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## Examining daily variability in willingness to drink in relation to underage young adult alcohol use

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### Abstract

A key component of the Prototype Willingness Model is willingness, which reflects an openness to opportunity to perform a behavior in situations that are conducive to that behavior. Willingness has traditionally been tested using global, hypothetical assessments, and has not been examined at the daily level. We expected to find within-person variability in willingness to drink, such that on days with greater willingness, individuals would report greater drinking. A national sample ( $N = 288$ ) of young adults aged 18 to 20 (31.60% female) completed a Web-based survey that was comprised of measures of drinking and sexual behavior, including the Timeline Follow-Back (Sobell & Sobell, 1992). Findings show daily variability in willingness to drink ( $ICC = 0.54$ ), which suggests that there are substantial differences from day-to-day in this drinking-related cognition. Participants drank more on days when individuals also reported feeling more willing to drink than their own average level across the two weeks. Daily process level mechanisms allow greater insight into factors contributing to increased risk in-the-moment, which may point to targets for interventions aimed at improving adolescents' and young adults' abilities to make healthier choices in moments when they may be at greater risk for engaging in risky behaviors.

### Keywords

Prototype Willingness Model; Young adults; Alcohol use; Willingness to drink

## 1. Introduction

Alcohol use is a public health concern that often initiates during adolescence and young adulthood (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2014; Substance Abuse and Mental Health Services Administration (SAMHSA), 2014). Because adolescents and young adults experience alcohol-related consequences (White, Macinnes, Hingson, & Pan, 2013), testing models with a focus on drinking during this developmental period is of critical importance. This study will provide the first daily-level test of the effects of willingness to drink on alcohol use among underage young adults (age 18–20), which will enhance our knowledge of a critical pathway in the Prototype Willingness Model (PWM; Gibbons, Gerrard, & Lane, 2003).

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Dual-processing models posit two different modes of information processing in decision making: one that is based on heuristics and one that is based on more analytic reasoning (e.g., Chaiken & Trope, 1999; Cosmides & Tooby, 2000; Epstein, 1973). Like most dual-process models, the PWM suggests that the reasoned and social reaction processes can, and often do, operate simultaneously (Gibbons et al., 2003). Thus, the PWM may improve prediction of adolescent and young adult health-risk outcomes more than other models as it addresses intentional behavior as well as volitional behavior that is reactive to risk-conducive situations (i.e., circumstances that facilitate but do not require or demand risky behaviors) involving social situations and peers. The PWM assumes two pathways to health risk (see Fig. 1, Gibbons et al., 2003). The reasoned pathway relies on reasoned processing as seen in the Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975; i.e., based on intentions, which vary as a function of attitudes and injunctive norms). Intentions are goals that are formulated after deliberation. The social reaction pathway relies on willingness, which varies as a function of perceived vulnerability, descriptive norms, and prototypes. Willingness reflects an openness to opportunity to perform a behavior in situations that are conducive to that behavior (Gibbons et al., 2003; Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008). It is important to note that although there may appear to be conceptual overlap among model components, these variables have been demonstrated to only influence particular pathways – i.e., reasoned or social pathway (Gibbons et al., 2003; Hukkelberg & Dykstra, 2009). For example, the model (and pathways within the model) have been tested numerous times and support the notion that intentions and willingness are unique constructs and have differential impact on behavior (Gibbons, Gerrard, Blanton, & Russell, 1998; Gerrard et al., 2008). The present study extends prior work with the PWM, specifically with the social reaction pathway, to more fully understand the relationships between willingness in predicting drinking by examining associations between willingness and alcohol use at the daily level.

The predictive utility and validity of the PWM has been well supported, with research showing that components of the social reaction pathway explain additional variance above reasoned pathway components (or traditional pathways of the TRA) when examining substance use, including alcohol, among both adolescent and young adult samples (e.g., Gerrard, Gibbons, Gano, & Vande Lune, 2005; Gibbons et al., 1998; Gibbons et al., 2004; Ravis, Sheeran, & Armitage, 2006; Litt et al., 2014; Pomery, Gibbons, Reis-Bergan, & Gerrard, 2009; Spijkerman, van den Eijnden, Vitale, & Engels, 2004; Zimmermann & Sieverding, 2010). Thus, research has demonstrated the predictive utility of the PWM, across both pathways, both cross-sectionally and longitudinally. However, this research establishes the need for a more refined examination of the model. Examining the PWM, or pathways within the model, at the daily level may further enhance the predictive utility of the PWM given the ability to examine characteristics of natural drinking environments and increase its potential to develop or refine interventions.

### **1.1. Need to examine the Prototype Willingness Model at the daily level**

Central to the PWM, social reactions to risk-conducive situations are captured by willingness, defined as an openness to risk opportunity, and measured by questions about what individuals would be willing to do in hypothetical situations. Because research on the

PWM focuses largely on the global, hypothetical assessment of willingness, little is known about whether willingness translates to naturally occurring drinking situations or how this relates to behavior on individual occasions. Hypothetical scenarios do not allow for the examination of variability in willingness that results from real-world contexts, as well as from variability in willingness due to fluctuations in perceived vulnerability, descriptive norms, and prototypes. Because the PWM suggests that drinking is a reaction to risk-conducive circumstances, the proposed study extends research by assessing willingness using Timeline Follow Back (TLFB) methodology to examine naturally occurring within-person variation in willingness and the association with drinking at the daily level aligning more directly with the theoretical basis of the PWM. Based on the social reaction pathway of the PWM, we expect on days with greater willingness, individuals will report a greater likelihood and amount of drinking.

## 1.2. The present study

The purpose of the present study was to empirically test the utility of the social reaction pathway of the PWM (i.e., willingness to drink to drinking behavior) in the prediction of drinking behavior at the daily level. Specifically, we expected on days with greater willingness, individuals will be both more likely to drink and to drink more. Moreover, we expected to observe individual differences in this association, such that this connection would be stronger in some individuals than others.

## 2. Materials and methods

### 2.1. Participants and procedures

Participants for this study were recruited nationally through various methods and asked to complete a brief, five-minute web-based screening survey to determine if they met inclusion criteria for a one-time web-based survey. Please see Fig. 2 for participant recruitment flow chart. Recruitment methods included online recruiting (e.g., Facebook, Craigslist, Amazon Mechanical Turk), advertisements in-print, flyers, participant referrals, and in-person recruiting. A majority of participants in the final sample ( $N = 1038$ ) were recruited via online methods (61.66% Craigslist, 7.13% Facebook), 5.69% were recruited via advertisements and flyers, 22.45% from participant referrals, and the remaining 3.95% were recruited via other methods (e.g., [Researchmatch.org](https://www.researchmatch.org)).

After learning about the study through one of the recruitment methods, participants logged into the brief, web-based screening survey. In the screening survey participants were presented with an information statement, and those who consented to participate were routed to the screening assessment. Participants were informed that if the study was right for them, they would be contacted by study staff to receive more information and to verify their eligibility. If they were eligible after the phone call, and wished to participate, they would be invited to complete a 30–45 min survey. Participants were then informed they would receive a \$25 gift certificate for completing the 30–45 min survey, and would also be entered in a drawing to win an Apple iPad or \$100 gift card. A Federal Certificate of Confidentiality was obtained to help ensure privacy of research participants. All study procedures were approved by the University's Institutional Review Board, and no adverse events were reported.

From the various recruitment methods, 5470 people completed the online screening survey. Eligibility criteria for the full study were: age 18–20, provide a birthdate consistent with the age provided, currently reside in the United States, provide a valid email address, correctly answer the check questions (select 4 for what is 2 + 2, and select the color green), provide a valid phone number, and provide a first and last name. Half (51%,  $n = 2803$ ) of those who completed the online screening survey were eligible based on this initial screening. Once the individual was initially screened, a research project staff member called the person to complete a telephone screening in which we verified the information provided in the online screening or eligibility survey before being invited to complete the baseline survey.

The telephone screening was completed by 79% ( $n = 2217$ ) of the individuals identified as eligible by the online screening, and after the telephone screening 1145 were invited to complete the baseline survey. To ensure a diverse sample, we stratified by gender, education level, and race/ethnicity. As a result, the primary reason that people were not invited to complete the baseline survey was that the quota, based on demographic information, had already been met (854 people). In addition, individuals were deemed ineligible for being duplicates (71 people) or for staff not being able to verify the information provided in the screening survey (147 people), and 20 people declined participation at the telephone screening.

Of the 1145 individuals who were invited to complete the online baseline survey, 1038 (91%) completed the survey and were included in the final sample. For the present study, we included the Timeline Followback two-thirds of the way through study recruitment, thus data are available for 288 participants. For those who completed the TLFB and were included in the present study, the mean age at baseline was 19.03 years old ( $SD = 0.81$ ). Gender and racial representation of the sample was 31.60% female, 11.46% Asian, 23.26% African American, 46.88% White, 2.43% American Indian/Alaska Native, 1.74% Native Hawaiian/Pacific Islander, and 13.89% Other/Mixed. For ethnicity, 23.61% identified as Hispanic. For current education status, 29.86% were not in any form of school with 22.09% of these participants indicating attending at least some college. Of the analytic sample, 32.99% were attending a 4-year university, 27.78% were attending a community college, 3.47% were attending a technical/vocational college, 0.35% were attending a graduate/professional school, and 0.69% were in high school. Approximately 5.21% of participants indicated having a post-secondary degree.

## 2.2. Measures

*Demographic characteristics* were entered as covariates and included: biological sex ( $0 =$  women,  $1 =$  male), age at time of survey, and educational status (coded as  $0 =$  not currently in postsecondary education,  $1 =$  currently in postsecondary education).

**Timeline Follow-Back**—Participants were asked to complete a modified version of the Timeline Follow-Back (TLFB; Sobell & Sobell, 2000; Quinlan, Goldstein, & Stewart, 2014) with respect to their alcohol use for each day in the prior two weeks (i.e., past 14 days). For each TLFB day, participants reported whether they were sad, angry or stressed during the drinking occasion.

**Number of drinks**—Participants were asked to indicate how many drinks they consumed for each day in the last two weeks. Definitions for standard drinks containing alcohol were included in TLFB instructions (i.e., 5 oz. of wine; 12 oz. of beer (10 oz. of Microbrew; 8 oz. of Malt Liquor, Canadian beer or Ice beer; 6 oz. of Ice Malt Liquor); 10 oz. of wine cooler; 1 1/4 oz. of 100 proof liquor or 1/2 oz. of 80 proof liquor).

**Willingness**—For each day, participants were asked to report how willing they were to drink on each day of the two weeks. Instructions asked participants to indicate how willing he/she was to drink alcohol on each day regardless of whether or not he/she actually consumed alcohol. Response ranged from 0 = not at all willing to 6 = extremely willing.

### 2.3. Analytic strategy

We tested our hypotheses using multi-level modeling (MLM) approach in SPSS 19.0 using maximum likelihood (ML) estimation. Multilevel models (also referred to as hierarchical linear models or HLM) are a powerful and flexible class of models that allow for the analysis of non-independent data. Because the current sample utilized daily diary data, and thus had participants missing data at each day, MLM was well suited as an analytic approach because it estimates parameters using the available Level 1 data (i.e. repeated observations of persons across days) and does not require all Level 2 observations (i.e. participants) to have identical or balanced observations at Level 1 (Raudenbush & Bryk, 2002; Snijders, 2011). Differences between nested models were tested with  $-2 \log$  likelihood testing. Because the alcohol data were heavily zero-inflated and skewed, we explored using multilevel zero-inflated negative binomial models in MPlus 6.1 to properly account for the distribution of the data. However, these models frequently failed to converge, particularly when attempting to model both zero-inflated count outcomes and random intercepts and slopes. Thus, we used separate models in SPSS 19.0 to predict whether or not an individual drank, from daily reports of willingness, and another model (using only days with non-zero drinking) to predict how much individuals drank on drinking days from willingness.

Daily reports of willingness reflect both between person differences (i.e. average levels of willingness) and within-person differences (i.e. daily deviations from that average). To isolate between and within person effects, we used a combination of centering within cluster at Level 1 and grand-mean centering at level 2 (Enders & Tofighi, 2007), which perfectly separates variation in a given predictor into within and between person variability, producing two scores which are perfectly un-correlated ( $r = 0.00$ ). Centering within cluster (CWC), is achieved by subtracting a participant-level mean across observations from each participant's score at each time point. This provides a time-specific score that only reflects within person variance, and observations at each time point essentially becomes a deviation score, representing that person's deviation *from their own average* at that time point. Throughout the results, we will refer to these CWC scores as “daily” willingness. Participant's mean scores across observations may be grand-mean-centered (GMC) by subtracting each participant's mean from the sample average of all participant means. Throughout the results, we will refer to these GMC scores as “average” willingness. We tested for random effects for all Level 1 predictors, and tested cross-level interactions between the CWC and GMC predictors, which tested whether the effects of daily predictors depends on the person's

average level of that variable. As an example, the multilevel equations for predicting daily alcohol use from willingness was as follows:

$$\text{Level 1: } \text{Alcohol}_{ij} = b_{0j} + b_{1j} \text{Weekend}_i + b_{2j} \left( \text{Willingness}_{ij} - \bar{x} \text{Willingness}_j \right) + r_{ij} \quad (1)$$

$$\text{Level 2: } b_{0j} = \gamma_{00} + \gamma_{01} \left( \bar{x} \text{Willingness}_j \right) + u_{0j} \quad (2)$$

$$b_{1j} = \gamma_{10} + u_{1j} \quad (3)$$

$$b_{2j} = \gamma_{20} + \gamma_{21} \left( \bar{x} \text{Willingness}_j \right) + u_{2j} \quad (4)$$

At Level 1, drinks on a given day are predicted by  $b_{0j}$  = the participants's level of alcohol use when all predictors are at zero (i.e. weekdays at average willingness) and ( $b_{2j}$ ) the effects of daily deviations ( $\text{Willingness}_{ij} - \bar{x} \text{Willingness}_j$ ) from a participants' average levels of willingness on that day. At Level 2, daily drinking and the effects of daily deviations in willingness are predicted by between-person differences ( $\bar{x} \text{Willingness}_j$ ) in average willingness over time.

We covaried biological sex, age, education, sexual orientation, and weekend/weekday, and tested all covariate by predictor interactions to ensure independence of effects. We also explored whether co-varying for participants' self-reported mood during the drinking occasion (angry, sad or stressed) changed the current effects. Very few participants endorsed these moods (ranging from 2.2% to 5.3% of all occasions), and controlling for them did not alter the main effects reported below. Thus, we excluded mood from the final models. We examined model residuals for normality and influential outliers, and used BIC, AIC and  $-2$  log likelihood to determine the optimally fitting models.

### 3. Results

#### 3.1. Descriptive statistics

On average, participants reported 0.76 drinks consumed over the span of 0.80 h each day, although there was significantly more drinking on the weekend relative to the weekdays (1.84 vs. 0.33,  $t(3926) = -19.695$ ,  $p < 0.001$ ) (Table 1). Participants reported drinking on 18.9% of days, and drank an average of 4.19 drinks ( $SD = 3.76$ ) over 2.91 h ( $SD = 2.26$ ) on those drinking days.

### 3.2. Daily variability in drinking and willingness to drink

Across the 14 day diary period, there was significant between person variability in the number of drinks reported, with the ICC = 0.21, indicating that 21% of the daily variability in alcohol use was accounted for by between person differences in drinking. Similarly, there was significant between person variability in willingness to drink (ICC = 0.54), but also day-to-day variability in participants' level of willingness. To understand what influences between person variability, we first predicted daily reports of willingness.

### 3.3. Predicting drinking from willingness

First, we tested whether daily and average willingness to drink were associated with whether or not participants reported drinking on each day, above and beyond the effects of weekdays vs. weekends (OR = 0.31, 95% CI 0.21–0.45) and the other covariates (age, sex, mood, and college enrollment). Participants who were more willing to drink on average across the study period were more likely to report drinking days (OR = 3.91, 95% CI = 3.08–4.96), and reporting a higher-than-usual level of willingness was also associated with a higher likelihood of drinking days (OR = 6.03, 95% CI = 4.79–7.58) (Table 2). The daily effects of willingness also varied across participants ( $SD = 0.60$ ,  $p < 0.001$ ). Finally, there was an interaction between the average and daily effects of willingness: the effects of willingness on drinking were stronger for those who were more willing to drink on average (OR = 0.71, 95% CI = 0.61–0.83). A 1  $SD$  increase in average willingness increased the effects of daily willingness on alcohol, such that those who were generally willing to drink *and* more willing to drink than usual on a given day had the highest odds of alcohol use (see Fig. 3).

We next tested whether between and within person variability in willingness was associated with the number of drinks on drinking days. A similar pattern emerged. The effects of daily willingness to drink varied across individuals ( $SD = 0.76$ ,  $p < 0.001$ ). Above and beyond the covariates, both daily ( $b = 0.87$ , 95% CI = 0.66–1.09) and average ( $b = 0.66$ , 95% CI = 0.27–0.73) willingness were associated with the amount of drinking on drinking days. Both the CWC ( $b = 0.27$ , 95% CI = 0.02–0.53) and GMC ( $b = 0.49$ , 95% CI = 0.23–0.74) effects, however, were moderated by weekend/weekday, indicating that a higher-than-usual willingness to drink and being generally more willing to drink more strongly predicted the number of drinks consumed on weekends relative to weekdays. There was no interaction between daily and average willingness on number of drinks on drinking days.

## 4. Discussion and conclusions

The present study has important theoretical implications for the PWM and health-risk behavior decision-making as it provides evidence that measuring willingness at a hypothetical and global level as is commonly done in this literature (Gerrard et al., 2008; Gibbons et al., 2003) may not accurately capture the complexity of this specific risk-related cognition. Research on the PWM states that willingness is based on a reactive, context-sensitive decision-making process, and yet no study to date has specifically tested whether there were intra-individual differences in willingness, nor inter-individual differences in the association between willingness and drinking. Although some research indicates anticipated consequences of alcohol consumption are associated with daily changes in cognitions—

specifically, changes in the anticipated consequences of alcohol consumption (Wall, McKee, & Hinson, 2000; Wall, Hinson, McKee, & Goldstein, 2001), this is the first study to examine willingness to drink at the daily level. The present work allows for greater insight into factors contributing to increased daily-level drinking based on theoretically important drinking cognitions. As expected, results indicate that there is daily variability in self-reported willingness to drink, which suggests that there are substantial differences from day-to-day in this drinking-related cognition.

Although there are studies using priming that demonstrate that the mere exposure to risk-inductive cues can increase associated risk cognitions and behavior (Bartholow & Heinz, 2006; Harris, Brownell, & Bargh, 2009; Roberts, Gibbons, Kingsbury, & Gerrard, 2014), little is known about actual real-life daily variations in risk-conducive situations and how they impact risk cognitions. As such, the present study is an important first step in understanding how risk cognitions such as behavioral willingness are sensitive to daily changes in context. The current study indicated that the effects of daily variations in willingness to drink on actual drinking were associated with both the likelihood and amount of alcohol use, and that these effects varied across individuals. Moreover, there was an interaction between the average and daily effects of willingness on the likelihood, but not level, of alcohol use: the effects of willingness on drinking were stronger for those who were more willing to drink on average. This suggests that being more willing to consume alcohol generally may put one at risk for experiencing even greater willingness to drink on specific occasions than individuals who are generally less willing. Alternately, the effects of daily willingness on the level, but not likelihood, of alcohol use were stronger on weekends versus weekdays. This indicates that these daily variations in willingness were not an artifact of being generally more willing to drink on weekends than weekdays, and that their influence may depend on temporal or contextual factors that facilitate greater alcohol use. Given the retrospective nature of the data, some recall bias (i.e. people recall being more willing to drink on days they drank) is likely. However, that general willingness and weekend/weekday explain inter-individual differences in the daily association between willingness and alcohol use suggest that the observed effects are also systematically explainable by other variables.

In addition to making important theoretical advancements, the present study also provides support for interventions aimed at improving adolescents' and young adults' abilities to make healthier choices in moments when they may be at greater risk for engaging in unsafe or risky behaviors based on their daily level of willingness. Given that the present study showed variations in willingness to drink, interventions should focus on highlighting situations in which individuals report greater willingness to drink and providing possible behavioral strategies they can use to avoid these situations or can use if they find themselves in these situations to minimize harm. In addition, the present study may also inform treatment efforts that help individuals identify maladaptive cognitions (willingness to drink) that are likely to prompt risky behavior both at the general and daily level. Further, the present study is a first step at determining in which situations cognitions best predict alcohol use and related negative consequences, which tells us under what contexts the PWM, and namely willingness, are more predictive of behavior, which ultimately can inform prevention.



Although the present study adds significantly to our understanding of daily-level cognitions for alcohol use, it is not without limitations. First, the present study assessed daily level constructs, including willingness and alcohol use, using a retrospective TLFB. While the use of TLFB for alcohol use has been shown to be valid (e.g., Sobell, Brown, Leo, & Sobell, 1996; Sobell & Sobell, 1992), use with cognitions has been limited and caution should be warranted in reviewing the results, particularly as willingness and drinking were reported after the fact across two weeks. For example, it could be that participant willingness may be altered or misremembered by a function of engaging in drinking on that same occasion. As such, to address issues of measurement and participant recall, future research should continue to examine daily-level variation using EMA and multiple assessments of daily and other risk cognitions. EMA data may further enhance the predictive utility of the PWM given the ability to examine characteristics of natural drinking environments and increase its potential to develop or refine interventions. In addition, the present study consisted of only 18–20 year olds who were 33.6% women, which is a limited age range and inclusion of biological sex. Future work should look at these daily level processes in different age groups as well as samples more equally inclusive of both biological sexes. Examining these processes as the daily level and developmentally over time can lead to a better understanding of how willingness might change throughout adolescence and young adulthood, which could lead to important implications regarding timing of preventative interventions. The present study was also limited in that it only examined the pathway from willingness to alcohol use. Future research is needed to examine the full PWM with EMA data. It is important to examine variation in perceived vulnerability, prototypes, and descriptive norms in predicating willingness. In sum, the present research is an important first step in better understanding day-to-day variability in willingness, an important risk-related cognition among young adults.

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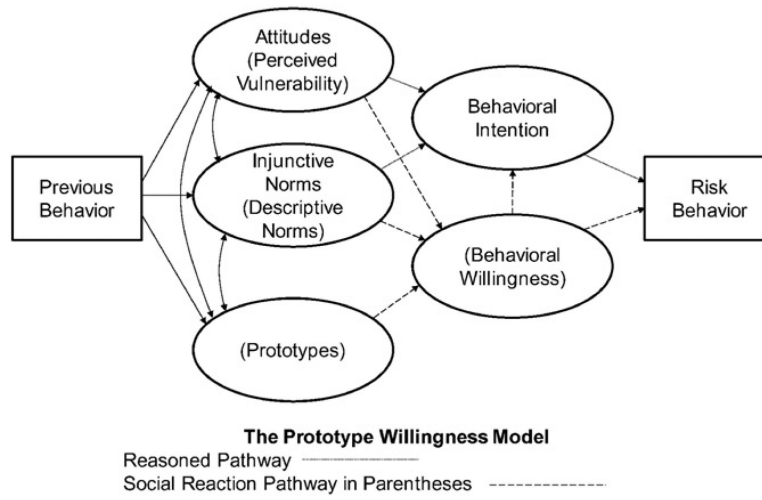
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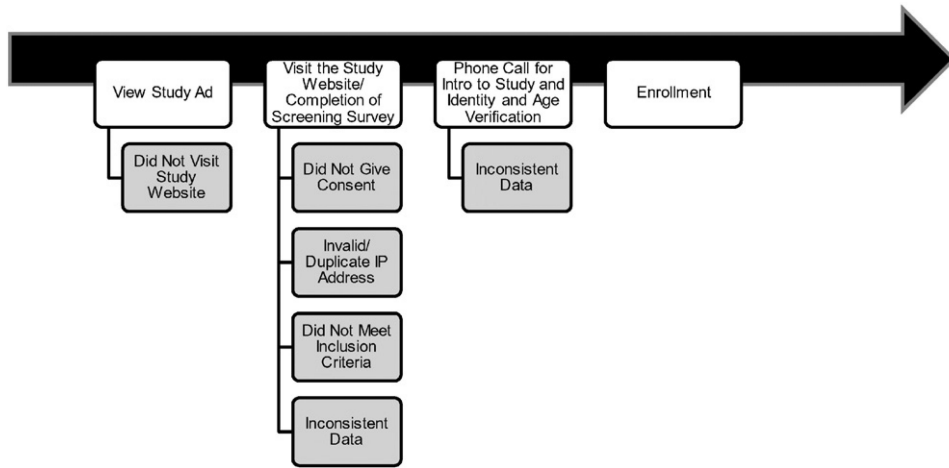
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**HIGHLIGHTS**

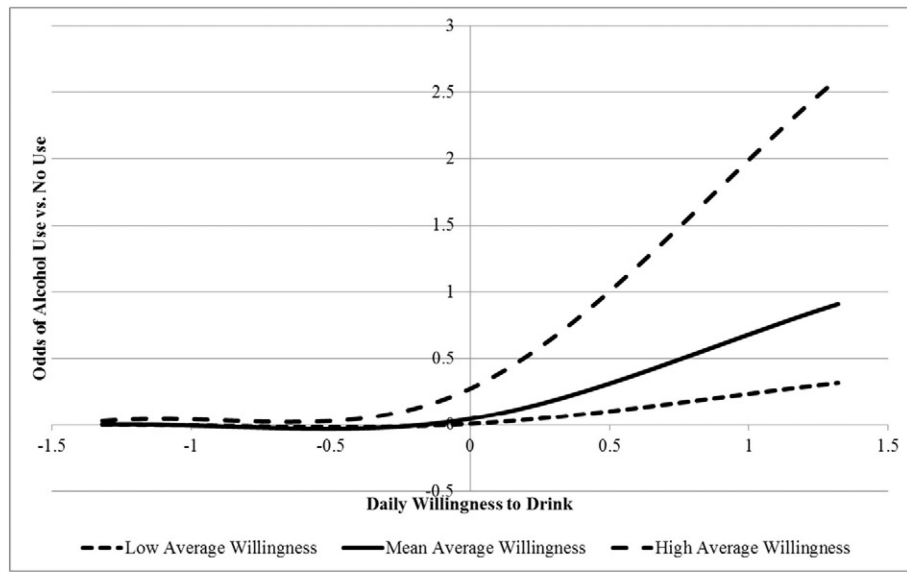
- Findings suggest substantial differences from day-to-day in willingness to drink.
- Participants drank more on days when feeling more willingness than their own average level across the two weeks.
- Daily process level mechanisms allow insight into factors contributing to increased risk in-the-moment.
- Interventions focusing on young adults' abilities to make healthier choices in moments of risk are needed.



**Fig. 1.**  
The Prototype Willingness Model.



**Fig. 2.**  
Study participant recruitment flow chart.



**Fig. 3.** The effects of daily willingness on the odds of alcohol use across average levels of willingness.

**Table 1**

Descriptive statistics of the current sample.

	Mean	SD	%0
Daily drinks	0.76	02.28	81.8
# of drinks on a drinking day	4.19	03.761	
Willingness to drink (0–7 scale)	1.51	02.01	
Willingness on drinking days	4.38	01.385	
	%	% on drinking days only	
I was with close friends	9.8	37.9	
I was somewhere I had never been before	1.9	07.4	
I was somewhere I commonly drink	2.5	13.3	
I was with people I didn't know well	1.5	06.3	

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**Table 2**

Final model predicting within and between person variability in drinking across 14 days.

Parameter	b	S.E.	OR	p	95% confidence interval OR	
					Lower bound	Upper bound
Likelihood of drinking						
Daily willingness	1.80	0.117	6.03	0.000	4.79	7.59
Average willingness	1.36	0.121	3.91	0.000	3.08	4.96
Daily willingness * weekday/weekend	-0.34	0.080	0.71	0.000	0.61	0.83
	b	S.E.	df	p	95% confidence interval	
					Lower bound	Upper bound
Number of drinks						
Daily willingness	0.87	0.11	155.04	0.000	0.66	1.09
Average willingness	0.50	0.12	202.48	0.000	0.27	0.73
Daily willingness * weekday/weekend	0.30	0.13	391.11	0.02	0.04	0.55
Average willingness * weekday/weekend	0.50	0.13	503.28	0.000	0.24	0.76

Note: Covariates (biological sex, college enrollment, and weekend/weekday status) were included but are not presented for parsimony. Both the intercept and the effects of daily willingness were estimated as random effects.