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Predicting alcohol consumption: Application of an integrated social cognition model of intentions, habits, and cue consistency

Danielle Simpson-Rojas[1] | **Daniel J. Phipps**[2,3] | **Kailas Jenkins**[3] | **Lena Fleig**[4] | **Martin S. Hagger**[1,2,3,5] | **Kyra Hamilton**[1,2,3,5]

[1]Department of Psychological Sciences, University of California, Merced, California, USA

[2]Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, Finland

[3]School of Applied Psychology, Griffith University, Mount Gravatt, Queensland, Australia

[4]Medical School Berlin, Berlin, Germany

[5]Health Sciences Research Institute, University of California, Merced, California, USA

Correspondence
Kyra Hamilton, Department of Applied Psychology, Griffith University, Mount Gravatt Campus, 176 Messines Ridge Rd., Mount Gravatt, QLD 4122, Australia.
Email: kyra.hamilton@griffith.edu.au

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Abstract

Drinking alcohol in excess is associated with deleterious health outcomes, highlighting the need for research to identify potentially modifiable correlates of excessive alcohol consumption to target in behavioral interventions. The present two-wave prospective correlational study applied an integrated theoretical model that included theory of planned behavior constructs alongside habit, cue consistency, affective attitudes, and past behavior as predictors of two alcohol-related behaviors, drinking within safe limits and regular alcohol drinking, in separate samples of Australian undergraduate students (total $N = 474$). Structural equation models identified direct effects of habit, affective attitude, and subjective norms on intention for both behaviors. Habit at follow-up, cue consistency, and past behavior directly predicted behavior in both samples, whereas intention predicted behavior only for drinking within safe limits, and affective attitude only predicted behavior for regular drinking. Cue consistency moderated the effects of habit on behavior for both behaviors and moderated the effect of past behavior on 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 defining characteristic of habit, as a moderator of habit and past behavior effects an integrated theory test.

KEYWORDS

affective attitudes, cue-behavior association, habitual behavior, health behavior theory, motivational theory

INTRODUCTION

Consuming alcohol in excess has been frequently flagged as a leading contributor to ill health worldwide (WHO, 2018), particularly dependent and risky single-session ("binge drinking") consumption patterns. As part of the global strategy to address the prevalence of deleterious alcohol-related health effects, the World Health Organization has published a draft action plan outlining worldwide goals for the reduction of alcohol consumption. In an Australian context, these goals are reflected in the national alcohol strategy, which presents a nationwide goal to achieve a 10% reduction in population-level alcohol consumption by 2026 (NHMRC, 2009). Despite these strategies and other public health efforts to stem excessive alcohol consumption patterns, a substantive proportion of the population exceeds published, evidence-based guideline limits on alcohol consumption intake recommendations, both in terms of overall levels of consumption and the frequency of risky patterns of alcohol consumption such as binge drinking (Australian Bureau of Statistics, 2022).

These risky patterns of alcohol consumption are particularly prevalent in undergraduate students, with studies indicating that nearly half of Australian university undergraduates report engaging in problematic alcohol use in the past month (Hallett et al., 2012). Further, there is considerable research literature on the consequences of excessive drinking among university students. The university context has been identified as one in which risky patterns of drinking are normative with indications of high peer pressure, implicit advocacy by student-run clubs and societies, and initiation rituals featuring excessive alcohol consumption (Larimer et al., 2004; McCabe et al., 2005). These patterns of alcohol consumption are associated with multiple deleterious health and social outcomes including impaired academic performance, increased risk of injury, sexual assault, overdose, blackouts, and changes in brain function and cognitive deficits (Hart & Burns, 2016). As a consequence, significant resources have been directed toward identifying the underlying drivers of excess alcohol intake in Australia and the global context, particularly with the aim of identifying modifiable behavioral determinants for behavior change interventions purposed to reduce alcohol consumption.

One key theoretical approach that has been applied to identify the determinants of health behavior, including excessive alcohol consumption patterns, is the theory of planned behavior (TPB, Ajzen, 1991). The TPB is a social cognition approach that focuses on beliefs with respect to future behavior engagement as the key determinants of behavior and, consistent with the broad social cognition approach, assumes individuals' decisions to engage in the *target* behavior of interest occur through reasoned deliberation of the merits and detriments of performing the behavior in future. A central prediction of the TPB is that an individual's stated intention with respect to their further performance of the behavior is its most proximal determinant. Intention is proposed

to be a function of three sets of belief-based constructs: attitude, an individual's beliefs in the utility of performing the target behavior in future; subjective norm, an individual's belief that salient others will approve or disapprove of their future performance of the behavior; and perceived behavioral control, an individual's belief in their capacity to perform the behavior in future. The TPB has demonstrated efficacy in accounting for variance in intentions and behavior in multiple health contexts and populations (see McEachan et al., 2011), including alcohol-related behaviors such as overall alcohol consumption and binge drinking (Cooke et al., 2007).

Although TPB predictions have been for the most part 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). That is, 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., Hagger, 2025). 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 relatively costly and time-consuming process (e.g., Gerrard et al., 2008; Sheeran et al., 2013; Wood, 2017). Instead, many behaviors are enacted through more automatic, non-conscious processes that rely on associative information stored in memory developed through prior experience. This has led to calls for existing social cognition theories including the TPB to be modified to include constructs that capture or represent these non-conscious processes and predict behavior directly rather than through the proposed intention-mediated mechanism.

A prominent example of such an extension to the theory and, in common with other social cognition theories (e.g., Hagger, 2025) stems from the distinction between *instrumental* and *affective* attitude components (Ajzen et al., 2007; Conner et al., 2015). Although the instrumental component reflects beliefs regarding the utility of a given health behavior in producing outcomes (e.g., consuming alcohol is unhealthy), the affective component reflects anticipated emotional outcomes that result from performing the behavior (e.g., consuming alcohol to feel good). Researchers exploring the effects of these conceptually distinct attitude components have identified that effects of the instrumental component on behavior tend to be intention mediated, whereas effects of the affective component tend to be stronger with a substantive direct effect on behavior unmediated by intention (Hagger et al., 2018; McEachan et al., 2016; Phipps, Hannan, et al., 2021; Phipps, Rhodes, et al., 2022). This is consistent with theories suggesting that affective attitudes reflect more impulsive, less reasoned behavioral enactment particularly when the behavior is expected to be affectively gratifying (Conner et al., 2015). Direct effects of anticipated emotions are, therefore, a reflection of expectations that the behavior leads to positive or negative affect and have been developed through associative learning or reinforcement. Affective attitudes may be a particularly pertinent behavioral determinant in the case of alcohol consumption, particularly for patterns like binge drinking, which are inherently gratifying and likely to be associated with positive anticipated affective responses by regular social drinkers.

Beyond the direct effects of these affective evaluations, another prominent construct representative of non-conscious determinants of health behavior is habit. Prior research has tended to use past behavior as a proxy for habit effects in social cognition theories like the TPB based on the premise that repetition of behavior is a primary means by which individuals develop habits (e.g., Ouellette & Wood, 1998; Phipps, Hannan, & Hamilton, 2022). 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 (McEachan et al., 2011; 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; Ajzen et al., 2007; Hagger et al., 2018).

However, contemporary research has conceptualized habit as a psychological construct defined as a behavior response enacted automatically 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; Wood & Rünger, 2016). Accordingly, researchers have developed measures aimed at capturing the essential components of habit such as those that capture the experience of behaviors as automatic, low effort, lacking in thought, and enacted quickly and efficiently (Gardner et al., 2012; Verplanken & Orbell, 2003); accessibility and rapid enactment (e.g., Verplanken et al., 1994); or frequent performance covarying with context or cue consistency (e.g., Wood & Neal, 2009). Research incorporating these measures in tests of the TPB have demonstrated direct effects of habit on behavior, independent of intentions (Hamilton et al., 2017; Jenkins et al., 2023; Kaushal & Rhodes, 2015; Phipps et al., 2023). 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; Phipps et al., 2020; 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; Hagger et al., 2023). Thus, habits may also predict intention, but it should be acknowledged that this is likely an artifact of measurement. In the context of alcohol consumption, research applying augmented versions of the TPB that encompass habit as an additional predictor has indicated that habits serve as a key direct predictor of binge drinking (Hamilton et al., 2020), independent of intentions, although there are also indirect belief and past-behavior mediated effects, consistent with prior research in other health behavior contexts (Brown et al., 2020). These findings indicate that the expected patterns of habit effects seem to hold in research applying the TPB modified to include the habit construct and add value in accounting for variance in this behavior.

A further important step in elucidating the processes underpinning behavioral enactment is the identification of environmental or within-person conditions that may serve to exacerbate or diminish the strength of effects of intentional or non-conscious processes on behavior. In the context of habitual as compared with intentional behavior, a defining characteristic of the habit construct is that it reflects performing the behavior in the presence of stable and consistent cues (Hagger, 2020; Wood & Neal, 2007). That is, once a behavior has been formed as a habit through its repetition in the presence of cues, encountering the cues again in the future should be sufficient to automatically activate the associated patterns of actions that contribute to enacting the behavior again (Gardner, 2012; Hagger, 2020). This has been reflected in measures that infer habit as the product of behavioral frequency and the consistency of the covarying environmental or social conditions in which it is performed (Wood & Neal, 2009). For habitual behaviors, therefore, it follows that past behavior effects on subsequent behavior should be maximized when enacted in highly stable conditions. Extrapolating this prediction, it would not be unreasonable to predict that habit, captured by some measures as behavioral automaticity (e.g., Gardner et al., 2012), may

be more likely to predict behavior in the presence of other key components of habit, such as cue consistency (e.g., the performance of the behavior at the same time or place).

In such cases, the effects of habit captured as behavioral automaticity on a given target behavior should be larger when the cues to the behavior are experienced consistently (Pimm et al., 2016; Sas et al., 2023). Such a finding would indicate the value of augmenting typical habit measures such as self-reported behavioral automaticity with measures of cue consistency, which not only incorporates an additional key component of habit but also examines the interactive role such cues play in magnifying or diminishing habit–behavior effects. This effect represents a key prediction derived from habit theory, which although it is rarely tested (e.g., Norman & Cooper, 2011; Phipps et al., 2024; Pimm et al., 2016) is important because it highlights the salience of context stability, here represented by cue consistency, on the habit–behavior relationship. This is a defining characteristic of habitual behavior and suggests that measures of habit should consider encompassing cue consistency (Grove et al., 2014; Sniehotta & Presseau, 2012).

The present study

In the current study, we aimed to test the efficacy of a novel integrated theoretical model based on the TPB in predicting two alcohol consumption behaviors: drinking alcohol within safe limits and regular alcohol drinking. Specifically, the TPB was augmented to include two constructs representative of non-conscious, automatic processes that may be implicated in the performance of these alcohol consumption behaviors beyond the reasoned processes represented by the TPB belief-based constructs: affective attitude and habit as self-reported behavioral automaticity. Alongside these additional constructs, we also included past behavior as an additional predictor as a variable that may encompass additional unmeasured constructs that represent non-conscious processes including other components of habit beyond automaticity (e.g., experiencing behavior as enacted rapidly and efficiently, and with little effort and thought). The inclusion of past behavior is also important to provide an indication of theory sufficiency—Ajzen (1991) predicted that the theory constructs should account for unique variance in behavior beyond behavioral consistency, modeled by past behavior effects; otherwise, the theory would be rendered redundant as an account of intentional behavior. In addition, and uniquely, we also included cue consistency as an additional predictor of behavior in the model in recognition that it is not only components of habit such as experienced automaticity and consistency of cues that are central defining characteristics of habit as a construct but also the interaction of the two. We tested the predictions of our integrated model in studies in two samples each focused on one of the target alcohol-related behaviors. The studies adopted a prospective design in which the TPB and additional constructs were measured on an initial occasion (baseline), with behavior, habit, and cue consistency measures administered on a subsequent (follow-up) occasion.

In terms of the specific predictions, we expected that prospectively measured alcohol use behaviors would be directly predicted by perceived behavioral control and intention, consistent with the original conceptualization of the TPB, but also by affective attitude, habit at follow-up, cue consistency, and past behavior. In addition, we predicted that affective and instrumental attitudes, subjective norms, perceived behavioral control, and habit at baseline would predict intention, with indirect intention-mediated effects of these constructs on behavior. Further, in keeping with habit theory, we predicted that cue consistency would moderate the effects of past behavior and habit on behavior, such that the effects of habit and past behavior on alcohol use

would be larger in those who reported that the cues to the behavior occurred with high consistency. Our prediction that cue consistency would interact with both habit measured as behavioral automaticity and past behavior in predicting these alcohol behaviors was based on the assumption that our habit measure captured only one component of the habit, experienced automaticity, and that past behavior effects likely capture other unmeasured habit components (e.g., rapidness and efficiency and lack of effort and thought), both of which would be cue dependent. Further, experience of behavioral frequency is a further component of habit, and its interaction with cue consistency is a definition of one prominent measure of habit (see Hagger et al., 2023; Wood & Neal, 2009). Finally, for completion, we also tested the moderating effect of habit on the intention–behavior relationship. Consistent with prior research (e.g., Gardner et al., 2020; Triandis, 1977), we expected the effect of intention on behavior to be smaller in those reporting stronger habits. A summary of all hypotheses is presented in Table 1.

TABLE 1 Summary of hypothesized direct and indirect effects of the integrated model predicting alcohol-related intention and behavior.

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 × Past behavior	Behavior (T2)	
H_{15}	Cue consistency × Habit (T2)	Behavior (T2)	
H_{16}	Intention × Habit (T2)	Behavior (T2)	
Indirect effects			
H_{17}	Affective attitude	Behavior (T2)	Intention
H_{18}	Instrumental attitude	Behavior (T2)	Intention
H_{19}	Subjective norms	Behavior (T2)	Intention
H_{20}	Perceived behavioral control	Behavior (T2)	Intention
H_{21}	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.

The value of this research is that it may assist in identifying key determinants of alcohol consumption, and the associated direct, mediating, and moderating effects of these variables, in keeping with augmented versions of the TPB and habit theory. Beyond providing important information on theory development and the processes involved, the current research is important for those interested in reducing alcohol consumption through the development and delivery of individual interventions because it may signal potentially modifiable constructs that may be targeted by behavior change techniques that could form the content of such interventions.

METHOD

Participants and procedure

Participants in the current study were two samples of undergraduate students who completed measures referring to one of the two target behaviors: drinking alcohol within safe limits ($N = 154$, M age $= 19.96$, 72% female) and regularly drinking alcohol ($N = 224$, 67% female). We screened students eligible to participate in the study against our inclusion criteria; those who were pregnant or reported not drinking alcohol were excluded. Participants completed an informed consent form prior to proceeding to the initial online survey. Participants were presented with a passage defining the target behavior prior to completing study measures. To assist participants' comprehension of our reference measure of alcohol consumption (a "standard drink"), participants were also presented with a standard drinks chart based on Australian national guidelines (e.g., one standard drink was equated to 10 g of alcohol) as a guide and asked to refer to it when estimating their behavior. Participants then completed study measures comprising social cognition constructs (instrumental and affective attitude, perceived behavioral control, subjective norms), intention, habit, and past behavior. Participants were subsequently contacted by email to participate in the follow-up survey and presented with measures of the targeted behavior, cue consistency, and habit 4 and 2 weeks after the initial survey for the drinking in safe limits and regular drinking samples, respectively. Additional demographic details of the samples and attrition rates across the two data collection occasions are presented in Appendix A in the Supporting Information. All procedures were approved by the Griffith University Human Research Ethics Committee.

Measures

Participants completed self-report measures of all study constructs with responses provided on scales with multiple response options. All measures are available in full in Appendix B in the Supporting Information.

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 ..." and "Regularly drinking alcohol over the next two weeks would be ...") followed by two bipolar adjectives for

affective attitudes (*unpleasant-pleasant*; *awful-nice*) and two bipolar adjectives for instrumental 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" and "People who are important to me would approve of me drinking alcohol regularly"). 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" and "It is up to me whether I drink alcohol regularly"). 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" and "I intend to drink alcohol regularly"). 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 ..." and "Each time I start to drink alcohol ...") 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 (Gardner et al., 2012; Verplanken & Orbell, 2003). Participants were asked to self-report the extent to which they experienced the target behavior as automatic and unthinking on four items (e.g., "Drinking alcohol within safe limits is something I do automatically" and "Drinking alcohol regularly is something I do automatically") with responses provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*).

Behavior

Drinking within safe limits was defined for participants as refraining from drinking no more than two standard drinks on any day and ensuring that they did not drink more than four standard drinks 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 4 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 defined as consuming more than 10 standard drinks within a given week. Drinking alcohol regularly was measured using a timeline follow-back method in which participants self-report the number of drinks consumed each night in the past 7 days (Sobell & Sobell, 1992).

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. 8.0 software (Kock, 2014). The "stable1" method was used to compute parameter estimates and standard errors, which yields estimates that approximate to bootstrapped estimates but are more robust to deviations from the normal distribution or the effects outliers. Each construct in the proposed model was a latent variable with proposed relationships among them set as free parameters. Sex was included as a covariate in the model for each sample. Model fit and quality

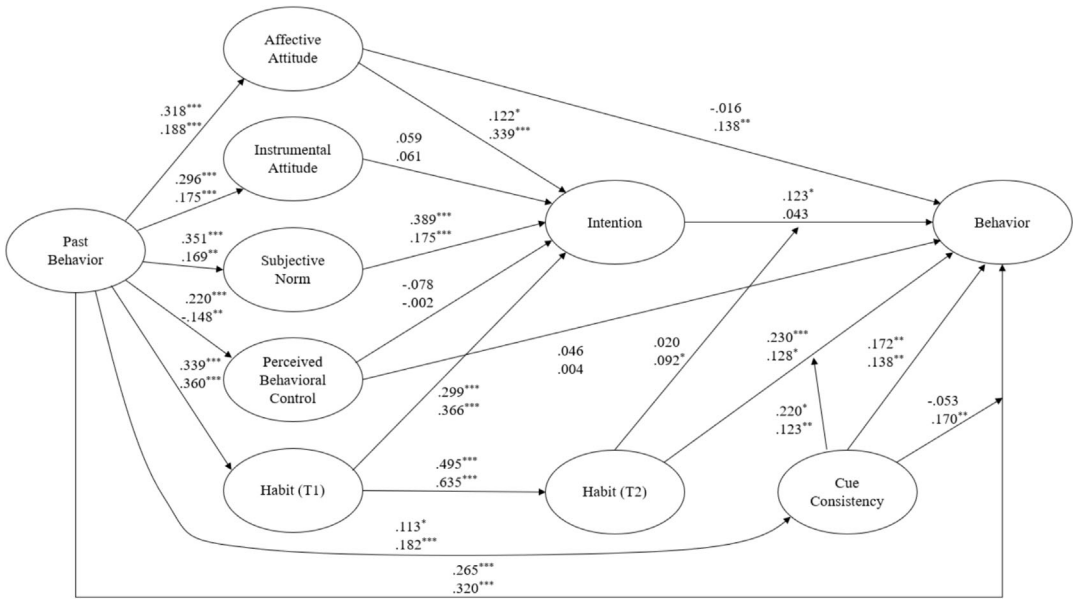

FIGURE 1 Proposed integrated social cognition model predicting drinking alcohol within safe limits and regular alcohol drinking behaviors. Note: Parameter estimates on the top row refer to the model estimated for the drinking within safe limits behavior, whereas the estimates on the lower row refer to the model estimates for the regular drinking behavior. *$p < .05$, **$p < .01$, ***$p < .001$.

were assessed using the Goodness of Fit index (acceptable if >.25, assuming medium-sized effects), the average variable inflation factor (acceptable if <3.30), and the Simpsons paradox ratio, statistical suppression ratio, and R^2 contribution ratio (all acceptable if >.70; Kock, 2018).

RESULTS

Model quality and fit indices were adequate in samples targeting drinking alcohol within safe limits (GoF = 0.376; AFVIF = 1.924; AVIF = 1.678; SPR = 0.864; SSR = 0.955; RSCR = 0.986) and regular alcohol drinking (GoF = 0.363; AFVIF = 1.97; AVIF = 1.453; SPR = 0.909; SSR = 1.00; RSCR = 0.999) behaviors. The model accounted for a substantial proportion of the variance in each behavior (R^2 drinking within safe limits = .389; R^2 regular drinking = .336). Standardized parameter estimates and associated effect sizes are presented in Table 2. We found non-zero effects of past behavior on all the TPB constructs and on baseline habit in the model for both behaviors. In addition, we found non-zero effects of affective attitude, baseline habit, and subjective norms on intention in the models for both behaviors. By contrast, zero was a viable value for the effects of instrumental attitude or perceived behavioral control on intention for the model for both behaviors. The effect of intention on behavior for the model for drinking within safe limits was non-zero, whereas the same effect for the model for regular drinking was no different from zero. Intention-mediated indirect effects of study constructs measured at baseline on behavior were also no different from zero for the model for both behaviors. Past behavior, habit, and cue consistency all displayed non-zero effects on alcohol behaviors for the model in each behavior. Further, cue consistency moderated the effect of follow-up automaticity on behavior for both models, such that the effect of automaticity on behavior was larger in the presence of stable cues. Similarly, the effect of past behavior was larger under conditions of consistent drinking cues for the model for regular drinking, although this effect was not observed for the model for drinking within safe limits. Finally, we observed a small but statistically significant moderating effect of habit on the intention–behavior relationship in the regular drinking sample, such that intentions had slightly stronger effects on behavior in those who reported stronger drinking habits. However, this effect was not observed in the drinking within safe limits sample. Zero-order correlations among all study variables and drinking behavior are presented in Table 3.

DISCUSSION

We tested the efficacy of a novel integrated theoretical model to predict two alcohol-related behaviors, drinking alcohol within safe limits and regular alcohol drinking, in two independent samples of Australian undergraduate students. Our model included TPB constructs, the effects of which were proposed to represent the reasoned, deliberative processes proposed to precede behavioral engagement, alongside measures of habit, cue consistency, and past behavior, the effects of which were proposed to represent the non-conscious processes involved in behavioral engagement. Model tests were conducted in a study adopting correlational prospective designs with theory-based constructs taken at an initial occasion (baseline) and measures of habit, cue consistency, and behavior taken on a second occasion (follow-up), 2 and 4 weeks later. Structural equation models identified non-zero effects of affective attitude, subjective norms, and habit on intention, and non-zero effects of intention, habit, cue consistency, and past

TABLE 2 Standardized parameter estimates for effects in the models predicting safe drinking and regular drinking.

	Safe drinking			Regular drinking		
Effect	β	p	f^2	β	p	f^2
Direct effects						
Past behavior→affective attitude	.318	<.001	.101	.188	<.001	.035
Past behavior→instrumental attitude	.296	<.001	.088	.175	<.001	.031
Past behavior→subjective norm	.351	<.001	.123	.169	.001	.028
Past behavior→perceived behavioral control	.220	<.001	.048	−.148	<.001	.022
Past behavior→habit (T1)	.339	<.001	.115	.360	.004	.130
Past behavior→cue consistency	.113	.042	.013	.182	<.001	.033
Past behavior→behavior	.265	<.001	.121	.320	<.001	.152
Affective attitude→intention	.122	.031	.041	.339	<.001	.199
Instrumental attitude→intention	.059	.181	.017	.061	.138	.029
Subjective norm→intention	.389	<.001	.219	.175	<.001	.084
Perceived behavioral control→intention	−.078	.115	.017	−.002	.485	.000
Habit (T1) → intention	.299	<.001	.147	.366	<.001	.205
Habit (T1) → habit (T2)	.495	<.001	.245	.635	<.001	.404
Affective attitude→behavior	−.016	.405	.003	.138	.007	.042
Perceived behavioral control→behavior	.046	.240	.010	.004	.469	.000
Intention→behavior	.123	.030	.048	.043	.221	.015
Habit (T2)→behavior	.230	<.001	.100	.128	.011	.050
Cue consistency→behavior	.172	.004	.044	.138	.007	.036
Habit (T2) × Cue consistency→behavior	.110	.046	.015	.123	.014	.023
Past behavior × Cue consistency→behavior	−.053	.205	.002	.170	.001	.046
Habit (T2) × Intention	.020	.378	.001	.092	.050	.027
Gender→behavior	−.013	.422	.000	−.023	.341	.002
Indirect and total effects						
Affective attitude→intention→behavior	.015	.372	.003	.015	.356	.004
Instrumental attitude→intention→behavior	.007	.437	.002	.003	.474	.001
Subjective norm→intention→behavior	.048	.150	.014	.008	.424	.002
Perceived behavioral control→intention→behavior	−.010	.417	.002	.000	.499	.000
Affective attitude (total)→behavior	−.001	.496	.000	.152	.003	.047
Perceived behavioral control (total)→behavior	.036	.288	.008	.004	.485	.000
Habit (T1) (total)→behavior	.151	.011	.013	.097	.041	.039
Past behavior (indirect total)→behavior	.097	.068	.044	.090	.054	.043
Past behavior (total)→behavior	.362	<.001	.165	.410	<.001	.194

Note: T1 = construct or variable measured at the first data collection occasion; T2 = construct or variable measured at the second data collection occasion.

TABLE 3 Zero-order correlations between theory of planned behavior variables, habit variables, and drinking behavior.

	1	2	3	4	5	6	7	8	9	10	11
1. Gender	-	−.025	.064	−.019	−.078	−.035	−.084	−.106	.019	−.001	.011
2. Past behavior	.224***	-	.309***	.291***	.334***	.218**	.500***	.317***	.417***	.100	.449***
3. Affective attitude	.056	.248***	-	.839	.362***	.417***	.355***	.190*	.209**	.118	.198*
4. Instrumental attitude	.000	.202**	.703***	-	.332***	.425***	.302***	.085	.149	.070	.229**
5. Subjective norm	−.067	.239***	.449***	.442***	-	.368***	.569***	.471***	.393***	.062	.285***
6. Perceived behavioral control	.019	−.030	.310***	.273***	.160*	-	.217**	.260**	.289***	.063	.208**
7. Intention	.056	.419***	.587***	.476***	.471***	.135*	-	.487***	.524***	.050	.358***
8. Baseline habit	.008	.504***	.351***	.276***	.338***	−.086	.571***	-	.495***	.095	.072
9. Follow-up habit	.051	.381***	.273***	.216**	.352***	−.060	.443***	.635***	-	.124	.423***
10. Cue consistency	.022	.224***	.253***	.087	.147*	.029	.164*	.253***	.369***	-	.256**
11. Behavior	.125	.561***	.307***	.309***	.249***	−.033	.372***	.434***	.428***	.238***	-

Note: Parameter estimates above the diagonal refer to the drinking within safe limits model, whereas estimates below the diagonal refer to the regular drinking sample.
*$p < .05$, **$p < .01$, and ***$p < .001$.

behavior on behavior in the model estimated for both behaviors in these samples of Australian undergraduate students. Further, cue consistency moderated the effect of habit on behavior for the model in both behaviors and also moderated the effect of past behavior on regular drinking, but not drinking within safe limits.

Consistent with theory and previous evidence (Gardner & Tang, 2014; Hamilton et al., 2017; Phipps et al., 2020; Pimm et al., 2016), the current study indicates the value of habit-based constructs such as habit and cue consistency as unique, direct predictors of these alcohol-related behaviors in these samples of Australian undergraduates. Further, in line with habit theory, cue consistency moderated the effects of habit on behavior for both behaviors and the effect of past behavior on future behavior in the regular drinking sample. These findings corroborate a central tenant of habit theory: that the automatic enactment of a behavior should be more likely in the presence of stable conditions, represented here by the stability of cues or triggers likely to line up these alcohol behaviors (Hagger, 2020; Wood & Neal, 2009). The assessment of cue consistency as a moderator of the effects of measures of the habit construct provides a novel test of this aspect of the theory. Similarly, the moderating effect of cue consistency on the past behavior–behavior relationship augments prior theory and research in which habitual behavior conceptualized as developing through frequent behavioral performance under stable conditions, as well as other components of habit that were not captured by our habit measures, represented as a frequency × stability multiplicative composite (Gardner, 2015; Wood & Neal, 2009). Our findings, therefore, support the theoretical implication that frequency of prior behavioral performance is a better predictor of subsequent behavioral performance when the cues likely to line up the behavior consistently coincide with its performance.

From a practical perspective, these findings may provide a signal of the constructs and associated processes that may inform the development of behavior change interventions aimed at promoting drinking within safe limits and curbing regular drinking. Specifically, our findings indicated that drinking alcohol regularly tended to be controlled by automatic processes, which singles-out habit, and the associated cues that line up habit, as potential constructs that may be targeted in interventions. Researchers have suggested numerous techniques to disrupt habits. In particular, techniques that facilitate alteration of cue presentation and, therefore, reducing their salience may be one of the most potent based on our finding that habit effects are dependent on cue consistency. However, we note that these findings only offer some initial guidance of practical possibilities—the current findings need further verification in research purposed to test causal effects, such as through the manipulation of habits or cues, prior to the issuance of more definitive recommendations.

Current findings also highlight the value of adopting an integrated approach to examining the correlates of behavior beyond the belief-based constructs from the TPB, as both habit and cue consistency predicted each behavior. Importantly, effect sizes for these constructs were substantively larger than those for intention, which exhibited only small-sized effects, and this effect was notably no different from zero for the model for regular drinking behavior in these samples of Australian students. These findings were somewhat surprising in the context of previous research adopting an integrated approach, which have often found simultaneous effects of intention, habit-based constructs, and past behavior on behavior (Hamilton et al., 2017; Kaushal & Rhodes, 2015; Phipps et al., 2020). However, even in situations where intention and habit simultaneously predict behavior in group-level model tests, it is unlikely that behavioral enactment at an individual level is simultaneously governed by conscious and non-conscious processes. Instead, a likely interpretation of these simultaneous effects is that different processes drive behavioral enactment for segments of the population studied (Hagger

et al., 2022). Thus, in the context of these samples of Australian undergraduates, the small effects of intention relative to effects of habit likely indicate that, for a notable portion of the sampled population, these alcohol behaviors are largely governed by automatic, non-conscious processes.

However, although intention displayed only small-sized effects in the context of alcohol consumption behaviors in these samples of Australian undergraduates, it is vital to note that early occurrences of health behaviors such as these are likely driven by volitional processes and only develop as habitual behaviors over time through repetition in the presence of stable cues (Wood et al., 2014). As a result, these students' intentions are likely to be congruent with their prior experience and habits. This is evidenced in the current research, as we observed medium-sized zero-order correlations between habit and intention in both samples. Thus, the small effects of intention in our model tests should not be interpreted as evidence that intention is an unimportant predictor of behavior. Rather, it is likely that intention effects are attenuated and, therefore, accounted for by automaticity once the behavior has been developed as a habit (Hagger et al., 2023; Ouellette & Wood, 1998).

The findings for the intention in these student samples imply that intervention strategies targeting change in the beliefs implicated in intention formation should not be disregarded for students for whom a habit has yet to be formed. This may be particularly important for the behavior of drinking alcohol within safe limits behavior given the residual effect of intention. Such techniques may, for example, target change in the sample-specific salient beliefs likely to inform intentions in this sample using persuasive communication techniques (e.g., messages targeting the salient advantages of keeping alcohol within safe limits—being able to study more effectively, not having a hangover the next day). As before, these suggestions should be considered in light of the caveat that these data are correlational and would need further corroboration in study designs that permit better causal inference before definitive practical recommendations can be made.

We observed a small but statistically significant moderation effect of habit on the intention–behavior relationship in the regular drinking sample, such that the effects of intention were stronger in those who reported regular drinking as habitual. From the weight of previous habit literature, one might expect the opposite effect, such that as a behavior is developed as a habit, smaller effects of intention on behavior should be observed (Gardner et al., 2020). However, it is also noted in habit theory that the strength and direction of this moderating effect are likely dependent on behavior-specific factors (Gardner et al., 2020). For example, in the current context, this divergence may be viewed as congruent with other theories of automatic behavior such as the APE or MODE models (Fazio, 1990; Gawronski & Bodenhausen, 2006), where aligned intentions and automatic processes may act synergistically to enhance the likelihood of behavioral enactment. For example, in the current context of the regular drinking sample, habits may reinforce the intention–behavior relationship because individuals draw from their perceived past regular actions and their features (e.g., their efficiency, lack of effort, and ease of enactment) when inferring their intentions, as Bem's (1972) self-perception theory suggests (Gardner et al., 2024). However, there may be occasions where the interactive effect may not be synergistic—that is, the moderating role of habit on the intention–behavior relationship may be negative or downward, as observed in many studies (see Hagger et al., 2023). In such cases, individuals who form habits mean that their intentions become less relevant to behavioral prediction, particularly when individuals have formed the behavior as a habit and no longer have to invest much cognitive effort or deliberation to perform the behavior, which may particularly be the case for simple behaviors such as toothbrushing or taking medication.

The modest effects of intention on the alcohol consumption behaviors identified in the students in the current study notwithstanding, the potential effects of constructs representing more reasoned processes that line up behaviors through the mediation of intentions should not be dismissed entirely. Accordingly, it would be remiss not to note affective attitude and subjective norm as the sole salient predictors of these students' intentions with respect to both behaviors, with modest effects that were indistinguishable from zero for instrumental attitude and perceived behavioral control. The prominent effects of subjective norms, in particular, mirrors similar findings identified in previous studies on alcohol-related behaviors. This is consistent with previous evidence on the pervasive effect of normative influences that tend to advocate excessive drinking or discourage moderation, particularly in university samples (Lorant et al., 2013; Neighbors et al., 2007). Similarly, the effect of affective attitude on alcohol use intentions is in line with evidence linking alcohol use to emotion-based expectations (Elliott & Ainsworth, 2012), such as feelings regarding pleasant taste or sensations when drinking, or the perception that avoiding binge drinking would result in feelings of boredom (Atkinson et al., 2023). These anticipated affective reactions may, therefore, inform intentions with respect to reducing their alcohol behavior but only contribute to explaining modest variance in behavior in these samples and for these alcohol consumption behaviors.

In contrast to our expectations, however, affective attitude only exhibited modest direct effects on these students' alcohol-related behaviors. Such a finding is in contrast to the theory that affective attitudes should represent impulsive processes that impact behavior and, therefore, should be implicated in alcohol-related behaviors that tend to be affectively rewarding and reinforcing (Conner et al., 2015). Evidence that alcohol-related behaviors are associated with measures of implicit attitudes or automatically activated affective responses independent of self-reported explicit attitudes or anticipated affective responses, similar to the affective attitudes measure used here (Hamilton et al., 2023; Payne et al., 2008; Phipps, Hagger, & Hamilton, 2021; Wiers et al., 2002), may point to these types of measures and affective constructs as more effective in modeling effects of affective responses (Gawronski et al., 2006). Thus, although affective attitudes were expected to impact behavior directly, it may be that self-reported affective attitudes are unable to fully tap the facet of affect that accounts for impulsive affect-driven actions that occur beyond intentions. It should also be noted that one of the current behaviors, drinking alcohol consumption within safe limits, is one that is less likely to be rewarding. Such limiting behaviors require students to actively monitor and moderate their alcohol consumption, which is more effortful and thus probably entails more reasoning. This may have contributed to the null effect identified for affective attitudes in the model estimated for this behavior in these student samples.

Strengths, limitations, and avenues for future research

The current study has several notable strengths: the adoption of an integrated theoretical approach that included constructs representing two key processes that are proposed to be related to behavioral enactment: social cognition constructs and habit, past behavior, and affective attitude; testing of the proposed integrated model in two separate samples of undergraduate students; 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 these data and their generalizability.

First, as we adopted a correlational prospective design, such designs preclude the inference of causal effects such that the direction in the proposed model effects is based solely on theory, not the data. This is an inherent limitation of research adopting correlational designs, and therefore, the current research should only signal potential associations of the direction and causal nature of which is implied through theory alone and are in need of verification in subsequent research. This issue is of particular concern when testing theory-based effects of constructs such as habit that are likely generated through repetition in the face of stable cues. Resolution lies in studies adopting longitudinal, cross-lagged panel designs that permit explicit modeling of temporal and intraindividual stability so as to isolate variance in effects over time attributable to true stability in individuals' perceptions constructs while controlling for other artifacts of change that may affect the effects. Further, adoption of experimental or intervention designs in which key constructs in the model (e.g., habit formation) could be manipulated or changed via change techniques or strategies (e.g., persuasive communication, prompting practices) are needed, and their effects on alcohol consumption intentions and behavior tested. Furthermore, lag in time between initial and follow-up measures varied across our two samples, which may have contributed additional variance in cross-sample comparisons of model effects. For consistency, future studies should adopt the follow-up period when comparing findings across multiple samples to control for this methodological artifact.

Second, although we tested the proposed effects in our models in multiple samples, both comprised undergraduate students in an Australian context. Although the alcohol-related behaviors targeted here are supremely relevant to this population and in this national context, as numerous studies have highlighted (Gill, 2002; Heather et al., 2011), we acknowledge that undergraduate students represent a homogenous group, particularly those in an Australian university context, and the exclusive focus on samples drawn from this population means that current findings cannot be generalized to the wider population. Related to this, our samples were neither randomly selected nor stratified according to the socio-demographic profile of the population. This precludes generalizability of the current findings to broader undergraduate university student samples, even within the Australian context. We look to future research that tests the current hypotheses in samples that are more representative of the student population at large.

Third, although we did not identify indirect effects of habit on this alcohol behavior in our current samples, we did observe non-zero zero-order correlations between habit and intention with medium-sized effects. Such correlations have been observed in multiple studies (Hagger et al., 2023) and would be expected as habitual behaviors most likely started out as goal-directed behaviors for which individuals had strong, stable intentions leading to the kinds of consistent practice in stable contexts that give rise to habits. As a consequence, when later prompted to report whether they intend to perform a behavior, individuals for which the behavior has formed as a habit are likely to indicate that they do intend to do so, regardless of whether the behavior itself is enacted habitually (see Wood & Rünger, 2016).

However, the association also reflects the tendency for individuals to draw, explicitly or implicitly, from their prior experiences when estimating their intentions such that habits serve an informational function. This is consistent with the predictions of social cognition theories that effects of constructs that reflect environmental (e.g., resource availability), intra-individual (e.g., personality), and experiential (e.g., past behavior and habit) factors on behavior should be mediated by the sets of belief-based constructs (e.g., attitudes, subjective norms, and perceived behavioral control) that line up behavior and intention (Hagger, 2025). This would imply an indirect effect of habit on behavior mediated by intention, hence our hypothesis in the current

study. It may also be the case that habit–intention correlations are partly attributable to common method variance associated with the use of self-report methods, which may inflate the associations. Regardless of the perspective adopted, it is important to note that expressing the habit–intention effect as a directional effect in our model consistent with the aforementioned conceptual basis, or as a correlation (actually, an error covariance) as an alternative perspective, would have no consequences for the size and pattern of effects elsewhere as they are statistically equivalent. However, as outlined previously, the proposed directional effect for habit on intention in our model is indicated conceptually, but not verified by our correlational data, and would need verification in studies adopting alternative designs that would permit directional and causal inferences.

Finally, the current study relied exclusively on self-report measures, particularly behavioral measures. Although the behavior measures used have reasonable evidence for their validity (Dollinger & Malmquist, 2009; Modecki et al., 2022; Sobell et al., 1996), there remains a possibility that results were affected by biases such as common method variance, acquiescence bias, response order bias, social desirability bias, and recall bias. Replication of current findings in studies adopting non-self-report measures of behavior is, therefore, warranted, which would enable comparisons with the current findings to assess the level of congruence. This may be of particular importance for the drinking alcohol regularly sample—our timeline follow-back measure targeted the frequency of occasions on which participants consumed over 10 standard drinks, which is only suggestive of overall alcohol consumption. Future studies making similar comparisons across keeping drinking within limits and regular drinking behaviors should include measures of overall alcohol consumption as a covariate.

CONCLUSION

In the present study, we applied a unique integrated theoretical model that encompassed constructs representing two key processes to identify the correlates of two alcohol behaviors: drinking within safe limits and regular drinking, 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, the inclusion of which was purposed to represent the non-conscious processes that lead to behavior. The goal was to develop a more comprehensive description of the correlates of these alcohol-related behaviors, particularly the extent to which constructs representing deliberative and non-conscious processes contributed decision-making and behavioral enactment. Results highlighted the importance of habit and past behavior as key predictors of these behaviors, with a comparatively modest role for intentions. Importantly, cue consistency moderated the habit–behavior relationship in both samples and the past behavior–behavior relationship in the regular drinking sample. This is consistent with a central tenet of habit theory that individuals are more likely to act in accordance with their prior experience when the cues in their environment are consistent. Findings contribute to a growing body of evidence indicating the importance of habitual processes in the enactment on health behavior and provide potential formative evidence to catalyze research on the effects of habit-forming interventions on subsequent behavior.

CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

Open materials and data: All research materials, data files, and analysis scripts and output are available open access on a permanent online repository: https://osf.io/m3ycw/

ETHICS STATEMENT

All procedures were approved by the Griffith University Human Research Ethics Committee.

ORCID

Daniel J. Phipps https://orcid.org/0000-0002-0217-0578
Kailas Jenkins https://orcid.org/0000-0002-7233-7775

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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