



The potential individual- and population-level benefits of encouraging drinkers to count their drinks



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ABSTRACT

Introduction: Cross-sectional studies have established a link between overall engagement in protective behavioral strategies (PBSs) and reduced alcohol consumption. However, there are mixed results on the effectiveness of individual PBSs, with some found to result in increased consumption. A recent study examining the effects of PBS use over time found the 'Count your drinks' strategy to be most reliably associated with reduced alcohol consumption among 16 strategies. Given the apparent superior efficacy of this PBS, this exploratory study aimed to extend these results by (i) determining the extent to which increasing the frequency of PBS enactment is associated with alcohol consumption over time and (ii) predicting potential changes in population-level consumption resulting from higher levels of PBS use.

Method: 1250 drinkers aged 18–70 years provided data at two time points relating to their drinking practices. Multiple regression analyses were conducted to model the relationship between changes in frequency of enactment of the 'Count your drinks' PBS and alcohol consumption. Coefficients were used to predict average reductions in alcohol consumption over one year associated with increased frequency of use of this PBS.

Results: Larger increases in the frequency of using the 'Count your drinks' PBS were associated with greater reductions in alcohol consumption. Exploratory extrapolation analyses demonstrated the potential for substantial reductions in overall alcohol consumption.

Conclusion: The results suggest health promotion efforts designed to increase the frequency with which drinkers count their drinks could produce substantial annual decreases in alcohol consumption at both individual and population levels.

1. Introduction

Alcohol is a cause of numerous adverse health consequences and is estimated to account for 5.3% of deaths globally (World Health Organization, 2018). In Australia, the context of the present study, the social cost of alcohol misuse through loss of productivity, traffic accidents, crime, and health care costs has been estimated at \$14.35 billion per year (Manning, Smith, & Mazerolle, 2013). Establishing practical and effective ways of equipping individuals with strategies to reduce their alcohol consumption is thus an important public health challenge.

One approach to reducing alcohol consumption and alcohol-related harm is the use of protective behavioral strategies (PBSs). PBSs are cognitive behavioral strategies that are self-regulatory and can be used prior to, during, or after drinking to reduce or limit alcohol consumption and minimize negative outcomes (Grazioli et al., 2015; Martens et al., 2005; Pearson, 2013). Previous studies examining the relationship between PBS enactment and alcohol consumption have reported

inconsistent results, which is likely due to the differing methods used to examine PBS use (e.g., in aggregate vs individually; cross-sectionally vs longitudinally; college student vs general adult population samples). In studies examining PBSs in aggregate in college student samples, enactment has typically been found to be associated with lower levels of alcohol consumption and alcohol-related harm (Kenney & Labrie, 2013; Linden, Lau-Barraco, & Millettich, 2014; Ray, Turrisi, Abar, & Peters, 2009), although with some exceptions (e.g., Sugarman & Carey, 2007). By comparison, studies with adult drinkers assessing individual PBSs suggest that not all strategies contribute to reduced alcohol consumption, and some may actually increase alcohol intake (Dekker et al., 2018; Jongenelis et al., 2016). Our recent study examining the effectiveness of 16 individual PBSs among adults found that only one – 'Count your drinks' – was associated with reduced alcohol intake (Dekker et al., 2018). Those who reported more frequent drink counting over a 4-week period demonstrated lower levels of alcohol intake over the same period relative to those reporting less frequent enactment.

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This outcome suggests that promoting the ‘Count your drinks’ PBS could constitute an effective intervention to reduce alcohol consumption at the population level.

Although it is not yet clear why the ‘Count your drinks’ strategy is more effective than other strategies, possible explanations include its ease of implementation and relevance to the general population of drinkers. Other PBSs may be more difficult to enact in all drinking contexts (e.g., the PBS ‘Make a point of eating while consuming alcohol’ relies on the availability of food) or may only apply to some drinking situations (e.g., the PBS ‘Put extra ice in your drink’ is unlikely to be relevant to beer drinkers).

Encouraging greater use of the ‘Count your drinks’ PBS will involve convincing more drinkers to adopt this strategy and encouraging drinkers who already count their drinks to do so more often. The between-subjects analyses conducted to date provide evidence that encouraging more people to adopt this strategy will result in reduced alcohol intake (Dekker et al., 2018), but do not quantify the extent to which intake can be reduced by increasing use of the ‘Count your drinks’ PBS over time (i.e., the within-subject effect of more frequent drink counting). The aim of the present exploratory study was thus to extend this prior work by conducting secondary analyses on the data (Dekker et al., 2018) to measure changes in individuals’ alcohol consumption in response to more frequent drink counting over the assessed 4-week period. Additional analyses were conducted to examine the potential population-level implications of encouraging drinkers to increase the frequency of counting their drinks.

2. Method

Ethical approval to conduct the study was obtained from the Curtin University Human Research Ethics Committee. All respondents provided informed consent prior to participation.

2.1. Recruitment and sample composition

Respondents were invited to participate in a two-wave survey assessing adults’ drinking practices. Recruitment was via a large web panel provider (PureProfile). The sample comprised drinkers aged 18 (the minimum legal purchase age in Australia) to 70 years, with participation eligibility based on self-reported alcohol consumption frequency of at least twice per month. Respondents were surveyed twice, approximately 4 weeks apart. A total of 2003 participants completed the baseline survey (Time 1: T1) and 1404 (70% of the original sample) completed the follow-up survey (Time 2: T2). Respondents were excluded from the present study if they: (i) did not complete both T1 and T2 surveys ($n = 599$), (ii) did not consume alcohol between T1 and T2 (as they would not have had the opportunity to engage in PBS enactment during the study period) ($n = 61$), (iii) selected *not applicable* for frequency of enactment at T1 or T2 ($n = 78$), or (iv) were classified as multivariate outliers (identified using Mahalanobis distance). The resulting final sample was $n = 1250$. The sample was generally representative of the broader adult population with respect to gender and socioeconomic status, but was slightly younger and more educated (Australian Institute of Health and Welfare. National Drug Strategy Household Survey, 2016) (see Table 1).

2.2. Measures

At both T1 and T2, respondents were asked about their alcohol consumption and frequency of PBS use. Questions assessing demographic characteristics and intentions to reduce their alcohol consumption (*In the next 4 weeks, how likely is it that you will reduce the amount of alcohol you have on each drinking occasion?*; response options: 1 = *definitely will not* to 4 = *definitely will*) were posed at T1 only. To facilitate accurate reporting of alcohol intake levels, respondents were provided with a figure (National Health and Medical Research Council,

Table 1
Sample profile ($n = 1250$).

Demographic attribute	<i>n</i>	Present study	Australian population ^a
		%	%
Gender			
Female	655	52	53
Male	595	48	47
Age			
Mean (<i>SD</i>)	41.76 (14.58)		N/A
18–30 years	354	28	17
31–45 years	421	34	29
46–70 years	475	38	52
Socioeconomic status ^b			
Low	360	29	34
Mid	542	43	41
High	347	28	25
Missing ^c	1	0.1	0
Education			
Tertiary	519	42	31
Non-tertiary	726	58	69
Missing ^c	5	0.4	0
Intentions to reduce alcohol intake (T1)			
Mean (<i>SD</i>)	2.31 (0.78)		N/A
Variance	0.61		N/A
Range	1–4		N/A
Drinks per week T1			
Mean (<i>SD</i>)	9.09 (10.81)		N/A
Variance	116.87		N/A
Range	0.25–52.25		N/A
Drinks per week T2			
Mean (<i>SD</i>)	9.42 (12.38)		N/A
Variance	153.15		N/A
Range	0.25–63.25		N/A

Note. N/A = not available.

^a Percentages for age and gender are estimated from the number of drinkers aged 18+ years sampled in the National Drug Household Survey ($n = 15,350$) and the percentages for socioeconomic status are estimated from the total National Drug Household Survey sample ($n = 23,722$) due to the unavailability of drinker-only data (Australian Institute of Health and Welfare. National Drug Strategy Household Survey, 2016). Percentages for education are based on the Australian Bureau of Statistics’ Education and Work data cubes for persons aged 20 to 64 years (Australian Bureau of Statistics, 2018a).

^b Socio-Economic Indexes for Areas (SEIFA) classification (Australian Bureau of Statistics, 2018b).

^c Treated listwise.

2009) defining standard drink quantities across a broad range of beverage and container types. Alcohol consumption was measured using the following two items from the National Drug Strategy Household Survey (Australian Institute of Health and Welfare. National Drug Strategy Household Survey, 2016): *In the last 12 months, how often did you have an alcoholic drink of any kind?* (Response options: 1 = *I did not have an alcoholic drink* to 8 = *every day*) and *On a day that you have an alcoholic drink, how many standard drinks do you usually have?* (Response options: 1 = *half a drink* to 11 = *20 or more drinks*). At T2, the time period assessed was changed from ‘*In the last 12 months*’ to ‘*In the last 4 weeks*’. At both T1 and T2, responses to both questions were used to calculate the average weekly number of drinks consumed by respondents.

At T1, frequency of PBS enactment was measured by asking respondents *Please indicate how often you do the following when drinking alcohol: ‘Count the number of drinks you have’* (Response options: 1 = *never*; 2 = *rarely*; 3 = *sometimes*; 4 = *usually*; 5 = *always*; adapted from Australian Institute of Health and Welfare. National Drug Strategy Household Survey, 2016). A *not applicable* option was also provided. At T2, enactment frequency was measured by asking respondents how often they counted their drinks ‘*In the last 4 weeks*’. The 5-point PBS scale was treated as continuous, as per previous research. (Kenney &

Labrie, 2013; Martens et al., 2005; Napper, Kenney, Lac, Lewis, & Labrie, 2014; Pearson, Kite, & Henson, 2013; Tyler, Schmitz, Ray, Adams, & Simons, 2018) To derive the independent variable of change in enactment frequency between T1 and T2, scores for frequency of engagement in the 'Count your drinks' strategy at T1 were subtracted from those at T2.

2.3. Statistical analyses

Prior to analysis, data were screened to identify outliers and deviations from expected distributions. Univariate outliers identified on the drinks per week T1 and T2 variables (z -scores > 3.29) (Tabachnick & Fidell, 2013) were replaced with the next highest score (Warner, 2013). As the T1 and T2 drinks per week variables were positively skewed, square root transformations were applied (Cohen, 2003). Descriptive statistics were calculated from the raw data and the transformed variables were used in inferential analyses.

Paired-samples t -tests were conducted to assess changes in alcohol consumption between T1 and T2, with Cohen's d effect sizes calculated using the approach recommended by Morris and Deshon (Morris & Deshon, 2002). A linear regression analysis was conducted to model the relationship between changes in frequency of enactment of the 'Count your drinks' PBS and drinks per week at T2, while controlling for drinks per week at T1, gender, age, education, intentions to reduce alcohol consumption, and change in drinking episode frequency between T1 and T2. To assess the robustness of results across various methodological assumptions, sensitivity analyses (the results of which are presented in the supplementary material) were also conducted in which T2 alcohol consumption was regressed on residualized change scores. Given previous cross-sectional research has observed a curvilinear relationship between PBS enactment and alcohol consumption (Sugarman & Carey, 2007), the potential presence of a curvilinear relationship was assessed. Results were used to calculate change in alcohol consumption associated with increasing frequency of counting drinks at both individual and population levels.

3. Results

Respondents reported consuming an average of 9.09 drinks per week at T1 ($SD = 10.81$), increasing to 9.42 drinks at T2 ($SD = 12.38$). Average frequency of enactment of the PBS 'Count your drinks' increased between T1 ($M = 3.40$, $SD = 1.27$) and T2 ($M = 3.52$, $SD = 1.32$, $t(1249) = 3.16$, $p = .002$, 95% CI = 0.18, 0.04, $d = 0.10$).

Results of the hierarchical regression analysis (presented in Table 2) revealed a significant negative linear effect between change in use

Table 2
Hierarchical regression analysis predicting alcohol consumption at T2.

Predictor	B	SE	95% CI for B	β	p
Step 1					
Age	-0.00	0.00	-0.01, 0.00	-0.02	0.204
Gender	-0.12	0.05	-0.20, -0.03	-0.03	0.012
Education	-0.14	0.05	-0.23, -0.05	-0.04	0.002
Drinks per week T1 ^a	0.87	0.02	0.84, 0.90	0.80	< 0.001
Δ Drinking frequency	0.85	0.02	0.81, 0.90	0.48	< 0.001
Intentions to reduce	0.08	0.03	0.02, 0.14	0.04	0.006
Step 2					
Age	-0.00	0.00	-0.01, 0.00	-0.02	0.155
Gender	-0.11	0.05	-0.20, -0.02	-0.03	0.013
Education	-0.14	0.05	-0.23, -0.05	-0.04	0.002
Drinks per week T1 ^a	0.87	0.02	0.84, 0.90	0.80	< 0.001
Δ Drinking frequency	0.85	0.02	0.81, 0.90	0.48	< 0.001
Intentions to reduce	0.08	0.03	0.02, 0.13	0.04	0.008
Δ Count your drinks (linear)	-0.04	0.02	-0.07, -0.00	-0.03	0.027

Note. T1 = Time 1. T2 = Time 2.

^a Square root transformation applied to variable.

frequency and alcohol consumption, with increases in use frequency between T1 and T2 predicting lower levels of alcohol consumption at T2. The analysis testing for a curvilinear relationship revealed no significant curvilinear effect ($p = .271$). Results were replicated in the sensitivity analyses (shown in the supplementary material).

The coefficients obtained from the linear regression were used to estimate the number of alcoholic drinks consumed per week at each value of change on the 'Count your drinks' PBS scale. Decreases in total alcohol consumption (expressed as drinks/week and drinks/year) potentially resulting from an increase in use from 'never', 'rarely', 'sometimes', or 'usually' to 'always' are simulated in Table 3 (equivalent results for increase to 'usually' are presented in the supplementary material). Increases in frequency of enactment were associated with decreases in alcohol consumption at each level of change, with the most pronounced decrease occurring when simulated use increased from 'never' to 'always'. The derived decrease in alcohol consumption associated with each change increment was extrapolated to the total drinking population to speculatively explore the potential benefit of promoting drink counting to Australian drinkers (Table 3). Calculations indicated that a large reduction in alcohol consumption at the population level (around 49 million fewer standard drinks/year) is possible if drinkers can be encouraged to always count their drinks.

4. Discussion

Our previous research has indicated the efficacy of one particular PBS, 'Count your drinks' (Dekker et al., 2018). The present study extends this work via secondary analyses to calculate the extent of reduction in alcohol intake over time that could be expected in response to increased use of this PBS. This information can be used to estimate the potential cost-benefit outcomes of interventions designed to encourage drinkers to count their drinks more often.

Results revealed that larger increases in enactment frequency were associated with larger reductions in alcohol consumption. These findings are inconsistent with previous research that found the 'Count your drinks' PBS to be part of a category of strategies positively associated with alcohol consumption among US college students (Sugarman & Carey, 2007). Differences in results may be attributed to variations in methodology (e.g., examining PBSs in categories rather than individually and testing the PBSs in student vs adult populations) that preclude direct comparisons. Exploratory analyses extrapolating these results to all Australian adult drinkers demonstrated the potential for substantial reductions in overall alcohol consumption. While these analyses are highly speculative and only provide an indication of possible outcomes, the results illustrate the likely value of harm-minimization messages that explicitly encourage more frequent drink counting. Previous Australian research suggests that around one-third to one-half of drinkers count their drinks 'usually' or 'always' (Dekker et al., 2018; Jongenelis et al., 2016), indicating substantial potential to increase enactment levels. The notion of counting one's drinks is consistent with the Australian low-risk drinking guidelines that are expressed in terms of numbers of drinks consumed (≤ 2 standard drinks on average/day to reduce the risk of long-term harm and ≤ 4 standard drinks on any single drinking occasion to reduce the risk of short-term harm) (National Health and Medical Research Council, 2009). Encouraging drinkers to count their drinks could potentially support greater compliance with these guidelines by making drinkers more aware of their intake levels. Drinkers have a tendency to underestimate the number of standard drinks consumed due to misconceptions about standard servings (Kerr & Stockwell, 2012). Promotion of the 'Count your drinks' PBS may thus need to be accompanied by education on standard servings across beverage types.

4.1. Limitations and future directions

This study had several limitations. First, drinkers were recruited via

Table 3

Simulated reduction in alcohol intake according to increases in enactment of the 'count your drinks' pbs to 'always', based on distribution of PBS enactment at T1.

Change in frequency of enactment ^a	n	%	Average total DPW decrease	Average total DPY decrease	Extrapolated population decrease in DPY (N = 14,700,400 ^b)
Never → always	105	8.4	0.16	8.32	10,273,816
Rarely → always	232	18.6	0.12	6.24	17,061,872
Sometimes → always	280	22.4	0.08	4.16	13,698,421
Usually → always	324	25.9	0.04	2.08	7,919,399
Always	309	24.7	–	–	–
Total	1250	100	–	–	48,953,508

Note. DPW = drinks per week. DPY = drinks per year.

^a Changes in frequency of enactment are based on four point (simulated as never → always), three point (simulated as rarely → always), two point (sometimes → always), and one point (usually → always) progression along the 'Count your drinks' PBS measurement scale.

^b Number of adults in the Australian population who reported consuming alcohol in the last 12 months (Australian Bureau of Statistics, 2018c).

a web panel provider, which may have introduced self-selection bias. The use of quotas to ensure appropriate coverage of various population segments addressed this issue to some extent. Second, PBS usage and alcohol consumption were assessed via self-report and therefore likely subject to social desirability bias. The anonymous survey may have mitigated this bias. Third, alcohol consumption at T1 was based on intake levels over the previous 12 months, whereas alcohol consumption at T2 was assessed over the previous 4 weeks. These time frames may have been differentially affected by recall problems. Fourth, potential confounding factors that were not measured in this study (e.g., drinking refusal self-efficacy or self-regulation) may have influenced the results and could be included in future research. Finally, the results are based on data from Australia, a country where alcohol is an integral part of the culture and consumption is normative (Halim, Hasking, & Allen, 2012). Replication of this research is needed elsewhere to assess generalizability, especially in non-student samples given the focus on this population segment in most prior work.

4.2. Conclusion

This study provides further evidence of the potential reduction in alcohol consumption that could be achieved by promoting the 'Count your drinks' PBS. An important contribution is the estimation of the size of this reduction according to extent of increase in enactment. Although individuals with the largest change in frequency (i.e., 'never' to 'always') benefited the most, any increase in enactment was associated with reductions in consumption. The results highlight the potential efficacy of intervention messages designed around the 'Count your drinks' PBS.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.abrep.2019.100210>.

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