habit (7)	.54*	.36*	.42*	.41*	.40*	.46*	—		
Planning (8)	.46*	.22*	.39*	.41*	.26*	.45*	.47*	—	
Past behavior (9)	.31*	.22*	.20*	.20*	.24*	.26*	.35*	.24*	—

Note. RAI = Relative Autonomy Index; PBC = Perceived Behavioral Control.

\*p < 0.01.

**Table 4.** Factor Loadings of Constructs Included in the Structural Equation Model (N = 667).

Indicator	Factor Loadings
Attitude	-
Attitude01	.95
Attitude02	.88
Attitude03	.80
Habit	-
Habit01	.89
Habit02	.92
Habit03	.92
Habit04	.73
Perceived behavioral control (PBC)	-
PBC01	.77
PBC02	.91
PBC03	.67
Consistency	-
Consistency01	.84
Consistency02	.81
Consistency03	.95
Subjective norm	-
Norm01	.80
Norm02	.77
Planning	-
Planning01	.88
Planning02	.80
Planning03	.82
Intention	-
Intention01	.95
Intention02	.97
Intention03	.98

Note. Dashes signify “not applicable”; factor loadings for all latent variables were found to be significant at p < .05.

assessment of one’s identity as an active vs. sedentary person; Prochaska et al., 2015) may be relevant strategies to address attitudes toward physical activity in older adults (Bartholomew Eldredge et al., 2016). Subjective norms and PBC also demonstrated significant effects on intentions, implying that skill

and ability to execute behavior, in addition to facilitating positive group-based interventions may likely facilitate physical activity intentions.

In support of one of the novel hypotheses specific to IBC, social cognitive constructs (attitudes, PBC, and subjective norms) were found to mediate the relationship between autonomous motivation and intention (H<sub>2</sub>). These results corroborate findings of behavioral, control-related as well as normative beliefs being of importance in the formation of exercise intentions (Hagger & Chatzisarantis, 2009). Our findings show that an individual’s motivational orientation plays a key role in the formation of attitudes and perceptions about PBC and the significance of the behavior of others. Individuals with greater autonomous motivation perceived greater benefits from physical activity, which in turn affected their intentions to engage in physical activity. Thus, fostering positive perceptions about physical activity, one’s control over behavioral enactment, and the perception of the importance of others may be achieved more efficiently through a previously identified importance of physical activity for one’s person or health. These findings are in line with previous meta-analytic findings on the predictive effects of autonomous motivation on TPB variables (Hagger & Chatzisarantis, 2009).

In addition to identifying the predictive role of autonomous motivation, this study examined the extent to which belief-based constructs of the TPB, autonomous motivation, as well as subsequent intention are a function of past behavior. In this regard, we found that the included TPB constructs mediate between past behavior and intention. This finding provides detailed insight into the psychological mechanisms by which past behavior affects intention formation via perceived barriers and beliefs (Hagger et al., 2018; Kaushal, Keith, et al., 2020; Ouellette & Wood, 1998). Past behavior also significantly predicted autonomous motivation to engage in physical activity (Hagger & Chatzisarantis, 2009), indicating that an individual’s activity status should be taken into consideration when developing interventions to foster the identified importance of physical activity and the

subsequent intention to engage in physical activity. Thus, our results support the theoretical integration of autonomous motivation from Self-Determination Theory among other determinants, as this construct was shown to be a significant antecedent of belief-based constructs and intention for behavioral enactment. Inclusion of this construct can provide greater insight into the psychological mechanisms by which intentions are formed or changed, also on the basis of past behavior.

Regarding the role of planning, our study illustrates the role of past behavior because we found that past behavior predicted action planning via intention ( $H_4$ ). Given the identified relationship between planning and intention, older adults may benefit from tailored interventions that are based on their previous levels of PA engagement so that they can develop (more) effective action plans. This may subsequently assist in the translation from intention to behavior. Previous research examining the role of planning has been mixed; some studies found planning to function as a mediator and others have found planning to function as a moderator (Rhodes & Dickau, 2013; Rhodes & Pfaeffli, 2010). In a study among older adults, Arnavtavska et al. (2017) showed that planning mediated between physical activity intentions and behavior, thereby adding support for the role for action planning as a mechanism to bridge the gap between intentions and behavior (Schwarzer & Luszczynska, 2008; Sniehotta et al., 2005). In this regard, studying an individual's goals may provide more detailed insight into mechanisms related to planning, intention, and behavior (Amireault et al., 2013). Further research on these different populations might add clarity to the role of planning as a post-intention construct.

Last, our model examined the automatic process of habits, in parallel to intention. The present model extended the automatic processes proposed in the IBC framework by including consistency as a further antecedent of habit. Consistency can also represent a regular physical activity environment, and hence, the present study also assessed environmental, along with temporal consistency. These measures were included to reflect contextual support for habit formation (Hagger, 2019; Wood & Runger, 2016). The present findings support previous work that found temporal consistency to facilitate habit formation among general adults (Kaushal & Rhodes, 2015; Kaushal et al., 2017). These findings are novel for older population groups, emphasizing the importance of having a regular, anticipated time and environment to engage in physical activity. Previous empirical work demonstrated feasibility of incorporating consistency among general adults to facilitate their habit formation and taking current findings into consideration encourages future interventions to test feasibility of implementing this construct among older adults.

To examine the predictive role of past behavior in the formation of habits, we included previous physical activity engagement into the model. Specifically, attitudes and autonomous motivation were found to mediate the relationship

between past behavior and habit. Conforming to previous work (Kaushal, Keith, et al., 2020; Radel et al., 2017), our results suggest that autonomously motivated individuals are more likely to indicate to habitually engage in physical activity. In line with Self-Determination Theory (Deci & Ryan, 1985), being autonomously motivated may be associated with habit formation as the target behavior is perceived to satisfy one's psychological needs. As a result, autonomously motivated individuals may be more likely to continuously seek engagement in the behavior, usually in similar environments or contexts (Kaushal, Keith, et al., 2020). Perceiving the performance of a behavior as highly rewarding in addition to consistency in context and behavior may in turn encourage the formation of habits (Gardner & Lally, 2013; Lally & Gardner, 2013). Consistent with the literature, the present results showed past behavior to predict habits via consistency. This corroborates findings regarding the need of stable contexts over a greater timeframe for the development of habits (Hagger, 2019; Kaushal & Rhodes, 2015).

In summary, the present study exemplified the importance of employing a multi-process approach (involving conscious and non-conscious processes) to predict complex behaviors such as physical activity. Though the proposed effects need to ultimately be established through randomized controlled trials, identifying patterns and effects while controlling for other determinants in a structural equation modeling test can help setting the groundwork for further refinement of health behavior theories as well as more tailored intervention designs.

### *Strengths and Limitations*

Though consistency has been found to be one of the strongest predictors of exercise habit formation (Kaushal et al., 2017), this study is among the first to extend previous findings and demonstrate predictive validity of this construct among older adults. These results provide formative notes for designing physical activity interventions for older adults, at least in the context of primary prevention. In addition, investigations of physical activity determinants using contemporary models, that were specifically designed to predict the target behavior, are sparse; this is especially the case for research on older adults. The present study contributes novel findings based on the described, updated theoretical approach. Nonetheless, we recognize that the observed relationships in this study are limited to the cross-sectional design, as causation cannot be inferred. Further, the inclusion of an objective measure of physical activity may have provided more detailed insight into the physical activity habits in the present sample. Regarding the generalizability of our findings, the sample included participants of higher education compared with the national average. This discrepancy is not uncommon when recruiting older adults from crowdsourcing platforms (Ogletree & Katz, 2021). As physical activity is correlated with education (Zhao et al., 2011) and the online advertisement appeared to sample a higher educated older adult



demographic, we acknowledge that the present sample may differ on behavioral, cognitive, or affective outcomes. We thus recommend that future studies explore decisional determinants of physical activity in a variety of older adult subpopulations via direct community recruitment methods. We also recognize that the sampling method could result in, for example, increased sedentary time and in turn increase the prevalence of high BMI scores. However, our sample shows great similarity in BMI to older adults from national reports who were recruited through other channels (Fryar et al., 2018). Similar online recruitment methods have previously been used regarding habit strength and physical activity in older adults (see Mullan et al., 2021).

In sum, this study extended previous investigations of older adults' activity intentions by including deliberative processes (social cognitive variables, planning, and motivational orientation) in addition to testing non-conscious (habit) processes. Specifically, older adults' physical activity adoption could benefit from facilitating these constructs. However, it is likely that this demographic may require adaptive methods to develop the constructs that were found to be effective in their younger counterparts.

## Conclusion

In conclusion, this study highlights the importance of multiple processes (social cognitive, habit/automatic, and post-intentional/planning) that formulate physical activity intentions among older adults. Further, mediation pathways revealed the importance of autonomous motivation for establishing proximal behavioral determinants (intentions and habit). Facilitating these processes among older adults could be effective for promoting physical activity. Future research should further explore the major identified determinants of physical activity among older adults as a basis for interventions by using randomized controlled trials that test their long-term effects on establishing the maintenance of physical activity behavior.

## Author Note

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