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Predicting Alcohol Consumption and Snacking Behaviors: Application of an Integrated Social Cognition Model

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Predicting Alcohol Consumption and Snacking Behaviors: Application of an Integrated Social Cognition Model

A Thesis in partial satisfaction of the requirements for the degree of Master of Arts

in

Psychological Sciences

by

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2023

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Abstract

Predicting Alcohol Consumption and Snacking Behaviors: Application of an Integrated Social Cognition Model

by Danielle Victoria Simpson-Rojas for the partial satisfaction of the requirements for the

degree of Master of Arts in Psychological Sciences

University of California, Merced 2023

Dr. Martin Hagger, Chair

Drinking alcohol in excess and unhealthy snacking behaviors are associated with deleterious health outcomes, highlighting the need for research to identify potentially modifiable correlates of these behaviors to target in behavioral intervention research. The present study applied a unique integrated theoretical model that encompassed constructs representing effects of deliberative (belief-based social cognition constructs) and non-conscious (habit, cue-consistency, affective attitudes, past behavior) processes to identify the correlates of three health-related behaviors: drinking alcohol within safe limits, regular alcohol drinking, and limiting unhealthy snacking. The study adopted a correlational prospective design. Separate samples of Australian undergraduate students completed self-report measures of social cognition constructs from theory of planned behavior, habit, cue consistency, and behavior on an initial occasion (T1) for drinking within safe limits (n = 250), regular drinking (n = 224), and unhealthy snacking (n = 184). Participants completed follow-up measures of habit and behavior on a second occasion (T2) two to four weeks later. Hypothesized model effects were tested using variance-based structural equation models in each sample. We found direct effects of habit (T1), affective attitude, and subjective norms on intention, habit (T2) and past behavior on behavior, and habit (T1) on habit (T2) in all three samples. Habit (T2) mediated the habit (T1) and behavior relationship in all three samples. Cue consistency moderated the effects of past behavior in the samples targeting drinking within safe limits and regular drinking. Results corroborate past behavior and habit as key correlates of behavior and provide preliminary evidence of the importance of integrating cue consistency, a key defining characteristic of habit, as a moderator of past behavior effects in theory-based models of health behavior.

Introduction

Regular participation in risky behaviors that are gratifying, inherently-rewarding in the short term, such as drinking alcohol in excess and unhealthy snacking, can have deleterious effects on health in the long run. For example, excessive patterns of alcohol consumption are associated with increased risk of unintentional injury (e.g., motor vehicle crashes, falls) and reduced functioning in the workplace (Cherpitel et al., 2003; Marzan et al., 2002; Taylor et al., 2010; Zeisser et al., 2013), and unhealthy snacking behaviors may contribute long-term to increased risk of chronic illness (e.g., diabetes) and health conditions (e.g., overweight, obesity) (Alhazmi et al., 2014; Jayedi et al., 2020). Health policy organizations worldwide have, therefore, prioritized the need for behavioral interventions that promote safe patterns of alcohol consumption and limiting unhealthy snacking as means to minimize these maladaptive health outcomes.

Development of optimally efficacious behavioral interventions necessitates a fundamental understanding of the determinants of the target behavior, particularly the psychological factors associated with the behaviors of interest and the processes involved. Social cognition theories have been identified as having utility in identifying these determinants, particularly those that are potentially modifiable through techniques that comprise the content of behavioral interventions. This is predicated on behavioral theory and research indicating that behavior change techniques used in behavioral interventions change behavior by altering or activating psychological mechanisms, represented by constructs from social cognition theories (Hagger et al., 2020; Rothman et al., 2020; Sheeran et al., 2023). Importantly, intervention research has suggested that theory-based interventions are more effective and efficient in changing health behaviors than those that are not theory based (Johnson et al., 2010; McEwan et al., 2019). Therefore, a key step in developing theory-based interventions is to identify the theory-based constructs that are reliably associated with the behavior that may form candidate targets of the behavior change techniques used in interventions (Hagger et al., 2020).

One theory that has been applied to predict behavior in multiple contexts and may have utility in identifying potentially modifiable behavioral determinants is the theory of planned behavior (TPB, Ajzen, 1991). The TPB identifies intention as the most proximal determinant of participation in some target behavior in future, and specifies sets of beliefs reflecting perceived utility, social pressure, and capacity as antecedents of intentions and, ultimately, behavior (Fishbein, 2008). The TPB has demonstrated efficacy in accounting for variance in intentions and behavior in multiple health contexts and populations (McEachan et al., 2016). However, a critique of the TPB and other social cognition theories of this type is that they focus exclusively on intentional processes that reflect conscious, deliberative consideration of the utility, normative consequences, and capacity evaluations that lead to behavior (Sniehotta et al., 2014). Theorists and researchers have suggested that such theories assume behavior is volitional and fail to incorporate factors that represent non-conscious processes (habit) and their effect on outcome (behavior) (Gerrard et al., 2008; Sheeran et al., 2013; Wood et al., 2014). Therefore, an integrated theoretical approach that combines constructs that represent both the conscious and non-conscious processes as predictors of behavior may have value in providing more comprehensive explanations of health behaviors and, ultimately, signal potential candidate constructs that may be targeted in behavioral interventions (Hagger et al., 2020).

To address this evidence gap, the current study aimed to develop and test the predictions of an integrated model that encompasses constructs that represent both conscious and non-conscious processes that lead to future participation in two key health-related behaviors: alcohol-related behaviors (e.g., drinking alcohol within safe limits), and snacking behaviors. The proposed model is informed by multiple theoretical perspectives including the TPB, the constructs of which represent the conscious processes involved in behavioral participation, and dual-process models, represented by the habit and cues to behavior constructs which represent the non-conscious processes that line up behavior. The research is expected to contribute to an evidence base of potentially modifiable constructs that are reliably related to behavior and could be targets for interventions aimed at promoting drinking within safe limits and reducing snacking behavior. Next, we outline the conceptual bases of our proposed integrated model drawing from the tenets of the TPB and dual-process theories.

An Integrated Approach to Health Behavior Determinants

Social cognition theories have been frequently applied to identify the determinants of health behaviors, including drinking alcohol and snacking (Conner et al., 2017). Prominent among these theories is the TPB. The theory posits that intention, the extent to which an individual is motivated to perform the behavior, is the most proximal antecedent of behavior. Intention is a function of three belief-based constructs: attitude, an individual’s evaluation of the outcome of performing a behavior; subjective norm, an individual’s perception that others will approve or disapprove of their performance of the behavior; and perceived behavioral control, an individual’s beliefs in their capacity to perform the behavior (Fishbein & Ajzen, 2010). The theory suggests that intention mediates the relationship between these constructs and behavior. Further, perceived behavioral control is a unique construct in that it may directly predict behavior when it closely matches actual control, or may serve as a candidate moderator of theory variables on intention and behavior, although these moderating effects are not routinely tested (Hagger et al., 2022). The tenets of the TPB have been supported in meta-analyses of research applying the theory across populations, contexts and health behaviors (Hagger et al., 2016; McEachan et al., 2011; Rich et al., 2015), including alcohol consumption (Cooke et al., 2016) and snacking (McDermott et al., 2015) behaviors.

While theory predictions have been supported through meta-analytic research, its scope of prediction has been questioned in research identifying its boundary conditions. Prominent among these concerns is its sole focus on constructs that capture reasoned, deliberative decision-making based on future expectations (e.g., Sniehotta et al., 2014). Specifically, similar to other social cognition theories, the theory assumes that individuals’ actions result from an active weighing-up of the costs and benefits of a future course of action and making a deliberative decision on whether or not to proceed with enacting the behavior (e.g., Conner & Sparks, 2015). However, research indicates that many behaviors tend not to be enacted as a consequence of such elaborated, reasoned consideration, and, in fact, do not necessitate such a relative costly and time-consuming process (Sheeran et al., 2013; Wood, 2017). Instead, many behaviors are enacted through more spontaneous, non-conscious processes that rely on associative information stored in memory developed through prior experience. Researchers have therefore proposed more comprehensive theoretical descriptions of the processes that lead to the enactment of health behavior drawing from so-called dual-process models that specify constructs that represent the reasoned processes that lead to behavior, such as those specified in the TPB, and constructs that represent non-conscious processes (e.g., Gibbons et al., 2008; Hagger & Chatzisarantis, 2014; St. Quinton & Bruton, 2017). By identifying constructs that represent both processes and specifying how they relate to behavior, integrated or dual process models, therefore, have the potential to provide more elaborate and comprehensive descriptions of behavioral enactment. They may also afford the opportunity to identify environmental or within-person conditions that may serve to exacerbate or diminish the strength of effects of model constructs on behavior (e.g., Rothman & Sheeran, 2021).

Accordingly, theorists have proposed integrated models based on existing social cognition theories and dual process models which have included constructs such as *habits* and *affective attitudes* as additional behavioral determinants alongside the constructs from existing social cognition theories (e.g., Conner et al., 2015; Hamilton et al., 2017; Kaushal & Rhodes, 2015; Lawton et al., 2009). Focusing on habit, researchers have tended to define habit as a construct that reflects perceived experience of the behavior as automatic, without elaborated thought or deliberation, and performed regularly in the context of stable cues (e.g., performance under similar environmental conditions, time of day, or people) (Gardner, 2015; Hagger, 2019; Wood & Runger, 2016). Prior research has tended to use past behavior as a proxy for habit based on the premise that repetition of behavior is a primary means by which individuals develop habits (e.g., Hagger et al., 2023; Ouellette & Wood, 1998). Accordingly, past behavior has been shown to have a pervasive effect on social cognition constructs, intentions and behavior in research incorporating measures of past behavior in prospective tests of the TPB (Ouellette & Wood, 1998). Such effects are consistent with the expectation that past behavior, as a proxy for habit, should predict behavior independent of intentions, but is also mediated by social cognition constructs and intentions, based on the premise that past behavior is also a source of information for belief and intention formation (Ajzen, 2002; Hagger et al., 2018). Furthermore, research suggests that past behavior effects are larger, and intention effect smaller, for behaviors that are more likely to be formed as habits, that is, are performed regularly and in the face of stable cues (Hagger et al., 2023; Ouellette & Wood, 1998).

However, researchers have extended this research by adopting measures of the habit construct that tap a broader set of its defining characteristics beyond frequency of performance, such as perceived automaticity, lack of thought, and typicality (e.g., Verplanken & Orbell, 2003; Verplanken et al., 1997). Research incorporating such measures in tests of the TPB have demonstrated direct effects of such measures on behavior, independent of intentions (e.g., Hamilton et al., 2017; Kaushal & Rhodes, 2015; Verplanken & Orbell, 2003). Importantly, research has also shown that such measures partially account for past behavior effects, corroborating the premise that past behavior, at least in part, reflects habits (Hagger et al., 2023; van Bree et al., 2015). It is also important to note that habit effects on social cognition constructs and intentions in such model tests have also been identified. This is because behaviors that become habitual are likely to have once been intentional and goal-directed and, therefore, measures of habits and intentions are likely to align (Wood et al., 2014). Effects of habit on intentions, and the mediation of habit effects on behavior through intentions, may, therefore, reflect the fact that individuals' intentions may have been based on individuals reflecting on their habits (De Bruijn et al., 2012; Galla & Duckworth, 2015; Hagger et al., 2023). Therefore, habits may also predict intention, but it should be acknowledged that this is an artifact of measurement. In keeping with this line of research augmenting social cognition theories with habit, we propose in the current study to include habit as an additional predictor of behavior in our integrated model and expect both direct effects of habit on behavior as well as effects mediated by the social cognition constructs and intentions.

Beyond habits, research applying the TPB in health behavior contexts has also made the distinction between *cognitive* and *affective* attitude components (Conner et al., 2015; Lawton et al., 2009). While the cognitive component reflects beliefs regarding the utility of a given health behavior in producing outcomes (e.g., reducing alcohol to promote better functioning at work, reducing snacking to assist in managing a healthy body weight), the affective component reflects anticipated emotional outcomes that result from performing the behavior (e.g., reducing alcohol intake leading to increased confidence, reducing snacking resulting in feeling less satisfied) (Ajzen, 1991; Trafimow & Sheeran, 1998). Researchers exploring the effects of these different attitude components have identified that effects of the cognitive component on behavior tends to be intention mediated, while effects of the affective component tend to be direct and unmediated by intentions (Hagger et al., 2018; Lawton et al., 2009; McEachan et al., 2016). This is consistent with theories suggesting that affective attitudes reflect more impulsive, less considered behavioral enactment particularly whether the behavior has the potential to be affectively gratifying (Conner et al., 2015). Direct effects of anticipated emotions is, therefore, a reflection of expectations that the behavior leads to positive or negative affect and have been developed through associative learning or reinforcement. As a consequence, we aimed to make the distinction between cognitive and affective attitude components in our test of our proposed integrated model, so as to provide representation of an additional non-conscious process likely to be implicated in behavioral enactment. We predicted intention-mediated indirect effects of the cognitive component on behavior, but predicted direct effects of the affective component on attitude.

A defining characteristic of the habit construct is that it reflects performing the behavior in the presence of stable and consistent cues (Galla & Duckworth, 2015; Hagger, 2019; Wood & Neal, 2009). This has been reflected in habit measures that comprise the product of measures of behavioral frequency and the consistency of the co-varying environmental or social conditions in which it is performed (Wood & Neal, 2009). Essentially, behavioral frequency x context stability habit measures represent moderating effects of past behavior by cue consistency, such that past behavior effects on subsequent behavior will be maximized when it has tended to be enacted in highly stable conditions. However, researchers have not tended to formally examine the moderating effects of cue consistency on habit and past behavior effects. Accordingly, we propose to test this prediction in our integrated model by examining the extent to which the consistency of the cues in which behavior had tended to be performed moderates past behavior and habit effects on behavioral performance. In keeping with theory on habit, we expect effects of both past behavior and habit to be moderated upwards by cue consistency. This test will provide an incremental contribution to knowledge by demonstrating the importance of stable cues in accounting for habit measure effects which has tended not to be routinely tested in such integrated models, and may future corroborate a key process involved in individuals' performance of health behaviors.

The Present Study

In the current research, we aimed to test the efficacy of a novel integrated theoretical model in accounting for variance in two key health-related behaviors: alcohol-related behavior and limiting unhealthy snacks. The model identifies a series of key constructs from two key theoretical perspectives that represent the reasoned, deliberative and automatic, non-conscious processes that may govern behavioral performance, respectively, and examines their effects on behavior. The model was tested separately in three samples, two with alcohol-related behaviors as the target behavior and one with reducing unhealthy snacking behavior as the target behavior. The study adopted a prospective correlational design with social cognition constructs, past behavior, and habit with respect to the target behavior collected on an initial occasion (T1) with follow-up measures of the behavior and habit on a second occasion (T2). Our specific hypotheses for the proposed model are summarized in Table 1 and illustrated in Figure 1. We expected affective attitude (H1), cognitive attitude (H2), subjective norms (H3), perceived behavioral control (H4), and habit measured at T1 (H5) to exhibit direct effects on intention. We also predicted that affective attitude (H6), perceived behavioral control (H7), intention (H8), habit measured at T2 (H9), cue consistency (H10), and past behavior (H11) would have direct effects on behavior measured at T2. In addition, we expected direct effects of habit on itself across occasions (H13). Further, we predicted that cues would moderate effects of past behavior (H14) and habit measured at T2 (H15) on behavior. Finally, we expected that intention would mediate effects of the TPB social cognition constructs on behavior (H16 – H19), and that habit measured at T2 would mediate the effect of habit measured at T1 on behavior (H20).

Method

Participants and Recruitment

The three samples of participants in the current study were undergraduate students who completed measures referring to our three target behaviors: drinking alcohol within safe limits (N = 154, M age = 19.96, SD age = 2.21, range = 18 to 25), regularly drinking alcohol (N = 224), and reducing unhealthy snacking (N = 184)[1]. Participants were recruited through research participant panels comprising students in undergraduate psychology courses. To be eligible for inclusion participants in the samples targeting drinking alcohol within safe limits and regular alcohol drinking behaviors, panel members had to report that they consume alcohol at least occasionally (defined as at least once per week) and were not currently pregnant. In all cases, participants completed an

[1]Participants did not report their age in the samples targeting the regular drinking and reducing unhealthy snacking behaviors. However, participants were undergraduate students with an age range of 18 to 24 years.

informed consent form prior to proceeding to an initial online survey comprising study measures. Participants in the sample targeting drinking alcohol within safe limits were followed up four weeks later, and participants in the samples targeting regular alcohol drinking and reducing unhealthy snacking samples two weeks later, via email. Demographic details and attrition rates are presented in Table 4. IRB approval of the study protocol was secured in advance of data collection for each sample.

Design and Procedure

The study adopted a correlational prospective design, with participants completing study measures on an initial occasion (T1) and follow-up online survey measures of behavior and habit taken on a second occasion (T2) between two and four weeks later. Study measures were administered online using a survey tool (Qualtrics). Measures taken at T1 comprised self-report scaled measures of the social cognition constructs (cognitive and affective attitude, perceived behavioral control, subjective norms), intention, habit, cue consistency, and past behavior and measures taken at T2 comprised scaled measures of habit, cue consistency, and behavior.

Measures

Study measures were developed according to published guidelines (Ajzen, 2002) or validated prior measures (Pimm et al., 2016; Sobell & Sobell, 1992) adapted to refer to the relevant target behavior. We give examples of measures for each targeted behavior, with full details of all measures presented in Table 5.

Demographic Variables. Participants self-reported their age in years, sex (male/female), marital status (never married, married, widowed, divorced, separated), education completed (junior school, senior/high school, post vocational diploma, university undergraduate degree, university postgraduate degree), race (Caucasian, Indigenous/Torres Strait Islander, Asian, Pacific Islander, African, other), income (nil-$18,000, $18,201-$37,000, $37,001-$80,000, $80,001-$180,000, and greater than $180,000), and employment status (currently unemployed/full-time caregiver, currently employed full-time, part-time/casual employed, full-time/part-time student). Participants in the sample targeting unhealthy snack consumption were also promoted to indicate whether they were on a specific diet and whether they were diabetic or not.

Attitudes. Affective attitude was measured using two items. Participants were presented with a common stem (e.g., "Drinking within safe limits over the next four weeks would be…"; "Regularly drinking alcohol over the next two weeks would be…"; "Limiting unhealthy snacks in your daily diet in the next two weeks would be…") followed by two bipolar adjectives for affective attitudes (*unpleasant-pleasant; awful-nice*) and two bipolar adjectives for cognitive attitudes (*unwise-wise; bad-good*) with responses provided on 7-point semantic differential scales.

Subjective norms. Subjective norms were measured using five items. Participants were prompted to rate the extent to which significant others would want them to perform the target behavior (e.g., "People who are important to me would want me to drink within safe limits"; "People who are important to me would approve of me drinking alcohol regularly"; "People who are important to me would approve of me limiting unhealthy snacks in my daily diet"). Responses were provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Perceived behavioral control. Perceived behavioral control was measured using four items. Participants were asked to assess how much control they had over participating in the behavior (e.g., "It is up to me whether I drink within safe limits"; "It is up to me whether I drink alcohol regularly"; "It is up to me whether I limit unhealthy snacks in my daily diet"). Responses were provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Intention. Participants' intention to participate in the target behavior was measured using three items (e.g., "I intend to drink within safe limits"; "I intend to drink alcohol regularly"; "I intend to limit unhealthy snacks in my daily diet"). Responses were provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Cue Consistency. Participants rated the extent to which specific cues to the target behavior arose when it was performed. Participants were presented with a common stem ("Each time I stop drinking alcohol to remain within safe limits…"; "Each time I start to drink alcohol..."; "Each time I start to eat unhealthy snacks…") followed by a set of six cues (e.g., "…it is the same time of day") with responses provided on 7-point scales (1 = *not at all true* and 7 = *very true*).

Habit. Habit was measured using the automaticity items from the Self-Report Habit Index (Verplanken & Orbell, 2003). Participants were asked to self-report the extent to which they experienced the target behavior as habitual on four items (e.g., "Drinking alcohol within safe limits is something I do automatically"; "Drinking alcohol regularly is something I do automatically"; "Eating unhealthy snacks as part of my daily diet is something I do automatically") with responses provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Behavior. Drinking within safe limits behavior was defined as ensuring no more than two standard drinks are consumed on any day, and that no more than four standard drinks are consumed on a single occasion, such as at a party, night out, visit to the pub, family or business event or other function. Participants were asked to think about the past four weeks, presented with four behavior items (e.g., "On average, how often did you drink within safe limits on the weekend?"), and prompted to respond on 7-point scales (1 = *never* and 7 = *very often*). Drinking alcohol regularly was measured as the frequency of drinking behavior and the amount of alcohol consumed over the prior two weeks. Participants were asked to think about the two weeks, presented with six behavior items (e.g., "How many standard drinks did you consume on average per week?"), and prompted to provide their responses on 7-point scales (1 = *never* and 7 = *very often*). Snacking behavior was measured as the frequency of consuming categories of unhealthy snacks in their daily diet. Participants were asked to think about the past two weeks, select which snack items they had consumed (e.g., "pizza, cakes, sweets"), and prompted to provide their responses on 9-point scales (1 = *never* and 9 = *4+ times a day*)[2].

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[2]It is important to note that the behavior measures prompted respondents to record their frequency of consuming unhealthy snacks while the social cognition and intention measures administered to this sample made reference to limiting consumption of unhealthy snacking behavior referred. As a consequence, relations between the social cognition and intention constructs were expected to be negative in sign.

Data Analysis

Hypothesized relations among the proposed integrated model (see Table 1 and Figure 1), were tested in each sample using variance-based structural equation modeling with the WarpPLS v. 7.0 software. Variance-based structural equation modeling (VB-SEM), also known as partial least squares modeling, has been recommended as a means to estimate models with high parameterization with relatively few cases. The Stable3 estimation method was used, which uses resampling methods to compute parameter estimates and standard errors that approximate to bootstrapped estimates. Each construct in the proposed model was a latent variable with proposed model relationships among them set as free parameters. Sex was included as a covariate in the model estimated in all samples. Being on a specific diet and diabetes status were included as covariates in the analysis of the sample targeting unhealthy snacking behavior. Missing data were imputed using multiple regression imputation, the method recommended by Kock (2022) as it yields the least biased mean path coefficient estimates.

Composite reliability and average variance extracted estimates for the latent variables, which should exceed .700 and .500, respectively were adopted to provide indication of the measurement adequacy of each. Discriminant validity of the constructs was supported when the square-root of the AVE for all constructs exceeds its correlation with other model variables.

We used standardized path coefficients and their confidence intervals to evaluate whether or not model effects were no different from the null, and used effect size estimates generated by the WARP Stable 3 algorithm which equates to Cohen's *f*-squared effect size coefficient but calculated using a different procedure to avoid distortion. Quality of the models, and their fit with the data in each sample, were established using multiple criteria. Tenenhaus' goodness-of-fit (GoF) index should produce values of 0.100, 0.250, and 0.360 for small, medium, and large model effect sizes (Tenenhaus et al., 2005). Average full collinearity variance inflation factor (AFVIF) and average block VIF (AVIF), which are both used to measure overall fit for model parameters, should be less than 3.3. Average R^2 (ARS), which explains the variance in the model explained by predictor variables, should be statistically significant at the level of .05. Average path coefficient (APC) provides information on the quality of the model through path coefficients and should be statistically significant at the level of .05. Simpson's paradox ratio (SPR), which checks for occurrences where relationships between variables are changed by the addition of a path model, and statistical suppression ration (SSR), which similarly measures the absence of statistical suppression, should each be greater than or equal to 0.7. R^2 contribution ratio (RSCR) provides the absence of negative R^2 contributions and should exceed .900. Finally, the nonlinear bivariate causality direction ratio (NLBCDR) supports the direction of the hypothesized model pathways are accurate and should be greater than or equal to 0.7. We also conducted pairwise comparisons of the size of the model parameter estimates across samples based on the confidence interval about the mean difference (Schenker & Gentlemen, 2001).

Results

Preliminary Analyses

Measurement-level statistics from our VB-SEM estimated in each sample provided support for the adequacy of our study measures as indicators of their respective latent constructs. Specifically, factor loadings and average variance extracted values exceeded the expected 0.700 and 0.500 criterion, respectively, for each latent variable and in all samples. Composite reliability estimates exceeded the 0.700 criterion for each latent factor, providing evidence of adequate internal consistency. There were only a few exceptions where latent variables did not meet these criteria: the factor loadings for the perceived behavioral control factor in the sample targeting regular alcohol consumption, and factor loadings and average variances extracted for subjective norms factor in the sample targeting reducing unhealthy snacking. Factor loadings, average variance estimates and reliability estimates are available in Table 3.

Latent variable correlations indicated zero order correlations among the social cognition constructs, intention, and behavior across all three samples, as expected (r range = .216 to .586, ps < .010). Similarly, we also observed non-zero correlations between the social cognition constructs and our habit measure, with the exception of the snacking sample (r range = .189 to .559, ps < .010). The largest correlations were observed between habit, intention, and behavior (r range = .284 to .518, ps < .001), while the cue consistency construct was not consistently correlated with any other constructs across all three samples. Descriptive statistics and zero-order factor correlation coefficients among latent constructs for each sample are available in Tables 6, 7, and 8.

Structural Equation Models

Model Fit and Variance Explained

Model quality and fit indices were adequate in samples targeting the drinking alcohol within acceptable limits (GoF = 0.529; ARS = 0.329, $p < .001$; AFVIF = 1.962; AVIF = 1.705; APC = 0.164, $p = 0.003$, SPR = 0.867; SSR = 0.933; NLBCDR = 0.867), regular alcohol drinking (GoF = 0.562; ARS = 0.434, $p < .001$; AFVIF = 1.703; AVIF = 1.461; APC = 0.181, $p < .001$; SPR = 0.867; SSR = 1.000; NLBCDR = 1.000), and the reducing unhealthy snacking (GoF = 0.643; ARS = 0.539, $p < .001$; AFVIF = 1.794; AVIF = 1.344; APC = 0.194, $p < .001$; SPR = 0.765; SSR = .941; NLBCDR = 0.882) behaviors. In addition, the models accounted for a substantial proportion of the variance in behavior in all cases (R^2 range = .335 to .590).

Model Effects

Standardized path coefficients for direct and moderator effects in the proposed models are presented in Figure 1 with coefficient variability and effect size statistics presented in Table 2 along with full estimates for the indirect effects. Focusing on the direct effects, we found non-zero effects of affective attitude, habit (T1), and subjective norms on intention, effects of habit (T2) and past behavior on behavior, and habit (T1) on habit (T2) in all three samples. We also found non-zero effects of PBC on intention for the samples targeting drinking within safe limits and reducing unhealthy snacking. There were non-zero effects of cue consistency on behavior, and significant moderation effects of cue consistency on past behavior-behavior relationships, in the samples targeting drinking within safe limits and regular drinking samples. We found a non-zero effect of intention on behavior in the sample targeting drinking alcohol within safe limits only. There was also a non-zero effect of PBC on behavior only in the sample targeting regular alcohol behavior.

Turning to the indirect effects, we found a non-zero indirect effect of self-reported habit (T1) on behavior through habit (T2) in all three samples. However, indirect effects of affective attitude, instrumental attitude, subjective norms, and perceived behavioral control on behavior through intention were no different from zero in all cases. Sums of indirect effects indicated a non-zero effect of habit (T1) on behavior in all three samples. We also found non-zero total effects of subjective norms and habit (T1) on intention, habit (T1) on habit (T2), and habit (T1), habit (T2), past behavior, and cue consistency on behavior in all three samples.

Model Effect Comparisons

We tested for differences in the standardized path coefficients for our model across samples. Although we identified a number of differences in the coefficients, it should be noted that the differences were in the relative size of the effects not in whether or not they were non-zero. This is important as it suggests that the overall *pattern* of effects in the model was consistent across samples, and the coefficients varied only in their relative size. Full results from the multi-group comparisons are presented in Tables 9, 10, and 11.

Turing to the differences in the coefficients, we found larger effects of affective attitude on intention and smaller effects of subjective norms on intention in the sample targeting regular drinking compared to the sample targeting drinking within safe limits. In addition, the moderating effect of cue consistency on the past behavior-behavior relationship was smaller in the samples targeting drinking within limits and reducing snacking compared to the sample targeting regular drinking. In addition, we found smaller effects of cognitive attitude and perceived behavioral control on intention, of past behavior on behavior, an of habit (T1) on habit (T2), as well as larger effects of habit (T1) on intention, and of cue consistency and intention on behavior in the sample targeting drinking within safe limits compared to the sample targeting reducing unhealthy snacking. In addition, we found larger effects of affective attitude and habit (T1) on intention and of affective attitude on behavior, and smaller effects of cognitive attitude and perceived behavioral control on intention and of past behavior on behavior in the sample targeting regular drinking when compared to the sample targeting reducing unhealthy snacking. Finally, we found that the moderating effect of cue consistency on the past behavior-behavior relationship was larger in samples targeting drinking within safe limits and regular drinking relative to the sample targeting reducing unhealthy snacking.

Discussion

We tested the efficacy of a novel integrated theoretical model in accounting for variance in behavior in separate samples of Australian students targeting three health-related behaviors, drinking alcohol within safe limits, regular alcohol drinking, and limiting unhealthy snacks, respectively. Our model included effects of social cognition constructs from the theory of planned behavior, which represent the reasoned deliberative processes proposed to precede behavioral engagement, and measures of habit and cue consistency construct, and frequency of past behavior, the effects of which are proposed to represent the non-conscious processes involved in behavioral engagement. Structural equation models of our proposed model fit the data well in each sample with high model quality. We found non-zero effects of affective attitude, subjective norms, and habit on intention, and non-zero effects of intention, habit, cue consistency, and past behavior on behavior in all three samples, with habit (T2) mediating the effect of habit (T1) on both behaviors. Moderating effects of cue consistency were inconsistent, with non-zero effects of cue consistency on the effect of past behavior on behavior in the samples targeting drinking within safe limits and regular drinking behaviors, and on the effect of habit on behavior in the sample targeting regular drinking only. Although we identified differences in the size of the effects among model constructs across samples, the general pattern of effects was consistent across all three. Effect sizes tended to be largest in the sample targeting unhealthy snacking behavior, with the exception of the moderating effect of cue consistency on the past behavior-behavior relationship, which was largest in the sample targeting regular drinking.

Our current findings highlight the value of adopting an integrated approach to examining the correlates of these health-related behaviors. Our model results indicated that, contrary to prior studies examining behavioral correlates derived exclusively from social cognition theories, the behaviors targeted here were predominantly a function of habit and prior behavior, with little contribution made by intentions or other constructs including affective attitudes. These findings were somewhat surprising in the context of previous research adopting an integrated approach, particularly those that have included measures of the habit construct and past behavior. Such studies typically find simultaneous effects of both intention, habit, and past behavior on behavior (Hagger et al., 2020; Hamilton et al., 2017; Kaushal & Rhodes, 2015). As it is unlikely that behavioral enactment is simultaneously governed by conscious and non-conscious processes, one interpretation of these simultaneous effects is that different processes drive behavioral enactment in segments of the population studied, and which determinant pervades is dependent on certain conditions, which serve to moderate effects of intentions, habit, and past behavior on behavior (for a full discussion of these issues see Hagger et al., 2023). A number of conditions have been proposed, such as the extent to which the behavior has been, or is likely to be, formed as a habit, or the extent to which the behavior is experienced as simple or complex by the individuals in the studied population.

For example, one possible moderator of intention-behavior effects relative to habit-behavior and past behavior-behavior effects could be behavior type. Behaviors that are likely to be impulsive or subject to endogenous reward, such as alcohol consumption and dietary behaviors, may be more dependent on non-conscious processes (Conner et al., 2015). Meta-analytic research has indicated that effects of the habit construct moderated the intention-behavior relationship in studies that targeted dietary behaviors compared to other behaviors like physical activity; as habit strength increased, the effect of intention on behavior decreased (Gardner et al., 2011). This may be because behaviors that are inherently more rewarding are more likely to be developed as habits. On the surface, the pattern of effects observed in the current are consistent with this notion and the selection of these behaviors therefore lead them to be more likely to be associated with constructs that represent non-conscious processes. However, there is an important caveat that should be noted with respect to this this interpretation. Strictly speaking, regular alcohol drinking is the only behavior in the current study that is consistent with a ‘rewarding’ behavior – by contrast the drinking alcohol behavior and reducing unhealthy snacking behaviors are really behaviors geared toward minimizing the more impulsive behaviors of drinking in excess and snacking unhealthily. Further, we do not have data targeting behaviors that offer a direct contrast to any of these behaviors to make comparisons. To confirm that it is the rewarding aspect of these behaviors responsible for the small intention effects and larger habit effects, we would need to compare them in similar samples but targeting the impulsive behaviors, that is, drinking above guidelines limits and unhealthy snacking behaviors.

It is also important to note that intentions tend to be strongly related to past behavior and habit, and an examination of the zero-order correlations indicated this was also the case in the current research for all three behaviors (see Tables 6, 7, and 8). In light of this, our findings should not be considered surprising. Although research has consistently demonstrated non-zero intention-behavior effects, even when including habit and past behavior as additional predictors, such tests also frequently report substantive attenuation of intention-behavior effects when these constructs are included and may even reduce the effect to a non-trivial size or even one that is no different from the null (Hagger et al., 2023; Ouellette & Wood, 1998). This is because individuals' intentions are likely to be congruent with their prior experience and also their habits. Thus, when prompted, to estimate their intentions to perform the behavior in question in future, individuals are likely to make judgements in accordance with their prior experience, and, in fact, prior experience serves as a key source of information when estimating intentions (Ajzen, 2002; Hagger et al., 2018). In addition, habits are likely to have once been intentional and, therefore, it should not be surprising that estimates of intention coincide with estimates of the extent to which the behavior is habitual (Wood et al., 2014). Tests of social cognition theories typically tend not to account for the effects of these constructs and, therefore, may present a somewhat misleading account of the correlates of health behaviors.

However, it is also important to identify potential candidate moderators of habit and past behavior effects in models of health behavior, this may elucidate potential conditions that determine more precisely when individuals' behavior is governed by non-conscious processes. As noted earlier, one candidate moderator may have been type of behavior, particularly the extent to which the behavior is essentially rewarding or otherwise. Although we could not formally contrast the current behaviors with the version of the behavior that is directly the more (e.g., drinking over guideline limits, snacking unhealthily) or less (e.g., restricting regular drinking) impulsive or rewarding version, we did examine effects of another candidate moderator of habit and past behavior: cue consistency. Consistent with predictions, individuals with high cue consistency were more likely to act on the basis of their prior behavior, which corroborates the findings of a substantive body of research that has adopted measures of habit conceptualized as a multiplicative composite comprising behavioral frequency x context stability and demonstrated its unique effects on behavior (Gardner, 2015; Wood & Neal, 2009). Our findings extend this research by formally indicating the basis of behavior in prior experience is heightened when the environmental cues or conditions are consistently presented. This aligns well with the defining characteristics of habit outlined in theory on habit, that is, habits are defined as behaviors that are more likely to be developed when repeated in the presence of the same conditions (Galla & Duckworth, 2015; Hagger, 2019; Wood & Neal, 2009). Our findings, therefore, support the implication that frequency alone does not always lead to behavioral enactment that is consistent with prior experience, and that cue consistency is a necessary condition for that to occur. This has clear corroborating ramifications for habit theory and its defining characteristics, but also implied that the development of habits, therefore, requires behavioral repetition coinciding with stable conditions.

Direct effects of affective attitudes were also included in our model to further represent a non-conscious process that may lead to behavioral enactment in these contexts, consistent with prior research (e.g., Conner et al., 2015; Lawton et al., 2009). However, these direct effects were not identified in any of our three samples. One possible reason for this is that we simultaneously included multiple constructs that represent non-conscious processes in the same model. Of particular relevance is the inclusion of past behavior. Individuals promoted to report their affective attitudes toward these behaviors, that is, the extent to which they anticipate the behavior to lead to positive affective responses and, therefore, emotional gratification, are likely to have drawn from their affective prior experience with the behavior. As a consequence, affective attitudes are likely to be highly congruent with past behavior measures. This was corroborated by the high correlations between affective attitude and past behavior in the current study in all samples (r range = .188 to .318, ps < .010). It is also likely that affective attitudes and past behavior are also likely to share common variance with subsequent behavior, and, as such, presented as the predominant correlate in our model when both variables were simultaneously included. Individuals' prior experience, therefore, entirely captures the effects of the behavior as affectively rewarding.

Strengths, Limitations, and Avenues for Future Research

The current study has several notable strengths: the adoption of an integrated theoretical approach that included constructs that representing two key processes that are proposed to be related to intention formation and behavioral enactment: social cognition constructs and habit, past behavior, and affective attitude; testing of the proposed integrated model in three separate samples of undergraduate students for three separate health-related behaviors; and adoption of robust measures and a prospective study design. These strengths notwithstanding, there are several limitations that should be highlighted that place limits on the inferences that can be drawn from on these data and their generalizability.

First, we adopted a correlational design which means that we were not able to infer causality in the effects identified data. While correlational designs provide some indication of associations between constructs, and a prospective design enables some inference of directionality in effects, we cannot draw causal effects based on these data, they are inferred from the theoretical perspective and the model alone. The proposed effects, therefore, warrant tests in studies adopting experimental or intervention designs, in which key constructs in the model are manipulated or changed via intervention strategies, and their effects on outcomes including intentions and behavior examined.

Second, while we tested the proposed effects in our models in multiple samples and for more than one health-related behavior, all samples comprised students. It should be noted that the behaviors targeted here are supremely relevant to this population – for example, numerous studies have highlighted high prevalence of risky alcohol consumption behaviors in student populations. Nevertheless, student samples reflect a relatively homogenous group and the exclusive focus on student samples means that it would be unwise to generalize the current findings to the general population.

Finally, the current study relied exclusively on self-report measures, particularly behavioral measures. Although self-report measures have shown reasonable correlations with non-self-report measures, providing evidence of concurrent validity (Gardner et al., 2012; Simons et al., 2015), associations are imperfect, suggesting that such measures may encompass a non-trivial degree of measurement error. Sources of such errors in self-report measures include common method variance, acquiescence bias, response order bias, social desirability bias, and recall bias (Chan et al., 2015; Danner et al., 2016). Although some of these biases may have been mitigated through the use of scales with strong psychometric properties, as indicated by our measurement estimates, such biases may be inherent in self-report methods. This is particularly the case for behavioral measures and some of the measures of constructs, where valid and reliable non-self-report measures of exist, such as observation measures of alcohol consumption or habit measures that incorporate non-self-report methods (e.g., Hoo et al., 2019; Samo et al., 1989). Importantly, research suggests that effects on behavior of social cognition and other constructs from integrated models, similar to that tested here, may vary depending on the use of self-report and non-self-report measures of behavior (e.g., Kalajas-Tilga et al., 2022). Replication of current findings using non-self-report measures is, therefore, warranted and comparisons made with the current findings to assess the level of congruence.

Conclusion

In the present study we applied a unique integrated theoretical model that encompassed constructs representing two key processes to identify the correlates of three health behaviors, namely, drinking within safe limits, regular drinking, and limiting unhealthy snacking, in samples of Australian undergraduate students. Specifically, our model included social cognition variables from the TPB, the effects of which represent conscious, deliberative decision-making processes that precede behavioral engagement alongside habit, cue consistency, and affective attitude constructs that represent non-conscious processes that lead to behavior. The goal was to develop a more comprehensive description of the correlates of these health behaviors in these student samples, particularly the simultaneous effects of constructs representing deliberative and non-conscious decision-making processes. Results highlighted the importance of habit and past behavior as key behavioral correlates, while intentions had a minimal role. Importantly, cue consistency moderated the past behavior–behavior relationship, which indicated, consistent with habit theory, that individuals are more likely to act in accordance with their prior experience when the cues in their environment are consistent, a hallmark of habitual acting. Findings contribute to a growing body of evidence indicating the importance of habitual processes in the enactment of these kinds of behavior, and provide potential formative evidence to catalyze research on the effects of habit forming interventions on subsequent behavior. For example, current data needs corroboration with research demonstrating that interventions prompting individuals to repeatedly perform the behavior in conjunction with stable and consistent cues will facilitate habitual patterns of behavior in future.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211.

Ajzen, I. (2002). Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and Social Psychology Review*, *6*(2), 107–122. https://doi.org/10.1207/S15327957PSPR0602_02.

Ajzen, I., & Fishbein, M. (2005). The influence of attitudes on behavior.

Ajzen, I. (2002). Constructing a TPB questionnaire: Conceptual and methodological considerations.

Alhazmi, A., Stojanovski, E., McEvoy, M., & Garg, M. L. (2014). The association between dietary patterns and type 2 diabetes: A systematic review and meta-analysis of cohort studies. *Journal of Human Nutrition and Dietetics*, *27*(3), 251–260. https://doi.org/10.1111/jhn.12139

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471–499. https://doi.org/10.1348/014466601164939

Chan, D. K. C., Ivarsson, A., Stenling, A., Yang, S. X., Chatzisarantis, N. L. D., & Hagger, M. S. (2015). Response-order effects in survey methods: A randomized controlled crossover study in the context of sport injury prevention. *Journal of Sport and Exercise Psychology*, *37*(6), 666–673. https://doi.org/10.1123/jsep.2015-0045

Cherpitel, C. J., Bond, J., Ye, Y., Borges, G., Macdonald, S., & Giesbrecht, N. (2003). A cross-national meta-analysis of alcohol and injury: Data from the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP): Meta-analysis of alcohol and injury. *Addiction*, *98*(9), 1277–1286. https://doi.org/10.1046/j.1360-0443.2003.00459.x

Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behavior: A review and avenues for further research. *Journal of Applied Social Psychology*, *28*(15), 1429–1464. https://doi.org/10.1111/j.1559-1816.1998.tb01685.x

Conner, M., McEachan, R., Lawton, R., & Gardner, P. (2017). Applying the reasoned action approach to understanding health protection and health risk behaviors. *Social Science & Medicine*, *195*, 140–148. https://doi.org/10.1016/j.socscimed.2017.10.022

Conner, M., McEachan, R., Taylor, N., O’Hara, J., & Lawton, R. (2015). Role of affective attitudes and anticipated affective reactions in predicting health behaviors. *Health Psychology*, *34*(6), 642–652. https://doi.org/10.1037/hea0000143

Conner, M., Sheeran, P., Norman, P., & Armitage, C. J. (2000). Temporal stability as a moderator of relationships in the Theory of Planned Behaviour. *British Journal of Social Psychology*, *39*(4), 469–493. https://doi.org/10.1348/014466600164598

Conner, M. T., & Sparks, P. (2015). The theory of planned behavior and reasoned action approach. In M. T. Conner & P. Norman (Eds.), *Predicting and Changing Health Behaviour: Research and Practice with Social Cognition Models* (3rd ed., pp. 142-188). Open University Press.

Cooke, R., Dahdah, M., Norman, P., & French, D. P. (2016). How well does the theory of planned behaviour predict alcohol consumption? A systematic review and meta-analysis. *Health Psychology Review*, *10*(2), 148–167. https://doi.org/10.1080/17437199.2014.947547

Danner, D., Blasius, J., Breyer, B., Eifler, S., Menold, N., Paulhus, D. L., Rammstedt, B., Roberts, R. D., Schmitt, M., & Ziegler, M. (2016). Current challenges, new developments, and future directions in scale construction. *European Journal of Psychological Assessment*, *32*(3), 175–180. https://doi.org/10.1027/1015-5759/a000375

de Bruijn, G.-J., Kremers, S. P. J., De Vet, E., De Nooijer, J., Van Mechelen, W., & Brug, J. (2007). Does habit strength moderate the intention–behaviour relationship in the Theory of Planned Behaviour? The case of fruit consumption. *Psychology & Health*, *22*(8), 899–916. https://doi.org/10.1080/14768320601176113

de Bruijn, G.-J., Rhodes, R. E., & van Osch, L. (2012). Does action planning moderate the intention-habit interaction in the exercise domain? A three-way interaction analysis investigation. *Journal of Behavioral Medicine*, *35*(5), 509–519. https://doi.org/10.1007/s10865-011-9380-2

Fishbein, M. (2008). A reasoned action approach to health promotion. *Medical Decision Making*, *28*(6), 834–844. https://doi.org/10.1177/0272989X08326092

Fishbein, M., & Ajzen, I. (2011). *Predicting and changing behavior: The reasoned action approach.* Taylor & Francis.

Galla, B. M., & Duckworth, A. L. (2015). More than resisting temptation: Beneficial habits mediate the relationship between self-control and positive life outcomes. *Journal of Personality and Social Psychology*, *109*(3), 508–525. https://doi.org/10.1037/pspp0000026

Gardner, B. (2015). A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behaviour. *Health Psychology Review*, *9*(3), 277–295. https://doi.org/10.1080/17437199.2013.876238

Gardner, B., Abraham, C., Lally, P., & de Bruijn, G.-J. (2012). Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 102. https://doi.org/10.1186/1479-5868-9-102

Gardner, B., de Bruijn, G.-J., & Lally, P. (2011). A systematic review and meta-analysis of applications of the self-report habit index to nutrition and physical activity Behaviours. *Annals of Behavioral Medicine*, *42*(2), 174–187. https://doi.org/10.1007/s12160-011-9282-0

Gerrard, M., Gibbons, F. X., Houlihan, A. E., Stock, M. L., & Pomery, E. A. (2008). A dual-process approach to health risk decision making: The prototype willingness model. *Developmental Review*, *28*(1), 29–61. https://doi.org/10.1016/j.dr.2007.10.001

Hagger, M., & Hamilton, K. (2020). Changing behavior using integrated theories. In M. Hagger, L. Cameron, K. Hamilton, N. Hankonen, & T. Lintunen (Eds.), *The*

Handbook of Behavior Change (Cambridge Handbooks in Psychology, pp. 208-224). Cambridge: Cambridge University Press. Doi:10.1017/9781108677318.015.

Hagger, M., Chatzisarantis, N., & Biddle, S. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport & Exercise Psychology*.

Hagger, M. S. (2019). Habit and physical activity: Theoretical advances, practical implications, and agenda for future research. *Psychology of Sport and Exercise*, *42*, 118–129. https://doi.org/10.1016/j.psychsport.2018.12.007

Hagger, M. S., Cameron, L. D., Hamilton, K., Hankonen, N., & Lintunen, T. (Eds.). (2020). *The Handbook of Behavior Change* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781108677318

Hagger, M. S., Chan, D. K. C., Protogerou, C., & Chatzisarantis, N. L. D. (2016). Using meta-analytic path analysis to test theoretical predictions in health behavior: An illustration based on meta-analyses of the theory of planned behavior. *Preventive Medicine*, *89*, 154–161. https://doi.org/10.1016/j.ypmed.2016.05.020

Hagger, M. S., & Chatzisarantis, N. L. D. (2014). An integrated behavior change model for physical activity. *Exercise and Sport Sciences Reviews*, *42*(2), 62–69. https://doi.org/10.1249/JES.0000000000000008

Hagger, M. S., Cheung, M. W.-L., Ajzen, I., & Hamilton, K. (2022). Perceived behavioral control moderating effects in the theory of planned behavior: A meta-analysis. *Health Psychology*, *41*(2), 155–167. https://doi.org/10.1037/hea0001153

Hagger, M. S., Hamilton, K., Phipps, D. J., Protogerou, C., Zhang, C.-Q., Girelli, L., Mallia, L., & Lucidi, F. (2023). Effects of habit and intention on behavior: Meta-analysis and test of key moderators. *Motivation Science*. Https://doi.org/10.1037/mot0000294.

Hagger, M. S., Moyers, S., McAnally, K., & McKinley, L. E. (2020). Known knowns and known unknowns on behavior change interventions and mechanisms of action. *Health Psychology Review*, *14*(1), 199–212. https://doi.org/10.1080/17437199.2020.1719184

Hagger, M. S., Polet, J., & Lintunen, T. (2018). The reasoned action approach applied to health behavior: Role of past behavior and tests of some key moderators using meta-analytic structural equation modeling. *Social Science & Medicine*, *213*, 85–94. https://doi.org/10.1016/j.socscimed.2018.07.038

Hagger, M. S., Smith, S. R., Keech, J. J., Moyers, S. A., & Hamilton, K. (2020). Predicting social distancing intention and behavior during the COVID-19 pandemic: An integrated social cognition model. *Annals of Behavioral Medicine*, *54*(10), 713–727. https://doi.org/10.1093/abm/kaaa073

Hagger, M. S., Trost, N., Keech, J. J., Chan, D. K. C., & Hamilton, K. (2017). Predicting sugar consumption: Application of an integrated dual-process, dual-phase model. *Appetite*, *116*, 147–156. https://doi.org/10.1016/j.appet.2017.04.032

Hamilton, K., Kirkpatrick, A., Rebar, A., & Hagger, M. S. (2017). Child sun safety: Application of an Integrated Behavior Change model. *Health Psychology*, *36*(9), 916–926. https://doi.org/10.1037/hea0000533

Hoo, Z. H., Wildman, M. J., Campbell, M. J., Walters, S. J., & Gardner, B. (2019). A pragmatic behavior-based habit index for adherence to nebulized treatments among adults with cystic fibrosis. *Patient Preference and Adherence*, *Volume 13*, 283–294. https://doi.org/10.2147/PPA.S186417

Huchting, K., Lac, A., & LaBrie, J. W. (2008). An application of the Theory of Planned Behavior to sorority alcohol consumption. *Addictive Behaviors*, *33*(4), 538–551. https://doi.org/10.1016/j.addbeh.2007.11.002

Jayedi, A., Soltani, S., Abdolshahi, A., & Shab-Bidar, S. (2020). Healthy and unhealthy dietary patterns and the risk of chronic disease: An umbrella review of meta-analyses of prospective cohort studies. *British Journal of Nutrition*, *124*(11), 1133–1144. https://doi.org/10.1017/S0007114520002330

Johnson, B. T., Scott-Sheldon, L. A. J., & Carey, M. P. (2010). Meta-synthesis of health behavior change meta-analyses. *American Journal of Public Health*, *100*(11), 2193–2198. https://doi.org/10.2105/AJPH.2008.155200

Kalajas-Tilga, H., Hein, V., Koka, A., Tilga, H., Raudsepp, L., & Hagger, M. S. (2022). Application of the trans-contextual model to predict change in leisure time physical activity. *Psychology & Health*, *37*(1), 62–86. https://doi.org/10.1080/08870446.2020.1869741

Kaushal, N., & Rhodes, R. E. (2015). Exercise habit formation in new gym members: A longitudinal study. *Journal of Behavioral Medicine*, *38*(4), 652–663. https://doi.org/10.1007/s10865-015-9640-7

Kock, N. *WarpPLS user manual:* Version 7.0. Laredo, TX: ScriptWarp Systems. 2020.

Lawton, R., Conner, M., & McEachan, R. (2009). Desire or reason: Predicting health behaviors from affective and cognitive attitudes. *Health Psychology*, *28*(1), 56–65. https://doi.org/10.1037/a0013424

Marzan, M., Callinan, S., Livingston, M., Leggat, G., & Jiang, H. (2022). Systematic review and dose–response meta-analysis on the relationship between alcohol consumption and sickness absence. *Alcohol and Alcoholism*, *57*(1), 47–57. https://doi.org/10.1093/alcalc/agab008

McDermott, M. S., Oliver, M., Simnadis, T., Beck, E. J., Coltman, T., Iverson, D., Caputi, P., & Sharma, R. (2015). The Theory of Planned Behaviour and dietary patterns: A systematic review and meta-analysis. *Preventive Medicine*, *81*, 150–156. https://doi.org/10.1016/j.ypmed.2015.08.020

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: A meta-analysis. *Health Psychology Review*, *5*(2), 97–144. https://doi.org/10.1080/17437199.2010.521684

McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. (2016). Meta-Analysis of the Reasoned Action Approach (RAA) to understanding health behaviors. *Annals of Behavioral Medicine*, *50*(4), 592–612. https://doi.org/10.1007/s12160-016-9798-4

McEwan, D., Beauchamp, M. R., Kouvousis, C., Ray, C. M., Wyrough, A., & Rhodes, R. E. (2019). Examining the active ingredients of physical activity interventions underpinned by theory versus no stated theory: A meta-analysis. *Health Psychology Review*, *13*(1), 1–17. https://doi.org/10.1080/17437199.2018.1547120

Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychological Bulletin*, *124*(1), 54–74. https://doi.org/10.1037/0033-2909.124.1.54

Pimm, R., Vandelanotte, C., Rhodes, R. E., Short, C., Duncan, M. J., & Rebar, A. L. (2016). Cue consistency associated with physical activity automaticity and behavior. *Behavioral Medicine*, *42*(4), 248–253. https://doi.org/10.1080/08964289.2015.1017549

Rich, A., Brandes, K., Mullan, B., & Hagger, M. S. (2015). Theory of planned behavior and adherence in chronic illness: A meta-analysis. *Journal of Behavioral Medicine*, *38*(4), 673–688. https://doi.org/10.1007/s10865-015-9644-3

Rothman, A. J., Klein, W. M. P., & Sheeran, P. (2020). Moving from theoretical principles to intervention strategies: Applying the experimental medicine approach. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen & T. Lintunen (Eds.), *The Handbook of Behavior Change* (pp. 285-299). Cambridge University Press. Https://doi.org/10.1017/97811086773180.020.

Rothman, A. J., & Sheeran, P. (2021). The operating conditions framework: Integrating mechanisms and moderators in health behavior interventions. *Health Psychology*, *40*(12), 845–857. https://doi.org/10.1037/hea0001026

Samo, J. A., Tucker, J. A., & Vuchinich, R. E. (1989). Agreement between self-monitoring, recall, and collateral observation measures of alcohol consumption in older adults. *Behavioral Assessment, 11*, 391-409.

Schenker, N., & Gentleman, J.F. (2001). On judging the significance of differences by examining the overlap between confidence intervals. *Am. Stat., 55*, 182-186.

Sheeran, P., Gollwitzer, P. M., & Bargh, J. A. (2013). Nonconscious processes and health. *Health Psychology*, *32*(5), 460–473. https://doi.org/10.1037/a0029203

Sheeran, P., Orbell, S., & Trafimow, D. (1999). Does the temporal stability of behavioral intentions moderate intention-behavior and past behavior-future behavior relations? *Personality and Social Psychology Bulletin, 25*(6), 724-734.

Sheeran, P., Suls, J., Bryan, A., Cameron, L., Ferrer, R. A., Klein, W. M. P., & Rothman, A. J. (2023). Activation versus change as a principle underlying intervention strategies to promote health behaviors. *Annals of Behavioral Medicine*, *57*(3), 205–215. https://doi.org/10.1093/abm/kaac045

Simons, J. S., Wills, T. A., Emery, N. N., & Marks, R. M. (2015). Quantifying alcohol consumption: Self-report, transdermal assessment, and prediction of dependence symptoms. *Addictive Behaviors*, *50*, 205–212. https://doi.org/10.1016/j.addbeh.2015.06.042

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review*, *8*(1), 1–7. https://doi.org/10.1080/17437199.2013.869710

Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back: A technique for assessing self-reported alcohol consumption. Measuring alcohol consumption: *Psychosocial and Biochemical Methods*, 41-72.

Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychological Bulletin*, *124*(1), 54–74. https://doi.org/10.1037/0033-2909.124.1.54

Pimm, R., Vandelanotte, C., Rhodes, R. E., Short, C., Duncan, M. J., & Rebar, A. L. (2016). Cue consistency associated with physical activity automaticity and behavior. *Behavioral Medicine*, *42*(4), 248–253. https://doi.org/10.1080/08964289.2015.1017549

Rich, A., Brandes, K., Mullan, B., & Hagger, M. S. (2015). Theory of planned behavior and adherence in chronic illness: A meta-analysis. *Journal of Behavioral Medicine*, *38*(4), 673–688. https://doi.org/10.1007/s10865-015-9644-3

Rothman, A. J., Klein, W. M. P., & Sheeran, P. (2020). Moving from theoretical principles to intervention strategies: Applying the experimental medicine approach. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen & T. Lintunen (Eds.), *The Handbook of Behavior Change* (pp. 285-299). Cambridge University Press. Https://doi.org/10.1017/97811086773180.020.

Rothman, A. J., & Sheeran, P. (2021). The operating conditions framework: Integrating mechanisms and moderators in health behavior interventions. *Health Psychology*, *40*(12), 845–857. https://doi.org/10.1037/hea0001026

Samo, J. A., Tucker, J. A., & Vuchinich, R. E. (1989). Agreement between self-monitoring, recall, and collateral observation measures of alcohol consumption in older adults. *Behavioral Assessment, 11*, 391-409.

Schenker, N., & Gentleman, J.F. (2001). On judging the significance of differences by examining the overlap between confidence intervals. *Am. Stat.*, *55*, 182-186.

Sheeran, P., Gollwitzer, P. M., & Bargh, J. A. (2013). Nonconscious processes and health. *Health Psychology*, *32*(5), 460–473. https://doi.org/10.1037/a0029203

Sheeran, P., Orbell, S., & Trafimow, D. (1999). Does the temporal stability of behavioral intentions moderate intention-behavior and past behavior-future behavior relations? *Personality and Social Psychology Bulletin, 25*(6), 724-734.

Sheeran, P., Suls, J., Bryan, A., Cameron, L., Ferrer, R. A., Klein, W. M. P., & Rothman, A. J. (2023). Activation versus change as a principle underlying intervention strategies to promote health behaviors. *Annals of Behavioral Medicine*, *57*(3), 205–215. https://doi.org/10.1093/abm/kaac045

Simons, J. S., Wills, T. A., Emery, N. N., & Marks, R. M. (2015). Quantifying alcohol consumption: Self-report, transdermal assessment, and prediction of dependence symptoms. *Addictive Behaviors*, *50*, 205–212. https://doi.org/10.1016/j.addbeh.2015.06.042

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review*, *8*(1), 1–7. https://doi.org/10.1080/17437199.2013.869710

Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back: A technique for assessing self-reported alcohol consumption. Measuring alcohol consumption: *Psychosocial and Biochemical Methods*, 41-72.

St Quinton, T., & Brunton, J. A. (2017). Implicit Processes, Self-Regulation, and Interventions for Behavior Change. *Frontiers in Psychology, 8*. https://doi.org/10.3389/fpsyg.2017.00346

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220-247.

Taylor, B., Irving, H. M., Kanteres, F., Room, R., Borges, G., Cherpitel, C., Greenfield, T., & Rehm, J. (2010). The more you drink, the harder you fall: A systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together. *Drug and Alcohol Dependence*, *110*(1–2), 108–116. https://doi.org/10.1016/j.drugalcdep.2010.02.011

Tenenhaus, M., Vinzi, V. E., Chatelin, Y.-M., & Lauro, C. (2005). PLS path modeling. *Computational Statistics & Data Analysis*, *48*(1), 159–205. https://doi.org/10.1016/j.csda.2004.03.005

Trafimow, D., & Sheeran, P. (1998). Some tests of the distinction between cognitive and affective beliefs. *Journal of Experimental Social Psychology*, *34*(4), 378–397. https://doi.org/10.1006/jesp.1998.1356

van Bree, R. J. H., van Stralen, M. M., Mudde, A. N., Bolman, C., de Vries, H., & Lechner, L. (2015). Habit as mediator of the relationship between prior and later physical activity: A longitudinal study in older adults. *Psychology of Sport and Exercise*, *19*, 95–102. https://doi.org/10.1016/j.psychsport.2015.03.006

Verplanken, B., Aarts, H., & Van Knippenberg, A. (1997). Habit, information acquisition, and the process of making travel mode choices. *European Journal of Social Psychology*, *27*(5), 539–560. https://doi.org/10.1002/(SICI)1099-0992(199709/10)27:5<539::AID-EJSP831>3.0.CO;2-A

Verplanken, B., & Orbell, S. (2003). Reflections on past behavior: A Self-Report Index of Habit Strength [1]. *Journal of Applied Social Psychology*, *33*(6), 1313–1330. https://doi.org/10.1111/j.1559-1816.2003.tb01951.x

Wood, W. (2017). Habit in personality and social psychology. *Personality and Social Psychology Review*, *21*(4), 389–403. https://doi.org/10.1177/1088868317720362

Wood, W., Labrecque, J. S., Lin, P.-Y., & Rünger, D. (2014). Habits in dual process models. In J. W. Sherman, B. Gawronski & Y. Trope (Eds.), *Dual-Process Theories of the Social Mind* (pp. 371-385). Guildford Press.

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review*, *114*(4), 843–863. https://doi.org/10.1037/0033-295X.114.4.843

Wood, W., & Neal, D. T. (2009). The habitual consumer. *Journal of Consumer Psychology*, *19*(4), 579–592. https://doi.org/10.1016/j.jcps.2009.08.003

Wood, W., & Rünger, D. (2016). Psychology of habit. *Annual Review of Psychology*, *67*(1), 289–314. https://doi.org/10.1146/annurev-psych-122414-033417

Zeisser, C., Stockwell, T. R., Chikritzhs, T., Cherpitel, C., Ye, Y., & Gardner, C. (2013). A Systematic review and meta-analysis of alcohol consumption and injury risk as a function of study design and recall period. *Alcoholism: Clinical and Experimental Research*, *37*, E1–E8. https://doi.org/10.1111/j.1530-0277.2012.01919.x

Table 1

Summary of Hypothesized Direct and Indirect Effects in the Theory of Planned Behavior for Alcohol and Snacking Behaviors

H	Independent variable	Dependent variable	Mediator(s)
Direct effects			
H_1	Affective attitude	Intention	–
H_2	Instrumental attitude	Intention	–
H_3	Subjective norms	Intention	–
H_4	Perceived behavioral control	Intention	–
H_5	Habit (T1)	Intention	–
H_6	Affective attitude	Behavior (T2)	–
H_7	Perceived behavioral control	Behavior (T2)	–
H_8	Intention	Behavior (T2)	–
H_9	Habit (T2)	Behavior (T2)	–
H_{10}	Cue consistency	Behavior (T2)	–
H_{11}	Past behavior	Behavior (T2)	–
H_{12}	Sex	Behavior (T2)	–
H_{13}	Habit (T1)	Habit (T2)	–
Moderator effects			
H_{14}	Cue consistency x Past behavior	Behavior (T2)	Intention
H_{15}	Cue consistency x Habit (T2)	Behavior (T2)	Intention
Indirect effects			
H_{16}	Affective attitude	Behavior (T2)	Intention
H_{17}	Instrumental attitude	Behavior (T2)	Intention
H_{18}	Subjective norms	Behavior (T2)	Intention
H_{19}	Perceived behavioral control	Behavior (T2)	Intention
H_{20}	Habit (T1)	Behavior (T2)	Habit (T2)

Note. H = Hypothesis T1 = Construct or variable measured at the first data collection occasion; T2 = Construct or variable measured at the second data collection occasion.

Table 2

Standardized Path Coefficients and Variability and Effect Size Estimates for the Proposed Models for Each Sample and Targeted Behavior

Effect	Targeted behavior								
	Drinking within safe limits			Regular drinking			Unhealthy snacking		
	β	*SE*	ES	β	SE	ES	β	SE	ES
Direct effects									
AA→Int.	.122*	.065	.041	.339***	.056	.199	.137*	.060	.051
CA→Int.	.059	.065	.017	.061	.056	.029	.300***	.060	.159
SN→Int.	.389***	.065	.219	.175***	.056	.084	.268***	.060	.107
PBC→Int.	-.078*	.065	.017	-.002	.056	<.001	.265***	.060	.121
Hab. (T1)→Int.	.299***	.065	.147	.366***	.056	.205	-.201***	.060	.051
AA→Beh. (T2)	-.010	.065	.002	.025	.056	.041	-.042	.060	.010
PBC→Beh. (T2)	.044	.065	.009	.134**	.056	<.001	.001	.060	<.001
Int.→Beh. (T2)	.117*	.065	.046	.046	.056	.016	-.096	.060	.030
Hab. (T2)→Beh. (T2)	.229***	.065	.099	.149**	.056	.058	.234***	.060	.128
CC→Beh. (T2)	.172**	.065	.044	.146**	.056	.038	-.007	.060	<.001
PB→Beh. (T2)	.266***	.065	.121	.331***	.056	.157	.585***	.060	.409
Sex→Beh. (T2)	-.012	.065	<.001	-.017	.056	.001	.011	.060	<.001
Hab. (T1)→Hab. (T2)x	.495***	.065	.245	.635***	.056	.404	.734***	.060	.539
Moderator effects									
CC x PB→Beh. (T2)	.130*	.065	.002	.174***	.056	.047	-.043	.060	.002
CC x Hab. (T2)→Beh. (T2)	-.073	.065	.015	.138**	.056	.026	.097	.060	.010
Indirect effects									
AA→Int.→Beh. (T2)	.003	.046	.003	.015	.039	.005	-.013	.043	.003
IA→Int.→Beh. (T2)	-.003	.046	.002	.003	.039	.001	-.029	.043	.002
SN→Int.→Beh. (T2)	.012	.046	.013	.008	.039	.002	-.026	.043	<.001
PBC→Int.→Beh. (T2)	.008	.046	.002	<.001	.039	<.001	-.026	.043	.006
Hab. (T1)→Hab. (T2)→Beh. (T2)	.160**	.065	.013	.111*	.056	.044	.191***	.060	.084

Note. β = Standardized path coefficient; *SE* = Standard error; ES = Effect size; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective norm; PBC = Perceived behavioral control; Hab. = Habit; PB = Past behavior; Beh. = Behavior; CC = Cue consistency; T1 = Construct or variable measured at the first data collection occasion; T2 = Construct or variable measured at the second data collection occasion.

$^{*}p < .05$ $^{**}p < .01$ $^{***}p<.001$.

Figure 1

Proposed integrated social cognition model predicting drinking alcohol within guideline limits, regular alcohol drinking, and unhealthy snacking behaviors.

Note. Sex was included as a covariate on the models estimated in samples targeting all three behaviors. Currently being on a specific diet and diabetes status were included as covariates in the model estimate in the sample targeting unhealthy snacking behavior.

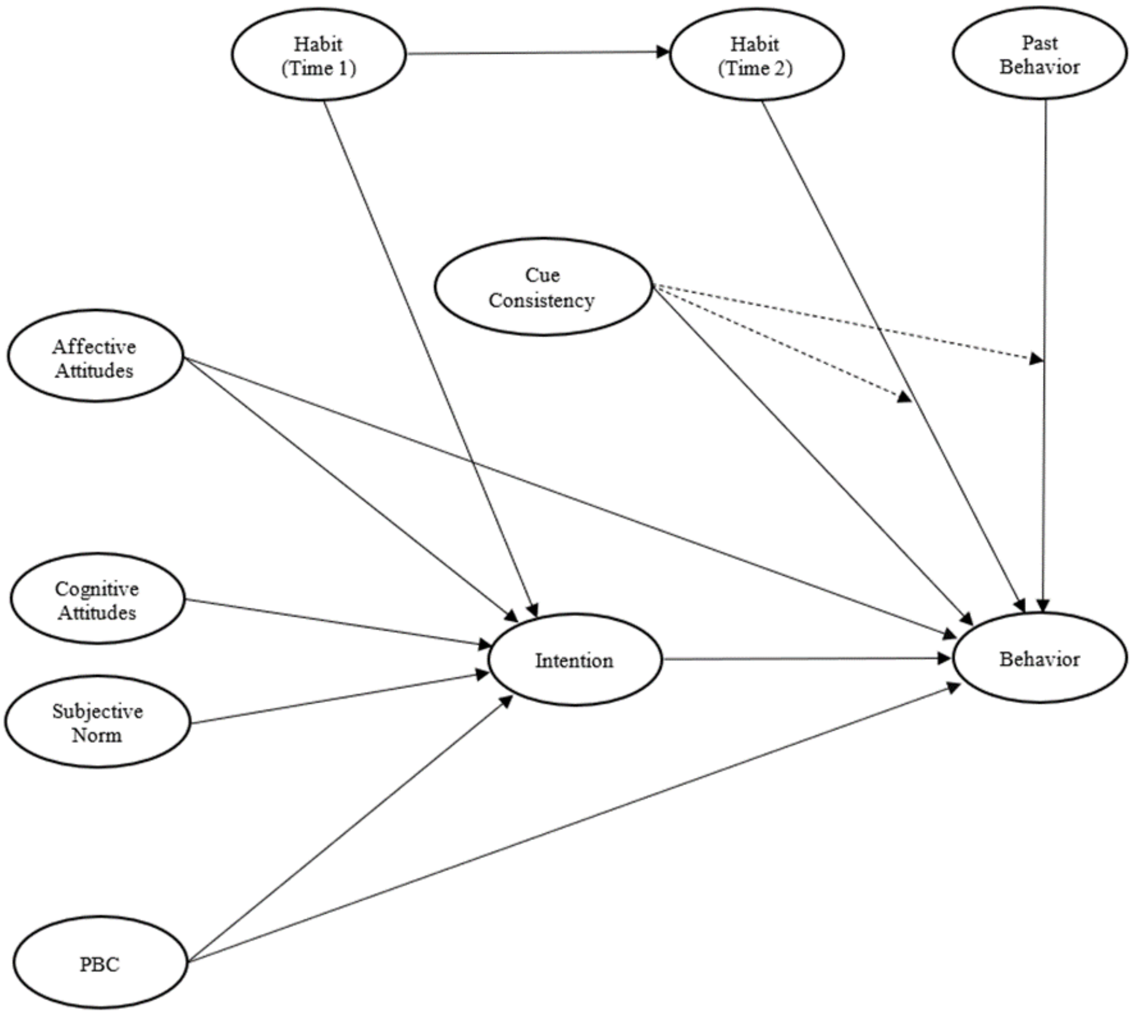

Table 3

Factor Loadings, Reliability Estimates, Average Variances Extracted, and Descriptive Statistics for Model Variables

Construct	FL	CR	AVE	*M*	*SD*	Skew.	Kurt.
Drinking Within Safe Limits							
Affective attitude		.975	.952	5.659	1.423	-1.008	0.470
Item 1	.995						
Item 2	.994						
Item 3	.706						
Cognitive attitude		.922	.856	5.684	1.429	-1.131	0.936
Item 1	.940						
Item 2	.930						
Subjective norm		.906	.620	5.088	1.242	-0.109	-0.930
Item 1	.930						
Item 2	.839						
Item 3	.830						
Item 4	.940						
Item 5	.971						
Perceived behavioral control		.936	.786	6.284	1.018	-1.393	1.007
Item 1	.935						
Item 2	.870						
Item 3	.936						
Item 4	.850						
Intention		.962	.895	5.329	1.771	-0.836	-0.356
Item 1	.987						
Item 2	.978						
Item 3	.993						
Habit (T1)		.965	.872	4.690	1.925	-0.428	-0.960
Item 1	.977						
Item 2	.984						
Item 3	.984						
Item 4	.949						
Habit (T2)		.958	.851	5.007	1.856	-0.458	-1.003
Item 1	.966						
Item 2	.980						
Item 3	.989						
Item 4	.917						
Cue consistency		.944	.738	3.726	1.795	0.110	-0.826
Item 1	.944						
Item 2	.979						
Item 3	.964						
Item 4	.946						
Item 5	.952						
Item 6	.920						
Behavior (T1)		.894	.683	5.202	1.642	-0.705	-0.183
Item 1	.901						
Item 2	.970						
Item 3	.744						
Item 4	.982						

Behavior (T2)		.937	.791	4.520	2.049	-0.222	-1.329
Item 1	.983						
Item 2	.979						
Item 3	.909						
Item 4	.990						
Regular Drinking							
Affective attitude		.930	.815	3.659	1.656	-0.145	-.902
Item 1	.876						
Item 2	.993						
Item 3	.964						
Cognitive attitude		.940	.839	4.176	1.559	-0.537	-.376
Item 1	.988						
Item 2	.991						
Item 3	.991						
Subjective norm		.861	.675	2.919	0.968	0.086	-0.727
Item 1	.966						
Item 2	.946						
Item 3	.901						
Perceived behavioral control		.744	.518	5.599	0.875	-1.083	2.493
Item 1	.975						
Item 2	.658						
Item 3	.974						
Intention		.970	.916	2.961	1.629	-0.500	-0.782
Item 1	.995						
Item 2	.996						
Item 3	.996						
Habit (T1)		.922	.747	2.225	1.153	1.089	1.125
Item 1	.870						
Item 2	.960						
Item 3	.979						
Item 4	.919						
Habit (T2)		.947	.816	2.301	1.289	0.818	-0.443
Item 1	.984						
Item 2	.984						
Item 3	.993						
Item 4	.976						
Cue consistency		.925	.673	4.205	1.406	-0.336	-0.633
Item 1	.910						
Item 2	.984						
Item 3	.980						
Item 4	.964						
Item 5	.947						
Item 6	.948						
Behavior (T1)		.565	.222	4.085	1.520	-.148	-.975
Item 1	.542						
Item 2	.856						
Item 3	.929						
Item 4	.858						
Behavior (T2)		.658	.244	3.759	1.562	-.057	-1.194
Item 1	.613						

Item 2	.864						
Item 3	.916						
Item 4	.943						
Unhealthy Snacking							
Affective attitude		.944	.810	3.755	1.499	0.166	-0.185
Item 1	.974						
Item 2	.985						
Item 3	.948						
Item 4	.992						
Cognitive attitude		.959	.943	6.166	1.093	-1.855	4.367
Item 1	.959						
Item 2	.976						
Item 3	.985						
Item 4	.958						
Subjective norm		.714	.475	4.406	1.254	-0.222	-0.533
Item 1	.826						
Item 2	.870						
Item 3	.568						
Item 4	.548						
Perceived behavioral control		.847	.588	5.923	0.926	-1.123	1.572
Item 1	.805						
Item 2	.928						
Item 3	.905						
Item 4	.966						
Intention		.968	.884	5.121	1.457	-0.808	0.084
Item 1	.987						
Item 2	.991						
Item 3	.973						
Item 4	.986						
Habit (T1)		.953	.835	3.602	1.659	0.340	-0.705
Item 1	.936						
Item 2	.990						
Item 3	.995						
Item 4	.982						
Habit (T2)		.968	.884	3.390	1.723	0.191	-1.069
Item 1	.967						
Item 2	.987						
Item 3	.987						
Item 4	.946						
Cue consistency		.905	.615	3.732	1.428	-0.033	-0.431
Item 1	.913						
Item 2	.876						
Item 3	.957						
Item 4	.926						
Item 5	.962						
Item 6	.918						
Past Behavior		.836	.280	3.165	0.750	0.357	0.388
Item 1	.561						
Item 2	.506						
Item 3	.316						

Item 4	.329						
Item 5	.252						
Item 6	.594						
Item 7	.820						
Item 8	.801						
Item 9	.668						
Item 10	.663						
Item 11	.753						
Item 12	.577						
Item 13	.552						
Item 14	.683						
Behavior (T2)		.822	.320	2.938	0.762	0.464	0.360
Item 1	.761						
Item 2	.754						
Item 3	.484						
Item 4	.507						
Item 5	.680						
Item 6	.513						
Item 7	.825						
Item 8	.704						
Item 9	.737						
Item 10	.598						
Item 11	.708						
Item 12	-.065						
Item 13	.622						
Item 14	.459						

Note. FL = Factor loading of each item on designated factor, coefficients are combined loadings and cross-loadings (oblique-rotated) from partial least squares structural equation model; CR = Composite reliability coefficient from partial least squares structural equation model; AVE= Average variances extracted for factor from partial least squares structural equation model; M = Mean; SD = Standard deviation; Skew. = Skewness estimate; Kurt. = Kurtosis estimate; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.

Table 4

Sample Characteristics at Baseline (T1) and at Follow-Up (T2)

Variable	Baseline (T1)	Followed-up (T2)
Drinking Within Safe Limits Sample		
Participants	250	154
Sex, *n* (%)[a]		
Female	182 (72.8)	111 (72.1)
Male	68 (27.2)	43 (27.9)
Race/ethnicity, *n* (%)[d]		
Caucasian/White	200 (80.3)	118 (77.1)
Indigenous/Torres-Trait Islander	9 (3.6)	4 (2.6)
Asian (South-East Asia/South Asia)	17 (6.8)	13 (8.5)
Pacific Islander	2 (.8)	2 (1.3)
African	4 (1.61)	3 (2)
Other	17 (6.8)	13 (8.5)
No response	1 (.4)	1 (.7)
Regular Drinking Sample		
Participants		224
Sex, *n* (%)[a]		
Female		150 (67)
Male		71 (31.7)
Other		3 (1.3)
Race/ethnicity, *n* (%)[d]		
Caucasian/White		183 (81.7)
Black		3 (1.3)
Asian (South-East Asia/South Asia)		16 (7.1)
Middle Eastern		1 (.4)
Other		15 (6.7)
Latino		6 (2.7)
Unhealthy Snacking Sample		
Participants		184
Sex, *n* (%)[a]		
Female		155 (84.2)
Male		26 (14.1)
Other		3 (1.6)
Race/ethnicity, *n* (%)[d]		
Caucasian/White		152 (82.6)
Black		3 (1.6)
Asian (South-East Asia/South Asia)		13 (7.1)
Middle Eastern		3 (1.6)
Other		11 (6)
Latino		2 (1.1)

Table 5

Items and Response Scales for Study Variables

Variable	Item(s)/measure	Scale/response options
Common measures		
Demographic variables		
Age	What is your age (in years)?	
Sex	What is your sex?	1 = *Male*, 2 = *Female*
Income	What is your approximate household income before tax?	1 = *Nil – $18,200*, 2 = *$18,201 - $37,000*
Race/ethnicity	What is your ethnicity?	1 = Black, 2 = Caucasian/White, 3 = Asian (South-East Asia/South Asia), 4 = Middle-Eastern, 5 = Latin American, 6 = Other
Drinking Within Safe Limits		
Social cognition constructs		
Affective attitude	How likely will the following result if you drank alcohol within safe limits on each individual occasion over the next four weeks?	1 = *Unpleasant*, 7 = *Pleasant* 1 = *Awful*, 7 = *Nice*
Cognitive (instrumental) attitude	How likely will the following result if you drank alcohol within safe limits on each individual occasion over the next four weeks?	1 = *Good*, 7 = *Bad* 1 = *Wise*, 7 = *Unwise*
Subjective norm	Most people who are important to me would approve of me drinking alcohol within safe limits. Most people who are important to me think I should drink alcohol within safe limits. My friends support me to drink alcohol within safe limits. My friends encourage me to drink alcohol within safe limits. My friends drink alcohol within safe limits. My friends think that drinking alcohol within safe limits is a good thing to do.	1 = *Strongly disagree*, 7 = *Strongly agree*
Perceived behavioral control	I have complete control over whether I drink alcohol within safe limits. It is up to me whether I drink alcohol within safe limits. If I wanted to it would be easy for me to drink alcohol within safe limits. I am confident that I could drink alcohol within safe limits. I am confident I can drink alcohol within safe limits on each individual occasion over the next four weeks… …even when others want to me drink. …even when my friends are drinking. …even when I am stressed.	1 = *Strongly disagree*, 7 = *Strongly agree*

	…even when I am at a pub / club / party. …even when my university commitments are low. …even when the alcohol is cheap to buy.	
Intention	In regards to drinking alcohol within safe limits on each individual occasion over the next four weeks, do you agree that... …I will drink alcohol within safe limits. …I intend to drink alcohol within safe limits. …I expect to drink alcohol within safe limits.	1 = *Strongly disagree*, 7 = *Strongly agree*
Habit-related constructs		
Habit	Drinking alcohol within safe limits on each individual occasion is something… …I do automatically …I do without having to consciously remember …I do without thinking …I start doing before I realize I am doing it	1 = *Strongly disagree*, 7 = *Strongly agree*
Cue consistency	Each time I stop drinking alcohol to remain within safe limits... …it is the same time of the day. …I am around the same people. …I do the same type of activity. …I am in the same part of my routine. …I am in the same place. …I am in the same mood.	1 = *Not true at all*, 7 = *Very true*
Behavior measures		
Alcohol behavior	Think about the past four weeks. In general, how often did you drink alcohol within safe limits on each individual occasion? Think about the past four weeks. On average, how often did you drink alcohol within safe limits on the weekend? Think about the past four weeks. On average, how often did you drink alcohol within safe limits on a week day? Think about the past four weeks. In general, to what extent did you did you drink alcohol within safe limits on each individual occasion?	1 = *Never*, 7 = *Always* 1 = *Never*, 7 = *Very often* 1 = *Never*, 7 = *Very often* 1 = *Never*, 7 = *Always*
Regular Drinking		
Social cognition constructs		
Attitude	For me, regularly drinking alcohol in the next two weeks would be…	1 = *Bad*, 7 = *Good* 1 = *Unpleasant*, 7 = *Pleasant* 1 = *Worthless*, 7 = *Valuable*

		1 = *Harmful*, 7 = *Beneficial* 1 = *Displeasing*, 7 = *Enjoyable* 1 = *Boring*, 7 = *Exciting* 1 = *Foolish*, 7 = *Wise*
Subjective norm	Most people who are important to me would approve of me drinking alcohol regularly. Most people whose opinions I value think that I should try to regularly drink alcohol. Most people who are important to me regularly drink alcohol.	1 = *Strongly disagree*, 7 = *Strongly agree*
Perceived behavioral control	It is mostly up to me whether I regularly drink alcohol. I am confident that I can regularly drink alcohol. I have complete control over whether I regularly drink alcohol.	1 = *Strongly disagree*, 7 = *Strongly agree*
Intention	Think about the next two weeks, how much do you agree with the following statements? - It is likely that... …I intend to regularly drink alcohol …I expect I will regularly drink alcohol. …It is likely that I will regularly drink alcohol.	1 = *Strongly disagree*, 7 = *Strongly agree*
Habit-related constructs		
Habit	Drinking alcohol regularly is something I do automatically Drinking alcohol regularly is something I do without having to consciously remember Drinking regularly is something I do without thinking Drinking regularly is something I do before I realize I'm doing it	1 = *Strongly disagree*, 7 = *Strongly agree*
Cue consistency	Each time I start to drink alcohol… …it is the same time of the day. …I am around the same people. …I do the same type of activity. …I am in the same part of my routine. …I am in the same place. …I am in the same mood.	1 = *Not true at all*, 7 = *Very true*
Behavior measures	How often did you engage in regular drinking?	1 = *Never*, 7 = *Extremely often*
	I engaged in regular drinking in the past two weeks.	1 = *Not at all true*, 7 = *Very much true*
	How often do you drink alcohol?	1 = *Never*, 7 = *Extremely often*
Unhealthy Snacking		
Social cognition constructs		

Attitude	Think about the next two weeks. Do you think limiting unhealthy snacks in your daily diet would be...	1 = *Useless*, 7 = *Useful* 1 = *Foolish*, 7 = *Wise* 1 = *Worthless*, 7 = *Valuable* 1 = *Harmful*, 7 = *Beneficial* 1 = *Boring*, 7 = *Entertaining* 1 = *Tiresome*, 7 = *Enjoyable* 1 = *Nasty*, 7 = *Pleasant*
Subjective norm	Most people who are important to me would approve of me limiting unhealthy snacks as part of my daily diet in the next two weeks. Most people whose opinions I value think that I should try to limit unhealthy snacks as part of my daily diet over the next two weeks. Over the past two weeks, most people who are important to me ate unhealthy snacks as part of their daily diet. Over the next two weeks, most people I know will make an effort to limit unhealthy snacks as part of their daily diet	1 = *Strongly disagree*, 7 = *Strongly agree*
Perceived behavioral control	It is mostly up to me whether I limit unhealthy snacks in my daily diet in the next two weeks I am confident that I can limit unhealthy snacks as part of my daily diet over the next two weeks. It would be possible for me to limit unhealthy snacks as part of my daily diet over the next two weeks. I have complete control over whether I eat unhealthy snacks as part of my daily diet in the next two weeks.	1 = *Strongly disagree*, 7 = *Strongly agree*
Intention	How strongly do you agree with the following statements? I intend to limit unhealthy snacks as part of my daily diet in the next two weeks. I expect I will limit unhealthy snacks as part of my daily diet in the next two weeks. It is likely that I will limit unhealthy snacks as part of my daily diet over the next two weeks. I plan to limit unhealthy snacks as part of my daily diet over the next two weeks.	1 = *Strongly disagree*, 7 = *Strongly agree*
Habit-related constructs		
Habit	Eating unhealthy snacks as part of my daily diet is something...	1 = *Completely untrue*, 7 = *Completely true*

	... I do automatically. … I do without having to consciously remember. ... I do without thinking ...I start to do before I realize I'm doing it.	
Cue consistency	Each time I start to eat unhealthy snacks… …it is the same time of the day. …I am around the same people. …I do the same type of activity. …I am in the same part of my routine. …I am in the same place. …I am in the same mood.	1 = *Not true at all*, 7 = *Very true*
Behavior measures		
	Please respond to the following items:	
	Meat pies, sausage rolls and other savoury pastries Pizza Hamburger with bun Cakes, sweets, muffins, pancakes, or pikelers Puddings or desserts Plain biscuits Fancy biscuits including jam or cream filled biscuits, chocolate biscuits, or fruit and nut biscuits Chocolate including chocolate bars Confectionary including lollies and candy Nuts Potato chips or corn chips Other snacks	1 = *Never*, 9 = 4+ times a day

Table 6

Latent Variable Correlations Among Model Variables for Drinking Within Safe Limits

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Sex	1.000										
2. AA	-.063	1.000									
3. CA	.013	.848***	1.000								
4. SN	.078	.359***	.331***	1.000							
5. PBC	.036	.416***	.427***	.363***	1.000						
6. Int.	.084	.336***	.284***	.564***	.216**	1.000					
7. Hab. (T1)	.102	.189*	.087	.469***	.257**	.490***	1.000				
8. Hab. (T2)	-.017	.206*	.152	.395***	.290***	.495***	.524***	1.000			
9. CC	.004	.114	.068	.061	.064	.032	.098	.120	1.000		
10. PB	.020	.318***	.296***	.351***	.220**	.518***	.339***	.431***	.113	1.000	
11. Beh (T2)	-.001	.209**	.240**	.294***	.214**	.390***	.089	.435***	.258	.456***	1.000

Note. Square roots of average variances extracted (AVEs) shown on diagonal; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective Norm; PBC = Perceived behavioral control; Hab. = Habit; PB = Past behavior; Beh = Behavior; CC = Cue consistency; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.
$^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

Table 7

Latent Variable Correlations Among Model Variables for Regular Drinking

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Sex	1.000										
2. AA	.055	1.000									
3. CA	.001	.699***	1.000								
4. SN	-.064	.447***	.448***	1.000							
5. PBC	.019	.125	.108	.000	1.000						
6. Int.	.056	.586***	.477***	.477***	-.061	1.000					
7. Hab. (T1)	.012	.346***	.275***	.335***	-.294**	.559***	1.000				
8. Hab. (T2)	.051	.272***	.215***	.353***	-.191**	.441***	.635***	1.000			
9. CC	.018	.255***	.086	.141*	-.055	.165*	.246***	.367***	1.000		
10. PB	.213**	.188**	.175**	.169*	-.148*	.284***	.360***	.280***	.182**	1.000	
11. Beh (T2)	.084	.305***	.315***	.263***	-.096	.356***	.400***	.393***	.260***	.475***	1.000

Note. Square roots of average variances extracted (AVEs) shown on diagonal; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective Norm; PBC = Perceived behavioral control; Hab. = Habit; PB = Past Behavior; Beh = Behavior; CC = Cue consistency; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.

$^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

Table 8

Latent Variable Correlations Among Model Variables for Unhealthy Snacking Behavior

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Sex	1.000										
2. AA	-.085	1.000									
3. CA	-.033	.295***	1.000								
4. SN	-.071	.214**	.385***	1.000							
5. PBC	.105	.260***	.323***	.037	1.000						
6. Int.	.059	.374***	.531***	.399***	.457***	1.000					
7. Hab. (T1)	-.039	-.111	-.006	.118	-.244***	-.252***	1.000				
8. Hab. (T2)	-.080	-.244***	-.011	.046	-.262***	-.342***	.734***	1.000			
9. CC	-.151*	.017	.136	.112	-.066	.069	.114	.076	1.000		
10. PB	.033	-.201**	-.018	.127	-.252***	-.278***	.504***	.493***	.100	1.000	
11. Beh (T2)	.026	-.234***	-.056	-.012	-.253***	-.310***	.438***	.547***	.074	.699***	1.000

Note. Square roots of average variances extracted (AVEs) shown on diagonal; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective Norm; PBC = Perceived behavioral control; Hab. = Habit; PB = Past behavior; Beh = Behavior; CC = Cue consistency; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.

$^{***}p < .001$ $^{**}p < .01$ $^{*}p < .05$

Table 9

Absolute Differences and Tests of Difference in Standardized Parameter Estimates for Model Effects of Drinking Within Safe Limits and Regular Drinking Behaviors

Effect	β differences	*t*	*df*	*p*	*d*
Direct effect					
AA→Int.	-.217	-2.529	337.027	.002	-.276
CA→Int.	-.002	-0.023	337.027	.981	-.003
SN→Int.	.214	2.494	337.027	.013	.272
PBC→Int.	-.076	-0.886	337.027	.376	-.097
Hab. (T1)→Int.	-.067	-0.781	337.027	.435	-.085
AA→Beh. (T2)	-.144	-1.678	337.027	.094	-.183
PBC→Beh. (T2)	.041	0.478	337.027	.633	.052
Int.→Beh. (T2)	.071	0.828	337.027	.409	.090
Hab. (T2)→Beh. (T2)	.080	0.932	337.027	.352	.102
CC→Beh. (T2)	.026	0.303	337.027	.762	.033
PB→Beh. (T2)	-.065	-0.758	337.027	.449	-.083
Sex→Beh. (T2)	.005	0.058	337.027	.954	.006
Hab. (T1)→Hab. (T2)x	-.140	-1.632	337.027	.104	-.178
Moderator effects					
CC x PB→Beh. (T2)	-.225	-2.622	337.027	.009	-.286
CC x Hab. (T2)→Beh. (T2)	-.027	-0.315	337.027	.753	-.034
Indirect effects					
AA→Int.→Beh. (T2)	-.001	-0.017	333.709	.987	-.002
IA→Int.→Beh. (T2)	.004	0.066	333.709	.947	.007
SN→Int.→Beh. (T2)	.038	0.630	333.709	.529	.069
PBC→Int.→Beh. (T2)	-.009	-0.149	333.709	.881	-.016
Hab. (T1)→Hab. (T2)→Beh. (T2)	.037	0.431	337.027	.667	.047

Note. β = Standardized path coefficient; SE = Standard error; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective Norm; PC = Perceived behavioral control; Hab. = Habit; PB = Past Behavior; Beh. = Behavior; CC = Cue consistency; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.

Table 10

Absolute Differences and Tests of Difference in Standardized Parameter Estimates for Model Effects of Drinking Within Safe Limits and Snacking Behaviors

Effect	β differences	*t*	*df*	*p*	*d*
Direct effect					
AA→Int.	-.015	-0.170	326.580	.866	-.019
CA→Int.	-.241	-2.724	326.580	.007	-.302
SN→Int.	.121	1.368	326.580	.172	.151
PBC→Int.	-.343	-3.878	326.580	.000	-.429
Hab. (T1)→Int.	.500	5.652	326.580	.000	.626
AA→Beh. (T2)	.032	0.362	326.580	.718	.040
PBC→Beh. (T2)	.043	0.486	326.580	.627	.054
Int.→Beh. (T2)	.213	2.408	326.580	.017	.266
Hab. (T2)→Beh. (T2)	-.005	-0.057	326.580	.955	-.006
CC→Beh. (T2)	.179	2.024	326.580	.044	.224
PB→Beh. (T2)	-.319	-3.606	326.580	.000	-.399
Sex→Beh. (T2)	-.023	-0.260	326.580	.795	-.029
Hab. (T1)→Hab. (T2)x	-.239	-2.702	326.580	.007	-.299
Moderator effects					
CC x PB→Beh. (T2)	-.008	-0.090	326.580	.928	-.010
CC x Hab. (T2)→Beh. (T2)	.014	0.158	326.580	.874	.018
Indirect effects					
AA→Int.→Beh. (T2)	.027	0.429	327.892	.668	.047
IA→Int.→Beh. (T2)	.036	0.572	327.892	.568	.063
SN→Int.→Beh. (T2)	.072	1.143	327.892	.254	.126
PBC→Int.→Beh. (T2)	.017	0.270	327.892	.787	.030
Hab. (T1)→Hab. (T2)→Beh. (T2)	-.043	-0.486	326.580	.627	-.054

Note. β = Standardized path coefficient; SE = Standard error; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective Norm; PC = Perceived behavioral control; Hab. = Habit; PB = Past Behavior; Beh. = Behavior; CC = Cue consistency; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.

Table 11

Absolute Differences and Tests of Difference in Standardized Parameter Estimates for Model Effects of Snacking and Regular Drinking Behavior

Effect	β differences	*t*	*df*	*p*	*d*
Direct effect					
AA→Int.	-.202	-2.461	394.827	.014	-.248
CA→Int.	.239	2.912	394.827	.004	.293
SN→Int.	.093	1.133	394.827	.258	.114
PBC→Int.	.267	3.253	394.827	.001	.327
Hab. (T1)→Int.	-.567	-6.908	394.827	.000	-.695
AA→Beh. (T2)	-.176	-2.144	394.827	.033	-2.16
PBC→Beh. (T2)	-.002	-0.024	394.827	.981	-.002
Int.→Beh. (T2)	-.142	-1.730	394.827	.084	-.174
Hab. (T2)→Beh. (T2)	.085	1.036	394.827	.301	.104
CC→Beh. (T2)	-.153	-1.864	394.827	.063	-.188
PB→Beh. (T2)	.254	3.095	394.827	.002	.312
Sex→Beh. (T2)	.028	0.341	394.827	.733	.034
Hab. (T1)→Hab. (T2)x	.099	1.206	394.827	.228	.121
Moderator effects					
CC x PB→Beh. (T2)	-.217	-2.644	394.827	.009	-.266
CC x Hab. (T2)→Beh. (T2)	-.041	-0.500	394.827	.618	-.050
Indirect effects					
AA→Int.→Beh. (T2)	-.028	-0.482	390.860	.630	-.049
IA→Int.→Beh. (T2)	-.032	-0.551	390.860	.582	-.056
SN→Int.→Beh. (T2)	-.034	-0.586	390.860	.558	-.059
PBC→Int.→Beh. (T2)	-.026	-0.448	390.860	.654	-.045
Hab. (T1)→Hab. (T2)→Beh. (T2)	.080	0.975	394.827	.330	.098

Note. β = Standardized path coefficient; SE = Standard error; AA = Affective attitude; Int. = Intention; CA = Cognitive (instrumental) attitude; SN = Subjective Norm; PC = Perceived behavioral control; Hab. = Habit; PB = Past Behavior; Beh. = Behavior; CC = Cue consistency; T1 = Variable measured at the first data collection occasion; T2 = Data collected at the second data collection occasion.