



Drink for drink: measurement of preloading motivations for field and survey research with correlates of alcohol related harms

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Abstract

Field researchers often use categorical systems to record *primary preloading motivations*, while survey researchers use continuous systems to examine *preloading motivation ratings*. We tested the psychometric properties of the two systems for measuring preloading motivations. Six hundred and eight-one undergraduate students and social media recruited participants (178 males; 503 females) completed an online survey pertaining to their last preloading experience. We measured preloading motivations by the categorical and continuous systems, general drinking motivations, estimations of preloaded standard drinks and harm. Measurements of preloading motivations by categorical (primary motivation) and continuous systems (motivation ratings) were concordant. The continuous system of preloading motivations held mix concurrence with general drinking motivations, implying conceptual differences between the two constructs. ‘Enhancement-based’ preloading motivations had strong relationships with estimations of preloaded standard drinks, while general drinking motivations for ‘coping’ were strong correlates of harm. Preloading motivations can be measured through either categorical or continuous systems. Implications for future psychometric measurement development is discussed.

Keywords Preloading · Motivations · Concordance · Validity · Harms

Introduction

Approximately seventy to ninety percent of individuals preload with alcohol before a party, event or night-out (Devilley et al., 2019b; Hughes et al., 2008; Merrill et al., 2016). Preloading is often contextualized as a behaviour practiced by young adults (i.e., 18 – 24 years; MacLean & Callinan, 2013; Wells et al., 2015), despite a smaller proportion of adults (i.e., 25 – 60 years) also reporting engagement in the practice (de Andrade et al., 2021; Devilly et al., 2017). For both individuals young and old, their decisions to preload are guided by various motivations to consume alcohol (LaBrie et al., 2012; Foster & Ferguson, 2014; Devilly et al., 2019a). These motivations subsequently influence the amount of alcohol consumed, often beyond safe and practical recommendations (National Health Medical Research

Council [NHMRC], 2020) and, therefore, increases the propensity to experience alcohol related harm (ARH). It is argued that reducing the harm associated with preloading can be achieved by identifying and targeting the motivations to preload (Wells et al., 2009). However, there is currently a lack of valid and reliable methods for measuring preloading motivations in the field. The current study aimed to examine and validate the measurement systems used for measuring preloading motivations during field research.

Field research

Investigation of the preloading phenomena can involve data collection in frequented night-time entertainment districts (NED). Field research designs require a team of researchers to intercept patrons as they enter, exit, or transition across venues in an NED (Devilley et al., 2017, 2019a, b). Researchers use observations (Coomber et al., 2016), participant interviews (Hughes et al., 2008) or a mixture of both (Devilley et al., 2019a, b) to collect data. Participant interviews require the use of brief condensed surveys to retain participant attention. Observational assessment can include counting the number of patrons on a given street or in a venue line (Townsend

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& Grimshaw, 2013). Real-time measurements of alcohol intoxication through the use of a breathalyser (Sorbello et al., 2018) is perhaps the greatest strength for preloading field research. However, field designs are expensive to implement, requiring a team of professional researchers using certain measurement systems to capture data.

Measuring motivations under two different systems

Defining both the term ‘preloading’ and the sample being assessed has not always been consistent between research groups and this has led to a recent proposal for a taxonomy to help make preloading research more specific (Hughes & Devilly, 2021). Likewise, the consistency of preloading ‘motivations’ is not always the same between research groups. Under one system, field researchers have operationalized preloading motivations into a single question measured by discrete nominal categories, which allowed participants to select one or multiple primary motivations (e.g., Devilly et al., 2017; Miller et al., 2016; Østergaard & Andrade, 2014). The rationale for this approach is to minimize time constraints and to maximize participation in busy environments. In addition, a participant’s initial primary motivation may explain a significant proportion of their decisions and behaviors to preload (Barton & Husk, 2014; DeJong et al., 2010). Categorical measurements of primary preloading motivations allow for quick and intuitive response selection for field research.

This measurement system is not without potential flaws. Categorical measurement implies that each participant was assigned to one particular motivation as their primary selection, e.g., participant 1 was assigned to the ‘save money’ motivation group. The analytical potential is reduced to group inferences on the response variable. This presents a conceptual problem about whether a participant’s motivation to preload can be explained exclusively by one selection. According to the qualitative literature, participants often reported a primary motivation which is supported by secondary motivations related to saving money, intoxication seeking and maximizing social interactions (DeJong et al., 2010; Barton & Husk, 2014; Atkinson & Sumnall, 2017). Inaccurate classification of a participant into a primary motivation group could inflate systematic measurement error (Watson & Petrie, 2010). Accordingly, preloading motivations may benefit from measurement under a different system.

The continuous system

Under a second system, preloading motivations are measured dimensionally, rather than categorically. Researchers have conceptualized preloading motivations into broad questionnaires measured on a continuum which

targets one’s endorsement across motivations (Pedersen et al., 2009; LaBrie et al., 2012; Labhart & Kuntsche, 2017). A participant is asked to rate their endorsement across all items presented on a questionnaire (usually on a Likert-type scale), whether captured in the field, or retrospectively after the night-out. The task assumes that all provided motivations on a questionnaire relate to the participant’s preloading to some level. Continuous measurements allow for greater depth and data manipulation across more powerful statistical models (Gregory, 2014). As such, this measurement system may benefit certain research designs with complex hypotheses.

In contrast, measuring preloading motivations under a continuous system may be impractical for field researchers. Participants navigating a busy NED are confronted with competing demands—e.g., lining up for night-clubs, managing one’s own intoxication or maintaining social group cohesion. These participants are unlikely to rate all preloading motivations on a continuous system when the questionnaire appears burdensome, meaningless to their current priorities, or could be collected in an alternative manner (Rolstad et al., 2011; Labhart et al., 2020, Yan et al., 2020). This may inflate systematic bias where participants skip or confabulate responses to complete the questionnaire. A second problem occurs with the ambiguous interpretation of labels for continuous intervals (Tabachnick & Fidell, 2013). One should keep in mind that intoxicated participants could misinterpret labels on a continuous scale across different preloading motivations (Del Boca & Darkes, 2003). These problems limit the applicability of the continuous systems to measure preloading motivations in the field.

Agreement between the systems

The measurement system which a researcher selects depends on tolerable strengths and limitations. Categorical measurements of primary preloading motivations capture efficient quasi-observations of the motivated preloading behavior, but the system is reliant on less powerful analytical methods and challenged by conceptual flaws. The continuous measurement system supports powerful statistical analysis and could be more representative of the multivariate influence across several preloading motivations. Yet the continuous system is poorly adapted to field research. Perhaps the more pressing concern is whether there is concordance between categorical and continuous measurement systems. Establishing the concordance between both measurement systems will reduce the systematic error attributed to measurement miscalibrations (Watson & Petrie, 2010). If both systems use similar motivations, agreement should be found, despite the different measurement attributes.

Establishing validity—the ‘gold standard’

Once concordance is established between categorical and continuous systems, validity analysis for the continuous system would normally follow. Demonstrating concurrent validity for an issue is frequently handled by comparing newly developed measures to an existing test (Gregory, 2014). It should be noted that there is no current accepted standardized test to measure preloading motivations. The closest example is the Drinking Motivations Questionnaire-Revised (DMQ-R; Cooper, 1994) which draws conceptual origins from the Motivational Model of Alcohol Use (MMAU; Cox & Klinger, 2011). Several researchers have used the DMQ-R to validate their own created measures of preloading motivations (e.g., Labhart & Kuntsche, 2017; LaBrie et al., 2012). Labhart and Kuntsche (2017) found their measure of preloading motivations evidenced moderate concurrent associations with the DMQ-R (Labhart & Kuntsche, 2017). It might be expected that motivations derived from the MMAU (which use a continuous system to measure preloading motivations) will evidence concurrent validity with the existing DMQ-R motivations. We aim to test this issue with our own continuous system of preloading motivations.

Establishing validity—predicting preloading outcomes

Any new preloading motivations measure is limited in use unless there is criterion related validity for preloading outcomes. Alcohol consumption (measured by standard units of alcohol consumed) is one primary self-reported outcome attributed to preloading motivations (Foster & Ferguson, 2014). A second outcome that usually follows as a result of preloading is ARH. Past research has found continuous measurements of preloading motivations had small to moderate associations with alcohol consumption and ARH (LaBrie et al., 2012; Pedersen et al., 2009; Smit et al., 2021). The strongest association were found for preloading motivations focused on fun/intoxication (e.g., get as drunk as possible; Smit et al., 2021) and personal-enhancement (e.g., I enjoy the feeling of intoxication; LaBrie et al., 2012; Pedersen et al., 2009). Smaller effects were found for nuanced motivations focused on saving money and social facilitation (e.g., meeting new people; Pedersen et al., 2009; Smit et al., 2021). While significant criterion related validity on alcohol consumption and ARHs was evident for preloading motivations in past research, the validity is strongest for ‘enhancement’ based preloading motivations.

The current study

The current study aimed to examine the concordance between categorical and continuous measurements of

preloading motivations. A secondary aim was to test the validity of the continuous measurement system. The study was not designed to validate a particular measure, rather it was designed to examine and validate the measurement systems used for preloading motivations. The following predictions are proposed:

(H1) Categorical measurements of primary preloading motivations will be concordant with continuous rating measurements of preloading motivations

(H2) The continuous measurement system of rating preloading motivations will be associated with the four factors of the drinking motivations questionnaire-revised-short-form (DMQ-R-SF).

(H3a) The continuous measurement system of rating preloading motivations will be associated with estimated standard drinks consumed at preloading,

(H3b) The strongest associations for preloading standard drinks will be among ‘enhancement-based’ preloading motivations.

(H4a) The continuous measurement system of rating preloading motivations will be associated with ARHs,

(H4b) The strongest associations for ARHs will be among ‘enhancement-based’ preloading motivations and ‘personal-enhancement’ general drinking motivations (from the DMQ-R-SF).

Method

Design Using Hughes and Devilly’s (2021) taxonomy, the current study measured historical accounts of the preloading of alcohol in private and public spaces. The study targeted demographic variables and motivations; assessing severity (subjective) by preloading quantity and impairment (subjective) by ARHs. The study used a convenience sampling approach and survey methodology. This study design was not pre-registered.

Participants Ethical clearance was granted by the University Human Research Ethics Committee (Protocol no: HREC 2019/104). Independent of power analysis, statistical analysis for multiple regression with 12 independent variables requires a minimum of 146 participants (Green, 1991). With one-sided testing, and keeping the alpha level at the 95th percentile, 311 people would be required to find a small effect size while obtaining a power level of 0.8. For two-sided testing, 395 participants would be required. Although, not every individual engages in preloading and this must be accounted for in the power analysis. Prior research has found that between 60 – 90% of individuals preload before

a night-out (Deville et al., 2019a, b; Hughes et al., 2008; Merrill et al., 2016). Therefore, we aimed to collect a maximum sample size of 700 individuals to ensure our analyses were not underpowered. Six hundred and eighty-one participants (178 males— \bar{x} age = 22.77, σ = 7.19; 503 females \bar{x} age = 21.73, σ = 6.95) aged 17–60 years from an Australian undergraduate university research subject pool (Brisbane, Queensland, Australia) and social media recruitment through online and physical advertising undertook this survey. University students who participated were completing their studies in psychological and criminological sciences, while social media recruiting was open to the Australian public. There was no set inclusion or exclusion criteria, with the exception that the participant must have preloaded in the last 12 months to be included in the analytical sample. Undergraduate subject pool participants were provided one course credit for participation, while social media recruited participants went into a prize draw.

Our convenience sample found an unfortunate imbalance between the genders (Males – 26%; Females – 74%) which is not an uncommon issue in designs using undergraduate research pool sampling (Dickinson et al., 2012). An overview of Table 1 provides an outline of the genders across the key variables. There was limited differences between the genders on these key variables, except for males reporting higher prevalence of primary motivations for ‘socialising’ and estimations of preloaded standard drinks. These exceptions are actually consistent with past field research which maintains our faith in the characteristics of this sample (see, Østergaard & Andrade, 2014 – for higher prevalence of males reporting social motivations; Devilly et al., 2017 – for males consuming more at preloading). It should be noted that there were no significant differences between men and women in primary motivation selection (χ^2 (df = 7, N = 517) = 11.64, ϕ = 0.15, p = 0.11). After conducting t -tests between men and women on the 8 preloading motivation ratings, two were found to be significant. However, after applying Bonferroni corrections for multiple comparisons on the same questionnaire, even those two did not meet the cut-off. With the gender imbalance in mind, we have used an abundance of caution and applied a post-stratification weighting adjustment (50% males, 1.92 correction; 50% females, 0.68 correction) prior to running our analyses to reduce the impact of any sampling bias.

Measures and procedure Participants were administered a survey through Qualtrics (2020) survey software to record responses. Informed consent was presented to the participant prior to commencement of the survey. Participation in preloading was measured over a twelve-month period and was defined to the participant as: “Some people purchase packaged alcoholic beverages (i.e., from a bottle store or take-away service) to drink before entering the Night-time

Table 1 Gender breakdown across age, preloading motivations and drinking outcomes

	Male	Female
Age (\bar{x} , σ)	21.72 (4.75)	21.23 (5.82)
Motivations		
Saving money		
Primary (n, %)	70, 55.00%	246, 63.24%
Endorsement (\bar{x} , σ)	4.09 (1.24)	4.37 (1.04)
Socialise		
Primary (n, %)	28, 21.90%	43, 11.05%
Endorsement (\bar{x} , σ)	3.85 (.97)	3.67 (1.10)
Pressure		
Primary (n, %)	1, 0.08%	2, 0.51%
Endorsement (\bar{x} , σ)	1.79 (1.05)	1.56 (.87)
Get drunk		
Primary (n, %)	6, 5.00%	20, 5.10%
Endorsement (\bar{x} , σ)	2.46 (1.28)	2.62 (1.38)
Comfort		
Primary (n, %)	10, 7.80%	28, 7.20%
Endorsement (\bar{x} , σ)	3.27 (1.16)	3.25 (1.20)
Confidence		
Primary (n, %)	2, 1.60%	13, 3.30%
Endorsement (\bar{x} , σ)	2.95 (1.27)	3.04 (1.32)
Enjoy the feeling		
Primary (n, %)	7, 5.50%	29, 7.50%
Endorsement (\bar{x} , σ)	3.41 (1.09)	3.49 (1.04)
Friends preloaded		
Primary (n, %)	4, 3.12%	8, 2.10%
Endorsement (\bar{x} , σ)	2.71 (1.20)	2.60 (1.28)
Key outcomes		
Estimated preloaded drinks (\bar{x} , σ)	8.70 (6.60)	6.55 (3.97)
AUDIT (\bar{x} , σ)	9.47 (5.31)	9.51 (5.47)

\bar{x} = mean; σ = standard deviation

Entertainment District (NED) / licenced premise (i.e., pubs, hotels, night-clubs or other licenced premises). This is referred to as ‘preloading’”. If the participant had not preloaded within the past year, they were excluded from the remainder of the survey. We measured the participant’s ‘usual’ standard alcoholic drinks consumed at preloading and provided a reference guide from the National Health and Medical Research Council (NHMRC, 2020). Preloading motivations were first measured through the categorical system and required participants to report one ‘primary’ preloading motivation from a selection of eight motivations: Socialise; Save money; I enjoy the feeling; To get as drunk as possible; To feel more comfortable/relaxed; Pressure from friends; Because my friends were preloading; To increase confidence. Our selection of motivations was focused on common motivations and therefore excluded cultural specific

motivations to our sample. The responses were randomised upon presentation to the participant using Qualtrics survey software. Afterwards, participants were presented all eight motivations on the continuous system and were required to provide a rating on a five-point Likert-type scale—Not at all (1); A little (2); Somewhat (3); Quite a lot (4); Extremely (5) – for each motivation. We decided against randomising the presentation order for the categorical and continuous measurement of preloading motivations. Qualitative literature has found that individuals will often report an initial primary motivation (i.e., ‘to save money’) and after deeper reflection contribute further secondary motivations for their preloading (Barton & Husk, 2014; Forsyth, 2010). We aimed to replicate this intuitive and reflective process by leaving a fixed order effect. We additionally measured general drinking motivations with the 12 item Drinking Motivations Questionnaire Revised Short-Form for comparing concurrent validity (DMQ-R-SF; Kuntsche & Kuntsche, 2009) and ARHs with the 10 item Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993).

Analytical plan We used SPSS v.27 (IBM, 2021) for data preparation, cleaning, assumption checking, examining missing values and conducting concordance analysis. Data examination, validity analysis and graphing were conducted using RStudio v1.4.1106 (RStudio PBC, 2021). In planning our analysis, we were surprised there was no conventional analytical procedure to evaluate the concordance between a categorical and continuous measure. Concordance analysis, therefore, used several methods to review the similarities between the categorical and continuous measurements of preloading motivations and then rigorously test for concordance between the systems (Hyp 1). Multiple regressions with standardised regression coefficients were used to assess the concurrent validity with the DMQ-R-SF four factors (Hyp 2). Hierarchical Multiple Linear Regression (HMLR) was used to test the criterion validity of the DMQ-R-SF factors and preloading motivation ratings for the criterion variables (Hyp 3 & 4).

Results

Agreement between measurements Several methods were used to test the similarities and concordance between categorical and continuous measures of preloading motivations. These methods included visual examination of the agreement between measurement systems (see supplemental materials 1), a paired samples t-test to establish similarities between primary motivations and primary ratings, chi-squares to establish independent associations for concordance between measurements, and Cohens’ kappa to test the agreement between measurement systems.

Preparation for concordance analysis to test hypothesis 1 began with matching the participant’s primary motivation and their corresponding rating for that motivation. This was recoded as their ‘Primary rating’. For example, where a participant selected ‘socialise’ as their primary motivation and selected the rating for ‘socialise’ as ‘quite a lot = 4’, their primary rating was coded as ‘4’. We observed the participant’s second highest rating after their primary rating and coded this into a new variable called ‘Secondary rating’. For example, for the same participant, if the highest option other than socialize was ‘save money’ and was rated as ‘Somewhat = 3’, their secondary rating was coded as ‘3’. If this option was actually higher (i.e., ‘extremely’) then the score of 5 was entered for their secondary rating. A paired samples t-test computed the mean difference between the primary and secondary ratings: $t(509) = 8.06, p < 0.001$, Hedges’ $g = 0.42$. A moderate effect was observed which suggested the participant’s primary rating was statistically greater than the second option but also represented a meaningful difference. This suggested that a participant’s categorical selection of a primary motivation was similar in categorical order to the selection of a motivation rating.

While we observed differences between primary and secondary ratings, we were more interested in the concordance between measurement systems. The next task was to establish the participant’s primary motivation by preloading motivation ratings (i.e., continuous system). Primary motivation by ratings (operationalised as the participant’s highest rating on the continuous measurement) was found by taking the highest rated value across the eight motivations. For example, where the participant rated ‘to get as drunk as possible’ as ‘extremely’ above all other motivation ratings, this was recoded as their primary motivation by rating. Where the participant had multiple motivations (e.g., ‘to socialise’ or ‘to save money’) rated as ‘extremely’, we coded these participants as having ‘multiple-joint’ rated motivations. This was examined more closely with the participant’s categorical selection of their primary motivation. Regardless of whether a participant rated multiple-joint motivations highly, if their categorical selection of a primary motivation matched the highest rating of that same motivation, we interpreted this as concordant with the participant’s primary motivation. For example, if the participant selected ‘get drunk’ as their primary motivation, and then rated ‘get drunk’ as ‘extremely’ and also rated ‘save money’ as ‘extremely’, then their primary motivation and primary motivation by rating were considered to be concordant and this was recoded as ‘get drunk’, despite a similar rating on ‘save money’. If the participant rated any one other motivation with a higher score, then the rating was considered ‘not concordant’. Table 2 provides more explanation of this process in a cross tabulation matrix (when this variable is compared to categorically selected primary motivations).

Table 2 Concordance rates between Categorical and Continuous measurements of primary motivations

Primary from ratings	Primary from ratings											Total
	Save money	Socialise	Pressure	Get drunk	Comfort	Confidence	Enjoy feeling	Friends preloaded	Multiple -Not concordant			
Save money	286	3	0	0	3	3	1	1	5		302	
Socialise	11	69	0	0	0	1	0	1	1		83	
Pressure	0	0	3	0	0	0	0	0	0		3	
Get drunk	3	0	0	16	3	0	0	0	3		25	
Comfort	2	3	0	1	26	2	0	0	5		39	
Confidence	1	0	0	0	0	12	0	0	0		13	
Enjoy feeling	3	2	0	0	2	1	24	0	3		34	
Friends preloaded	1	0	0	0	0	0	1	8	4		14	
Total	307	77	3	17	34	19	26	10	20		513	

‘Multiple-Not Concordant’ represents if there were multiple preloading motivations from the continuous system that were rated higher than the individual’s primary motivation from the categorical system

Table 3 Measures of independent association and agreement between primary preloading motivation measurement and preloading motivation rating

Motivation	χ^2	ϕ	κ
Save money	361.09 ***	.84	.84
Socialise	348.16 ***	.83	.83
Get drunk	298.46 ***	.77	.75
Comfort	258.76 ***	.71	.71
Confidence	290.68 ***	.76	.74
Enjoy feeling	315.84 ***	.79	.78
Friends preloaded	196.43 ***	.62	.59

N= 507, df = 1; *** $p < .001$, ϕ =Phi; κ =Kappa

We examined the participant’s primary motivation and whether their primary motivation by rating was the highest of all motivations or jointly shared with another motivation. This was coded into a new variable on whether the rating was concordant with the primary motivation: 0 = ‘No’; 1 = ‘Yes’. The motivation ‘Pressure from friends’ was dropped prior to analysis due to low group size ($N=3$). A 7 primary motivations (Socialise, Save money, ..., Friend Preloaded) \times 2 rating concordant (Yes/No) chi-square found a significant independent association with at least a medium effect size, $\chi^2(6, N=507) = 53.90, \phi = 0.33, p < 0.001$. Examination of the cross tabulation found primary motivations to ‘socialize’, ‘save money’ and ‘increase confidence’ were the most independently associated between concordance ratings. While ‘get drunk’, ‘comfort’, ‘enjoy the feeling’ and ‘because friends preloaded’ were less consistent in concordance ratings.

Primary motivations were recoded into seven individual dummy coded variables for each motivation – e.g., socialise primary motivation: 0 = ‘No’; 1 = ‘Yes’. Likewise, primary motivations by ratings were matched with their primary motivation and recoded into seven dummy coded variables for each motivation – e.g., socialise primary rating: 0 = ‘No’; 1 = ‘Yes’. We ran seven 2 primary motivation (No/Yes) \times 2 primary rating (No/Yes) cross tabulations to obtain chi-squares, phi and kappa values between the measurement systems. The results for the concordance analysis are presented in Table 3.

The agreement results displayed in Table 3 suggested that both primary motivation and primary rating measurements had excellent agreement between the measurement systems. For example, the agreement between socialise by primary motivation and socialise by primary ratings was excellent, $\chi^2(df=1, N=507) = 348.16, p < 0.001, \kappa = 0.83$. The lowest concordance rate was with ‘because my friends preloaded’, yet the kappa of 0.59 is still considered a moderate agreement (Landis & Koch, 1977; Watson & Petrie,

2010). Overall, our analyses suggested that categorical measurements of preloading motivations were concordant with rating measurements of preloading motivations on a continuous scale (Hyp 1).

Concurrent validity With concordance established, we moved to test concurrent validity for the continuous ratings of our preloading motivations. To test hypothesis 2, motivation ratings were regressed onto the DMQ-R-SF motivations. Table 4 provides four multiple regressions using the Enter method and with the total variance (R^2) of DMQ-R-SF factors explained by preloading motivation ratings in the end column. We observed good concurrence between the corresponding preloading ratings and DMQ personal-enhancement (Get drunk $\beta=0.19, p<0.001$; Enjoy the feeling $\beta=0.42, p<0.001$) and conformity factors (Pressure $\beta=0.28, p<0.001$; Friends Preload $\beta=0.23, p<0.001$), albeit with ‘confidence’ ($\beta=0.15, p<0.001$) preloading ratings regressing onto DMQ conformity factors. DMQ coping and social factors were less clearly concurrent with the preloading motivation ratings. DMQ coping motivations were moderately associated with preloading motivation ratings for ‘comfort’, ‘confidence’, ‘get drunk’ and ‘enjoy the feeling’. DMQ socialise motivations was not associated with preloading ratings to ‘socialise’ at all. DMQ socialise evidenced stronger associations with preloading ratings for ‘confidence’, ‘comfort’, ‘get drunk’ and ‘enjoy the feeling’. Saving money did not share concurrent validity with any DMQ-R-SF factor—as one would expect with the DMQ having no face-valid concomitant, being a measure of general alcohol use motivations.

Criterion validity HMLR was used to examine the individual variance attributed by demographic factors, general drinking motivations and preloading motivations on preloaded standard drinks (Hyp 3 a & b). At step one age and gender were entered; DMQ-R-SF motivations were entered at step two and preloading motivation ratings were entered at the final step. The results for the HMLR is displayed in Table 5 using ‘apaTables’ R package (Stanley, 2021). Age and gender accounted for 5.30% of the variance in estimations of preloaded standard drinks. General drinking motivations

contributed an additional 7.30% variance. DMQ socialise and DMQ coping motivations were associated with significant independent variance in preloaded standard drinks. Preloading motivation ratings contributed a further 7.70% variance. As expected, ‘get drunk’ and ‘enjoy the feeling’ were associated with significant variance in estimations of preloaded standard drinks. For one rating increase on ‘get drunk’ and ‘enjoy the feeling’ preloading motivations, estimated preloaded consumption increased by 1.07 and 0.61 standard drinks respectively.

We then ran a swapped model with preloading motivations ratings entered at step two and DMQ-R-SF motivations at step three. When entered into the model at step two, preloading motivation ratings accounted for an additional 11.70% combined variance in preloaded standard drinks— $F(7, 502) = 14.68, p < 0.001, R^2 = 0.170, \Delta R^2 = 0.117$. However, DMQ-R-SF motivations contributed only 3.30% of additional variance to preloaded standard drinks at step three— $F(10, 499) = 12.67, p < 0.001, R^2 = 0.202, \Delta R^2 = 0.033$. In effect, preloading motivations better accounted for drinks consumed than did the DMQ-R-SF.

A second HMLR was computed with the AUDIT scores used as the criterion, also displayed in Table 5 (Hyp 4 a & b). Age and gender accounted for limited variance in AUDIT scores. As one would expect, general drinking motivations contributed significant variance, explaining 24.7% of the total variance in AUDIT scores. At step two, DMQ personal-enhancement and DMQ coping motivations were significant predictors, accounting for 16 – 28% of the individual variance in AUDIT scores. At step 3, preloading motivation ratings contributed a small significant influence on AUDIT scores, accounting for 5.30% of the additional variance. For every single unit increase in preloading motivation ratings for ‘get drunk’ and ‘enjoy the feeling’, AUDIT scores increased by 0.64 and 0.69 respectively. Interestingly, the preloading motivation to ‘feel comfort’ was associated with a 0.57 decrease in AUDIT scores, while a DMQ coping motivations were associated with a 0.79 increase in harm.

As before, we ran a swapped model with at step preloading motivations at step two and the DMQ-R-SF motivations at step three. Preloading motivation ratings accounted for

Table 4 Continuously measured preloading motivations regressed onto DMQ-R-SF factors

Variable	Socialise	Save money	Pressure	Get drunk	Comfort	Confidence	Enjoy	Friends preload	R^2
1. DMQ socialise	.01	.08	-	.13**	.16**	.15**	.17***	-.01	.23***
2. DMQ enhancement	.02	.00	-	.19***	-.01	.04	.42***	-	.30***
3. DMQ coping	-.07	-	.04	.12*	.18***	.13*	.13**	-	.17***
4. DMQ conformity	.09*	-	.28***	-.03	.03	.15**	-.01	.23***	.29***

β coefficients are displayed. * $p < .05$. ** $p < .01$. *** $p < .001$,—indicates that the preloading motivation was excluded from multiple regression to reduce model saturation because of poor correlation with the DMQ factor

Table 5 Regression results using Estimated Preloaded Standard Drinks and AUDIT total as the criterion

Model	Predictor	Preloaded standard drinks			AUDIT		
		<i>b</i>	<i>p</i>	<i>sr</i> ²	<i>b</i>	<i>p</i>	<i>sr</i> ²
1	(Intercept)	13.61	<.001		9.76	<.001	
	Age	-.12	<.01	-.12	-.01	.76	-.01
	Gender	-2.22	<.001	-.20	.04	.94	.00
	Model- $F(2, 509) = 14.59, p < .001, R^2 = .053$				Model- $F(2, 507) = 0.05, p = .95, R^2 = .000$		
2	(Intercept)	8.96	<.001		1.12	.37	
	Age	-.12	<.01	-.12	-.02	.62	-.02
	Gender	-2.30	<.001	-.20	-.20	.64	-.02
	DMQ socialise	.33	<.01	.11	.19	.10	.06
	DMQ Enhancement	-.01	.97	-.00	.55	<.001	.16
	DMQ coping	.49	<.001	.17	.80	<.001	.28
	DMQ conformity	-	-	-	.11	.34	.04
	Model- $F(5, 504) = 14.49, p < .001, R^2 = .126, \Delta R^2 = .073$				Model- $F(6, 503) = 27.62, p < .001, R^2 = .248, \Delta R^2 = .248$		
3	(Intercept)	6.79	<.001		-1.15	.47	
	Age	-.09	<.05	-.08	.01	.84	-.01
	Gender	-2.39	<.001	-.21	-.40	.34	-.04
	DMQ socialise	.26	<.05	.08	.15	.21	.05
	DMQ enhancement	-.36	<.05	-.09	.25	.08	.07
	DMQ coping	.45	<.001	.15	.79	<.001	.26
	DMQ conformity	-	-	-	.18	.13	.06
	PL socialise	-	-	-	-	-	-
	PL save money	.19	.35	.04	.32	.09	.06
	PL get drunk	1.07	<.001	.22	.69	<.001	.14
	PL comfort	-.17	.48	-.03	-.57	<.05	-.09
	PL confidence	-.18	.42	.03	.16	.77	.01
	PL enjoy feeling	.61	<.05	.09	.64	<.01	.10
Model- $F(10, 499) = 12.67, p < .001, R^2 = .202, \Delta R^2 = .077$				Model- $F(12, 498) = 19.48, p < .001, R^2 = .301, \Delta R^2 = .053$			

A significant *b*-weight indicates the semi-partial correlation is also significant. *b* represents unstandardized regression weights; *sr*² represents the semi-partial correlation squared. Once again,—indicates that the variable was excluded from multiple regression to reduce model saturation because of poor correlation with preloaded standard drinks and AUDIT scores

an additional 17.40% combined variance in AUDIT scores— $F(7, 502) = 15.10, p < 0.001, R^2 = 0.174, \Delta R^2 = 0.174$. DMQ-R-SF motivations contributed 12.60% of additional variance at step three— $F(10, 499) = 19.48, p < 0.001, R^2 = 0.301, \Delta R^2 = 0.126$. In effect, while the DMQ-R-SF does contribute a significant and non-trivial amount of unique variance to AUDIT scores, preloading motivations contributed a comparable amount of unique variance in AUDIT scores for this sample.

Auxiliary analyses It was brought to our attention during review that it would be of interest to evaluate whether the two measurement systems are associated with alcohol related harms and whether they have equal utility in this regard. As one system is binary (yes / no to each motivation)

and the other gives a continuous measure of each motivation, we needed a common metric with which to compare. We created a hazardous drinking cut-off of more than 4 standard drinks (NHMRC, 2020) and an AUDIT cut-off of 8 or above (Babor et al., 2001). We then computed a percentage shared variance metric for both a non-parametric chi-square analysis for the categorical system ($100 \times \Phi^2$) and a parametric ANOVA analysis for the continuous rating system ($100 \times \text{partial } \eta^2$) for both measures of harmful drinking. We then rank ordered each motivation based on contributed variance for both the categorical system and the continuous rating system – which could then be compared. As can be seen in Table 6, the continuous system obviously accounts for more variance for both measures of hazardous drinking. This is expected as there is more variance to share.

Table 6 Explained variance of the two systems associated with preloaded standard drinks alcohol related harms

Motivation	Preloaded standard drinks consumed –above or below 4.1 std drinks					AUDIT – above 7.9 or below 8				
	Categorical variance (%)	Categorical ranking	Continuous variance (%)	Continuous ranking	Diff in rankings	Categorical variance (%)	Categorical ranking	Continuous variance (%)	Continuous ranking	Diff in rankings
Save money	1.93	1	7.01	2	1	1.17	2	2.04	4	2
Socialise	0.18	8	2.70	5	3	1.74	1	0.84	7	6
Pressure	0.69	5	0.07	7	2	0.22	7	0.36	8	1
Get drunk	1.22	2	9.57	1	1	0.86	4	11.08	1	3
Comfort	1.00	3	0.86	6	3	0.40	6	1.96	5	1
Confidence	0.24	7	3.06	4	3	0.51	5	5.81	3	2
Enjoy feeling	0.94	4	5.91	3	1	0.01	8	9.84	2	6
Friends	0.62	6	0.01	8	2	0.91	3	1.00	6	3

Formula to compute categorical variance association: $100 * \phi^2$. Continuous variance association computed via ANOVA (IV: above versus below cut-off; DV: motivation rating): $100 * \text{partial } \eta^2$

Looking at drinking more than 4 standard drinks in one session, the two systems correlated highly with a *Spearman's r* ($n=8$) = 0.55, $p=0.16$. With only 8 possible ranking pairs this was not significant but did demonstrate a large effect size. However, the two systems did not correspond with each other for the AUDIT cut-off. In fact, the small effect derived was negatively correlated (*Spearman's r* ($n=8$) = -0.19, $p=0.85$).

Discussion

The advancement of preloading research benefits from reliable and valid measurement systems. Our aim was to examine the concordance of primary preloading motivations (measured categorically and used predominantly in field research; e.g., Devilly et al., 2017; Miller et al., 2016; Østergaard & Andrade, 2014) with preloading motivation ratings (measured continuously, and predominantly utilised in survey based studies; e.g., Labhart & Kuntsche, 2017; LaBrie et al., 2012; Pedersen et al., 2009). Supporting our first hypothesis, categorical and continuous measurements of preloading motivations were consistent across both measurement systems. Our second hypothesis looking at concurrent validity was partially supported – we found mixed concurrence between our preloading motivation ratings and general drinking motivations as measured by the DMQ-R-SF. Criterion validity was also partially supported for hypothesis three and four. Our preloading ratings accounted for a significant proportion of variance in estimations of preloaded alcohol consumption and ARHs. Single-item preloading motivation measurements were judged to be concordant, with partial concurrent and criterion validity.

Concordance

Categorical and continuous measurements of single item preloading motivations were found to be similar and concordant across our analyses. Each primary motivation demonstrated good to strong acceptance with the corresponding preloading motivation rating system. Our concordance findings provide evidence that previously used categorical measurements of preloading motivations by field researchers hold value (e.g., Devilly et al., 2017; Miller et al., 2016; Østergaard & Andrade, 2014). Concordance between the two systems was sustained regardless of primary motivation group size, whether that be motivations with large numbers of endorsements (i.e., ‘save money’ & ‘socialising’) or a small number of endorsements (i.e., ‘comfort’ or ‘because friends preloaded’). A participant’s selection of a primary motivation is likely to correspond with higher ratings of that motivation, along with possible similar ratings on other motivations.

Concurrent validity

While the measurement systems were concordant, we found mixed evidence for the validity of the continuous measurement system. When compared to the Drinking Motivations Questionnaire (DMQ-R-SF), personal-enhancement and conformity motivations were clearly concurrent with the respective preloading ratings. DMQ-R-SF socialising and coping motivations shared overlaps with preloading ratings to ‘get as drunk’, ‘feel comfort’ and ‘confidence’, to name a few. Consistent with qualitative research (DeJong et al., 2010; Forsyth, 2010), there were multiple underlying preloading motivations for ‘social’ drinking which included rapid intoxication (‘get drunk’), reducing social anxiety

(‘feel comfort’ and ‘confidence’) and enjoying intoxication in social environments (‘enjoy the feeling’). These findings suggest that *general* drinking motivations and *preloading* motivations share some overlapping elements but are separate concepts.

Preloading motivation ratings to ‘save money’ and ‘socialise’ were not concurrent with most DMQ-R-SF motivations – with the exception of ‘socialise’ preloading motivations sharing a minor association with DMQ-R-SF conformity motivations. Closer examination of the DMQ-R-SF items suggests that the socialising domain was indicative of general alcohol consumption to enhance parties and social gatherings (Kuntsche & Kuntsche, 2009) and not social facilitation (i.e., meeting and connecting with others) as we had operationalised the respective preloading motivation rating. ‘Socialise’ preloading motivations may also relate to one’s ‘fear of missing out’—in that individuals feel pressured to preload with alcohol, or miss-out on the preloading event (Riordan et al., 2021). Moreover, the DMQ-R-SF does not mention any motivations targeted towards reducing financial expenditure, which explains the limited concurrence for the ‘save money’ preloading motivation rating. The lack of concurrence for these two preloading motivation ratings suggest that preloading should be conceptualised separately from general alcohol drinking motivations.

Criterion validity

Criterion related validity for the continuous system of measurement was partially supported. Preloading motivation ratings were related to preloaded standard drinks and ARHs as measured by the AUDITs. ‘Enhancement-based’ preloading motivations (i.e., ‘get drunk and ‘enjoying the feeling’) were the only preloading motivations associated with increased estimations of preloaded standard drinks. This is consistent with past research for ‘enhancement-based’ preloading motivations contributing to higher preloading alcohol consumption (e.g., LaBrie et al., 2012; Pedersen et al., 2009; Smit et al., 2021). Likewise, higher ratings on ‘enhancement-based’ preloading motivations were associated with increased ARHs—which is also consistent with past research (Pedersen et al., 2009; Smit et al., 2021). Those who rated ‘get drunk’ and ‘enjoy the feeling’ preloading motivations were likely to consume more alcohol at preloading and this increased their risk for ARHs.

General drinking motivations also shared strong associations with estimated preloading standard drinks and ARHs. Consistent with past research, DMQ socialise and DMQ coping motivations were associated with increased preloaded standard drinks (Pedersen et al., 2009; Bachrach et al., 2012; LaBrie et al., 2012), while DMQ coping and enhancement motivations were associated with AUDIT scores (Cook et al., 2020; Stevenson et al., 2019). Despite

these consistencies, our results yielded some unexpected findings. For example, DMQ enhancement motivations were associated with reduced preloaded standard drink consumption and also became a non-significant predictor of ARHs once preloading motivations were entered into a different regression model. In contrast, DMQ-coping motivations remained the strongest predictor of ARHs, despite the expected concomitant for preloading motivations, (i.e., ‘feel comfort’), contributing to negative AUDIT scores. These findings lend further support to the conceptual differences between preloading and general drinking motivations when predicting relevant alcohol consumption and harm outcomes.

Comparing how the two systems fared in concordance with each other in shared variance with ARHs, a complex system was required to compare shared variance (as in Table 6). The two systems were concordant with each other in rankings of shared variance with a hazardous drinking metric of more than 4 standard drinks. However, the two systems did not positively correlate with each other in which motivations most related to AUDIT scores (and were, in fact, negatively correlated). With only seven points to correlate, this result is preliminary and needs more research.

Selecting a measurement system

Measuring preloading motivations will depend on the elected research design and sampling procedure. Both measurement systems are reliable with each other – although test–retest reliability requires investigation. The categorical system will benefit designs targeting a larger sample of the population for gathering prevalence data (i.e., field research). However, researchers should be mindful that the system is likely to produce inequalities in group numbers, due to the popular selection of ‘save money’ and ‘socialise’ preloading motivations. The continuous system has improved variability for investigating preloading related outcomes and benefits designs targeting smaller samples or samples with more time to respond. This is not to say the continuous system cannot be implemented in the field, rather researchers should be mindful that it will require participants who are willing to commit more time to data collection. If researchers elect to use the continuous system in the field, one option could be to reduce the list of preloading motivations relevant to that particular population. However, this would require future research to quantify the effects of cultural specific motivations. This approach will reduce task burden and allow for a wider sampling of that population—usually a feature of the categorical system.

There are caveats to keep in mind when selecting relevant preloading motivations under a measurement system. Preloading motivations for ‘saving money’, ‘socialising’ and ‘coping’ require further conceptual clarity, due to limited

concurrent and criterion validity. ‘Saving money’ for the night-out could be a construct distinct from other preloading motivations that focuses not just on reducing expenditure on alcoholic drinks but also costs associated with the night-out (e.g., food, transportation and club-entry fees). The ‘socialise’ preloading motivation may have a combination of underlying reasons, including: meeting new people (Bachrach et al., 2012; Labhart & Kuntsche, 2017); increasing one’s social confidence (LaBrie et al., 2012); or not missing-out on a social event (Rioridan et al., 2021). Future researchers could alter the item to capture the diverse qualities of social preloading – e.g., ‘To socialise – i.e., have a comfortable social space/meet new people/feel more sociable’.

‘Coping’ preloading motivations were related to DMQ socialise, coping and conformity motivations. These preloading motivations may function to improve a perceived negative mood/affect for the expectation that one must be fun and sociable for the night-out. Therefore, ‘coping-related’ preloading motivations could include this expectation – e.g., ‘To feel relaxed/confident for the night-out/party’. The adjustments to these preloading motivations may improve conceptual clarity, but will require further examination.

Implications and future directions

There is a growing evidence base that those who highly rate preloading for ‘enhancement-based’ motivations (e.g., ‘get drunk’ and ‘enjoy the feeling’) are at increased risk for ARHs (LaBrie et al., 2012; Pedersen et al., 2009; Smit et al., 2021). These individuals possibly arrive at NEDs highly intoxicated and continue to maintain/and or increase their intoxication levels. Early identification of these individuals in the field by using our brief primary preloading motivation questions may assist harm minimisation efforts. Implementing brief motivational or normative personalised feedback (by text message) to individuals at drinking events has evidenced utility in reducing alcohol consumption and lower estimated blood alcohol concentration levels (eBrAC; Bernstein et al., 2018; Cadigan et al., 2019). Such an intervention would need to describe how the participant’s preloading motivation for ‘getting drunk’ and ‘enjoying the feeling of intoxication’ are linked to traumatic injuries and ARHs (Soderstrom et al., 2007). Future research could establish the efficacy of this proposed ‘identify and intervene’ approach, particularly in the field.

The use of the AUDIT requires some consideration for the applicability to preloading behaviours. The AUDIT is a ‘general’ screening measure of ARHs (Babor et al., 2001), which may limit the adaptability for measuring ARHs resulting from preloading. If preloading behaviours are conceptually different to general drinking behaviours, the harms

resulting from preloading may also be conceptually unique. Such preloading specific harms are linked to the NED, the night-out and succeeding days – e.g., assaults, unwanted/unprotected sex, embarrassing oneself while out and on social media (Barton & Husk, 2014; Davies & Paltoglou, 2019; Haas et al., 2017). The AUDIT measures alcohol use quantity, frequency and harms and lacks specificity to account for the variance attributed by preloading. Future research may seek to develop preloading specific measures of ARHs that go beyond long-term cognitive, physiological, and interpersonal harms.

Our results should be interpreted with a few limitations in mind. We used a student population with a high proportion of female participants. This may impact the validity of our findings because of the gender differences between preloading consumption rates and past experiences of harm (Deville et al., 2017; Kuntsche & Labhart, 2013; Pedersen et al., 2009). Where possible, we have statistically controlled for the influence of gender and applied post-stratification weighting adjustments prior to main analyses. However, there is growing evidence that intoxication levels between the genders (as opposed to number of drinks consumed) is becoming negligible (e.g., Chaney et al., 2019; Devilly et al., 2019a, b; Reed et al., 2011). With this in mind, we would also suggest that conducting this test of concordance and validity in the field, whilst gathering intoxication data, has value.

Conclusions

The aim of our study was to examine the concordance between two different measurement systems of preloading motivations and test validity for use in the field. We obtained a large sample of participants who preloaded within the past year and examined their motivations for preloading and general drinking. Our measures of primary preloading motivations and preloading motivation ratings were quick and simple to administer for survey or field research. Single item measures of preloading motivations are reliable between categorical and continuous systems of measurement. Caution is advised for measuring preloading motivations targeting ‘saving money’, ‘socialising’ and ‘coping’ reasons until further conceptual clarity is developed. With that said, ‘enhancement-based’ preloading motivations evidenced good validity for predicting associations for preloaded standard drinks and ARHs. Preloading motivations can be measured using categorical or continuous systems of measurement.

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Author contribution Sorbello designed the research, collected the data, performed the experiments, analyzed the data, prepared figures and/or tables, authored and reviewed drafts of the manuscript. Devilly supervised the research programme, designed the research, analysed the data, authored and reviewed drafts of the manuscript. Both authors have contributed to and approved the final manuscript.

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Declarations

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

All data generated or analysed during this study are included in this manuscript [and its supplementary information files].

Transparency declaration The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Ethical committee approval Ethical clearance was granted by the University Human Research Ethics Committee (Protocol no: HREC 2019/104).

Consent Informed consent was obtained from all individual participants included in the study.

Conflicts of interest/Competing interest None. In particular, the authors have not received any funding during this research from local or state governments, political organizations, lobby groups, temperance societies and health based registered charities, or companies involved in the supply or sale of alcohol.

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