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Substance Abuse Treatment, Prevention, and Policy

RESEARCH

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Tailoring health messages to drinking motives: effects on intentions, self-efficacy, and attentional bias to alcohol stimuli

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Abstract

Background Gain and loss framed health messages are a scalable, low-cost approach to reduce alcohol consumption, yet little is known about whether tailoring such messages to individuals' drinking motives supports their effectiveness in achieving behaviour change. This study assessed whether gain- and loss-framed messages tailored to drinking motives influenced motivation to drink less alcohol.

Method A three-arm parallel randomised experiment was conducted among adults who consumed alcohol at least weekly or engaged in at least one heavy drinking episode per month who expressed an interest in alcohol behaviour change ($N = 554$; mean age = 59.98 years; 68% male). Participants were randomised to receive either a gain-framed or loss-framed vignette (both tailored to their primary drinking motive), or a control vignette. Primary outcomes were intentions to reduce drinking, self-efficacy to reduce drinking, and attentional bias towards alcohol-related cues.

Results Gain-framed and loss-framed messages both led to greater intentions to reduce drinking than those in the control group. The strongest effect on intentions was observed for participants endorsing social motives who viewed loss-framed messages. Gain-framed messages increased self-efficacy to reduce drinking. No overall main effects were observed for attentional bias; exploratory analyses indicated motive-by-framing interactions effects.

Conclusions Motive tailored gain- and loss-framed messages influenced motivational responses associated with alcohol reduction. Drinking motives represent a theoretically grounded and accessible way to personalise alcohol related behaviour change communication. Replication studies incorporating behavioural outcomes could help establish whether motivational effects translate into sustained reductions in alcohol use and why.

Trial registry ISRCN register(ISRCH12456514), 06/03/2024.

Keywords Drinking motives, Health persuasion, Public health, Bayesian Inference, Message framing, Gain-loss framing, Tailored health communication, Alcohol reduction, Hazardous drinking, Behaviour change, Attentional bias

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Introduction

Europe has the highest rate of alcohol consumption per capita and the most alcohol-related harms worldwide [1]. In northern European countries, such as Sweden and the United Kingdom, approximately 80% of adults consume alcohol, with up to 30% engaging in risky drinking (i.e., consuming more than national guidelines) [2, 3]. Drinking at these levels markedly increases the risk for both chronic and acute harms, such as cardiovascular diseases, cancer, liver disease, accidents and injuries, assault, blackouts, and interpersonal problems [4–8]. To reduce the potential for experiencing harm, there is a need to create effective interventions.

Current brief interventions, such as motivational interviewing and brief cognitive behavioural therapy, have demonstrated effectiveness and efficacy in reducing risky drinking by enhancing motivation to change and enabling the development of adaptive coping strategies across a variation of outcomes [9–11]. Nonetheless, these approaches can be resource intensive and can require trained practitioners, highlighting a need for scalable, low-burden alternatives that incorporates understanding of how language can shape outcomes as part of intervention design. Health persuasion messages framed in terms of gains (e.g., drinking less reduces the risk of cancer) or losses (e.g., drinking alcohol increases the risk of cancer) [12], represent one such alternative that offers a brief, accessible means of targeting motivation to change drinking behaviour [12]. Existing findings demonstrate that both types of framing produce moderate effects on consumption, along with increasing intentions to reduce consumption [13–16].

Evidence suggests that persuasive alcohol messages may be differentially effective depending on an individual's motivational and psychological characteristics [15], suggesting that message relevance and responsiveness may potentially be enhanced by tailoring content to personally salient characteristics. One such dimension is an individual's underlying motives for consuming alcohol. Drinking motives derive from the motivational model of alcohol-use, which posits engagement with alcohol consumption is motivated by the prospective outcomes of drinking regarding valence (positive or negative) and source (internal or external) [17]. For example, an individual may drink to achieve an outcome perceived as positive or to avoid a negative one, whilst receiving an internal or external reward. Cooper [18] crossed the dimensions of valence and source to create four drinking motives; enhancement (positive and internal), e.g., drinking to improve mood, social (positive and external), e.g., drinking to facilitate social bonding, coping (negative and internal), e.g., drinking to alleviate negative affect, and conformity (negative and external) e.g., drinking to fit in.

Extant literature highlights that all four motives (enhancement, social, coping and conformity) predict engagement with risky drinking [19–21], and subsequent alcohol-related consequences, including blackouts, impaired control, poor self-care, anti-social behaviour, physiological dependence and interpersonal problems [22–24]. Furthermore, evidence suggests motives act as a proximal driver of consumption, which mediate the effects of other more distal drivers such as alcohol expectancies [25–27]. Motives have also been shown to provide a link between the context of alcohol-use and alcohol consumption; those who drink for enhancement or social motives in social contexts (e.g., at a party with friends) report increased levels of consumption, whilst those drinking for coping motives in non-social contexts (e.g., at home alone) report drinking at a greater frequency [25, 28]. Meta-analytic evidence supports this pattern, indicating that solitary drinking is most strongly associated with coping motives and is linked to greater alcohol-related harm relative to social drinking contexts [29].

In addition, alcohol-related stimuli present in such drinking contexts may preferentially capture attention, particularly among heavier drinkers and those with stronger alcohol-related motivations, potentially contributing to cue-driven drinking behaviour [30]. Many studies focus on self-report measures such as intentions, attitudes, or behavioural outcomes; fewer assess at the cognitive processing level to understand behaviour change, not just report it occurred [13–16, 31]. Assessing how individuals respond to alcohol-related stimuli has the potential to provide insight into whether tailored health messages influence cognitive responses linked to alcohol use.

Overall, existing evidence highlights that drinking motives are proximal drivers of alcohol consumption, predict risky drinking and alcohol-related consequences, and may shape drinking behaviour across various contexts. As motives represent personally meaningful reasons for drinking, they may provide a particularly relevant basis for tailoring health persuasion messages. Messages that explicitly acknowledge an individual's underlying motivations for drinking may be perceived as more personally salient than generic health communication, potentially increasing engagement with message content and responsiveness to recommendations for reducing consumption. It is currently unknown if such tailoring can effectively support changes in drinking-related motivational and cognitive outcomes.

The current study sought to explore if health persuasion messages, tailored to reflect an individual's drinking motives can influence motivation to drink less. Developing and testing personalised messages that reflect an individual's underlying motivations for drinking has the

potential to determine whether drinking motives provide a useful basis for tailoring alcohol-related health messages to enhance motivation to reduce alcohol consumption. To explore this, the study estimated the effects of gain and loss-framed message vignettes, tailored for drinking motives against a control on intentions and self-efficacy to reduce consumption, alongside attentional bias to alcohol-related stimuli as an exploratory indicator of attentional processing.

Method

Study design

A three-arm, parallel groups randomised experiment was used. The intervention groups received either a gain-framed vignette (gain-intervention) or a loss-framed vignette (loss-intervention); the control group received a vignette pertaining to alternative behaviours (e.g., physical activity or completing cognitive tasks). To accommodate a secondary objective of the study, the control group was further randomised to receive either a gain-framed control vignette (gain-control) or a loss-framed control vignette (loss-control). The intervention groups were stratified by drinking motives, each received a vignette matching their respective motive, which reflected their highest endorsed motive mean score. The study was pre-registered on the ISRCTN registry (ISRCN12456514), and ethical approval was waived by the Swedish Ethical Review Authority, due to participants being anonymous (Dnr. 2023-06474-01). There were no deviations from the study protocol after commencement, and the full protocol and analysis plan were published prospectively [32].

Participants and settings

The target population was adults in Sweden and the UK. Participants were recruited using online adverts in Swedish and English (Google and Meta platform). Participants were required to be 18 years of age or older and consume at least one standard drink in the past week (a standard drink contains 12 g of pure alcohol), and/or having one instance of heavy episodic drinking (HED) in the past month. This was defined as drinking 4 or more standard drinks of alcohol in a single session. A threshold of 4 or more standard drinks was applied uniformly across sexes, consistent with the HED threshold recommended by Socialstyrelsen (Swedish National Board of Health and Welfare) [33], which was used as the primary public health reference for risky drinking given the dual-country sample. The UK guidelines also do not delineate by sex. Participants were shown a visual reference guide defining a standard drink that approximated across both countries (with 12 g of pure alcohol a standard drink in Sweden and 8 g in the UK).

Potential participants who clicked a study advert were taken to a webpage containing information outlining the study before being asked to provide informed consent to participate in the study, and have their unidentified responses published. After providing consent, participants completed a baseline survey to assess eligibility (appendix A contains the survey), and the drinking motives questionnaire (Drinking Motives Questionnaire-Revised; DMQ-R) [18]. The individual DMQ-R results were used to create an aggregate score for each motive, with each participant being allocated to a specific motive based on their highest aggregate score.

Interventions

The intervention consisted of ten vignettes, eight experimental that were framed in terms of gains or losses and adapted for each specific drinking motive (enhancement, social, coping and conformity), and two control vignettes, framed in terms of gains or losses of alternate behaviours, other than alcohol consumption. For a detailed description of the vignettes and how they are proposed to impact the outcomes, please see the study protocol from Crawford et al., [32]. Participants meeting eligibility criteria were automatically randomised by the back-end server to receive either a gain-framed intervention vignette, a loss-framed intervention vignette, or a control vignette, which was delivered directly after screening to participants' smartphones.

After viewing the vignette participants were asked to record their intention and self-efficacy to reduce alcohol consumption before completing an alcohol- and neutral Stroop task. Overall, the experiment took approximately 10 min to complete and was done in one session. Finally, participants were thanked for their participation and given links to support websites regarding health and alcohol.

Outcomes and measures

The primary outcomes were: (1) Intentions for reducing alcohol consumption, (2) Self-efficacy for reducing consumption and, (3) Attentional bias to alcohol-related stimuli. A secondary outcome was interest in further information and support, measured by recording if participants clicked on the links to the support websites at the end of the session.

Items used to measure intentions and self-efficacy were adapted from Norman and Conner [34] to reflect plans and ability for reducing alcohol intake. Intentions were measured using three items to record plans for future drinking within a specific timeframe (e.g., "*I plan to reduce my drinking in the next week*"). Self-efficacy was measured using four items reflecting self-belief in being able to reduce drinking (e.g., "*For me, reducing my drinking in the next week would be easy/difficult*"). All items had 5-point Likert scales. Individual items were summed to create an overall score for intentions and self-efficacy

respectively. Internal consistency of the scales was assessed using Cronbach's alpha, which indicated both the intentions scale, α = 0.96, 95% CI [0.92, 0.99] and the self-efficacy scale, α = 0.94, 95% CI [0.90, 0.98] were highly reliable (see appendix A for all survey items).

A Stroop task was used to assess attentional bias in response to alcohol-stimuli. In a Stroop task, participants are presented with words printed in coloured ink and are asked to name the ink colour as quickly as possible while ignoring the word content [35]. When the words are alcohol-related, individuals with elevated attentional bias typically respond slower than to neutral words, as automatic attention is captured by the alcohol content, interfering with colour-naming. This interference effect, known as the Stroop effect, is considered an index of attentional bias towards alcohol-related stimuli [30, 35, 36]. The words used reflected either non-alcoholic drinks (e.g., soda, tea) or a participant's preferred drink (e.g., merlot, bourbon), including popular brand names. Evidence highlights the predictive validity of alcohol-Stroop tasks are improved when using individualised stimuli [36]. Reaction times (milliseconds) to the Stroop task were recorded and compared between stimuli – alcohol vs. neutral. Attentional bias to the alcohol stimuli was assessed via faster reactions to alcohol-related stimuli compared to neutral stimuli (i.e., alcohol reaction time minus neutral reaction time).

Alcohol consumption was assessed using two items based on Socialstyrelsen's public health guidance on risky drinking, noted previously, in terms of the number of standard drinks consumed weekly (12 g of pure alcohol per drink) and the number of HEDs per month (i.e., 4 or more standard drinks in one session). Access to funds – '*If you should suddenly find yourself in a situation where you had to find 1 800 Euros in one week, would you manage it?*' – *'Yes/No'*, was included as a proxy measure of socioeconomic status (SES). This reflected participants' self-reported access to money for everyday expenses.

Randomisation and blinding

Stratified block randomisation grouped participants into fixed-size blocks to ensure allocation was balanced across conditions within each block. Random block sizes of 3 and 6 were used. For blocks of 3, three participants are randomised at a time with 1 participant assigned to each condition. For blocks of 6, six participants are randomised, with two participants assigned to each condition. Once a block was consumed, a new block of either 3 or 6 was randomly created. This procedure ensures that if somebody were to observe the sequence the chance of correctly guessing the next allocation is severely reduced compared to using a fixed block size; however, in this particular trial all procedures were automated and so the risk of the randomisation being subverted was minimal. Randomisation was stratified by preferred drink and motives. Those allocated to the control condition were further randomised to a gain or loss-framed control vignette using simple randomisation. Participants and research personnel were blinded to the conditions, whilst allocation to each arm of the experiment was completed automatically by the backend server, hence neither personnel nor participants were able to discover the allocation sequence.

Data analysis

All randomised participants were included in the analysis (intention-to-treat). Both available data analyses and analyses with missing data imputed were conducted. Missing data was imputed using multiple imputation with chained equations (generating 200 data sets with predictive mean matching) [37]. All regression models were estimated using Bayesian inference with medians of posterior distributions used as point estimates, reported alongside 95% compatibility intervals (CoI) defined by the 2.5% and 97.5% percentiles of posterior distributions [38]. The proportion of the posterior distribution in the direction of the median was used as the probability of effect (PoE). Coefficients for regression covariates were given Student's t priors centred at 0 with 3 degrees of freedom and a scale of 2.5. Error terms were given half-Student's t priors with the same parameterisation.

Self-efficacy and intentions were analysed using linear regression with standardised measures. The models were adjusted for age, sex, current alcohol consumption (weekly consumption and heavy drinking episodes), access to funds and the two stratifying covariates (favourite drink and drinking motives). Past alcohol consumption and access to funds (proxy for SES) were included as covariates to account for potential confounding. The same analytical approach was taken for attentional bias to alcohol-cues. Information and support interest was modelled as a binary variable (i.e., clicked or did not click), and the effect was estimated using logistic regression and adjusted for the same variables outlined for the primary outcomes. To estimate if drinking motives moderated the primary analysis, linear regression models with an interaction term between group allocation and drinking motives (including the covariates from the non-interactional model) was used.

To assess effects between the message frames, the control condition was used as the reference category, whilst the largest motive group (i.e., enhancement) was used as the reference category for effects between motives and interactions with message framing. Interaction estimates therefore indicated whether the effect of a given message frame relative to the control condition differed between each motive group and the enhancement reference group.

To investigate systematic attrition to follow-up, non-response to primary outcomes were modelled using logistic regression including covariates for all baseline variables, group allocation, and interaction terms between each baseline variable and group allocation. Cauchy priors centred at 0 with standard normal hyper-priors for the scale parameter that shrink coefficients towards the null were used to account for the excessive number of parameters included in the models. To For the full analysis plan, see the protocol [32].

Sample size

A Bayesian sequential design was used to monitor recruitment. As data became available, the primary outcomes were modelled according to the analysis plan, and the coefficients for group allocation were assessed for effect, harm and futility. Please see the study protocol for details [32]. Recruitment ended on 16/06/2024 at which point the criteria were deemed sufficiently met.

Results

Figure 1 describes the participant flow through a CONSORT flow-diagram. Between 24/03/24 and 16/06/24, 1030 participants showed interest, 660 completed the baseline measures, with 106 being excluded. A total of 554 individuals were randomized, 417 from Sweden and 137 from the UK. Table 1 presents sample characteristics. Most participants were male, had secondary education, access to money, and reported drinking at risky levels. The average weekly consumption was approximately 12 standard drinks per week, and participants engaged in approximately seven episodes of heavy drinking monthly (>4 standard drinks per occasion). Table 2 presents the group scores for intentions, self-efficacy. and attentional bias scores in milliseconds.

Intentions

Results for intentions to reduce alcohol consumption are reported in Table 3. Effects were observed for both intervention groups against the control (as a whole), with the largest effect observed in the loss intervention group against the control. Secondary analyses comparing the intervention groups against the framed control groups (i.e., gain-control and loss-control) found that the effect was again largest for the loss-framed intervention group compared to both control groups. The effect of the gain-intervention was only evident when compared to the loss-control, whilst there was no evidence of effect when compared against the gain-control group. An effect of framing was observed, with the loss-framed intervention having a greater effect on intentions than the gain-framed intervention.

Interaction effects between motives and message framing were also observed. Using enhancement motives as the reference category, there was evidence of an interaction between social motives and loss framing: the increase in intentions associated with loss framing relative to the control condition was greater for participants endorsing social motives than for those endorsing enhancement motives. Additionally, when using social motives as the reference category, increases in intentions for those viewing the loss-framed message relative to the control, were greater for participants who endorsed social motives than those endorsing conformity motives (PoE = 85.7%) and coping motives (PoE = 97.7%) (see appendix D for the additional analyses). Overall, loss-framed messages appeared particularly effective for individuals whose drinking was motivated by social reasons. No strong evidence for the remaining motive-by-framing interactions was observed. Figure 2 highlights the interaction effects.

Self-efficacy

Results for self-efficacy to reduce consumption are reported in Table 4. An effect was observed for the gain-framed intervention group against the control (as a whole), suggesting that the gain framed vignettes produced higher self-efficacy. There was no evidence for an effect on self-efficacy when comparing the loss-framed intervention group against the control group. Secondary analyses comparing the intervention groups against the framed control groups (i.e., gain-control and loss-control) provided evidence of an effect of the gain-framed intervention group compared to both control groups, whilst no effects were observed for the loss-framed intervention group against both control groups. An effect of framing was observed, with the gain-framed intervention having a greater effect on self-efficacy than the loss-framed intervention.

Interaction effects between motives and message framing were also observed. Negative interactions were observed between conformity motives and both loss and gain-framed messages, indicating that the effects of both message frames relative to the control condition on self-efficacy were smaller among participants endorsing conformity motives than among those endorsing enhancement motives. Additionally, using conformity motives as the reference group, also showed when viewing the loss-frame message those endorsing conformity motives recorded lower self-efficacy relative to the control condition than participants endorsing social motives (PoE = 96.2%) and coping motives (PoE = 99.1%). Furthermore, the conformity motives model also showed when viewing the gain-frame message, those endorsing conformity motives recorded lower self-efficacy relative to the control, than those endorsing social motives (PoE = 87.3%) and coping motives (PoE = 87.1%) (see appendix D for full results).

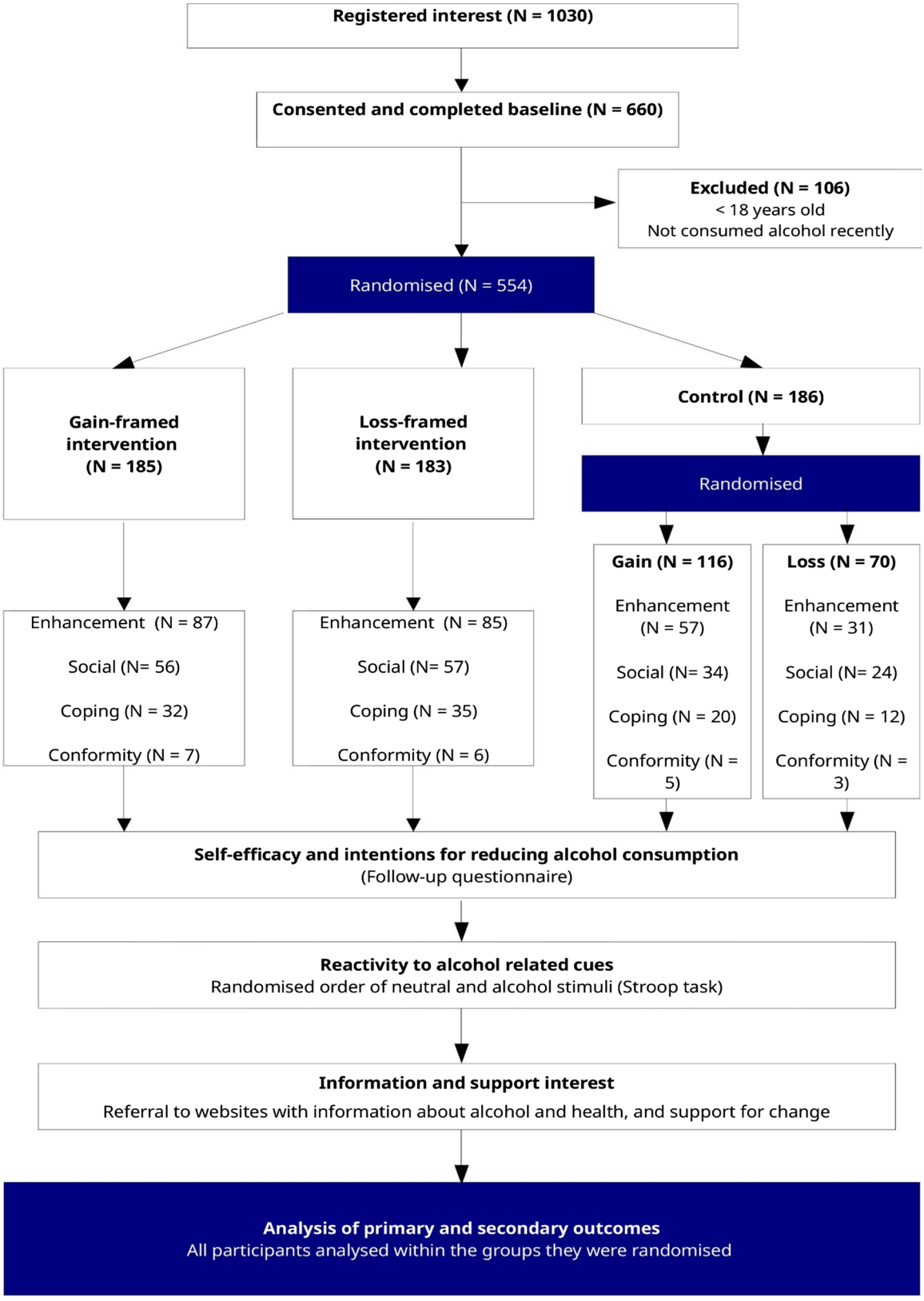

Fig. 1 Participant flow

Table 1 Sample characteristics and alcohol consumption

	Total	Intervention-Gain (n=185)	Intervention-Loss (n=183)	Control – Gain (n=116)	Control – Loss (n=70)
AgeMean (SD)Median (IQR)	59.98 (11.92)62 (13)	59.48 (12.51)61 (15)	59.67 (11.11)60 (13)	60.53 (12.51)63 (13)	61.23 (11.51)63 (11)
Region (N)					
Sweden	417	139	136	87	55
UK	137	46	47	29	15
Gender (N)					
Female	177	60	57	40	20
Male	377	125	126	76	50
Education (N)					
None	12	3	6	3	0
High School	68	22	27	14	5
College/ Sixth Form	222	80	73	38	31
University	223	67	72	52	32
Other	29	13	5	9	2
Books at home (N)					
0-10	107	32	38	26	11
11-100	142	42	51	30	19
101-500	271	97	87	53	34
500+	34	14	7	7	6
Access to money					
Yes	470	157	162	92	59
No	84	28	21	24	11
Weekly Alcohol ConsumptionMean (SD)Median (IQR)	11.89 (11.89) 8 (11)	11.63 (11.30)9 (11)	11.80 (11.30)9 (13)	12.00 (11.80)8.5 (11)	12.51 (11.74)8 (12)
Monthly HEDs Mean (SD)Median (IQR)	7.39 (8.77)4 (8)	7.09 (8.85)4 (7)	7.67 (8.55)4 (8)	7.58 (8.90)4 (8)	7.14 (9.10)4 (7)
MotiveEnhancementSocialCoping Conformity	26017110221	8756357	8556356	5734205	3124123

However, the number of participants endorsing conformity motives was small, suggesting uncertainty with these estimates, hence these findings should be interpreted with caution. No strong evidence for the remaining motive-by-framing interactions was observed. Figure 3 highlights the interaction effects.

Attentional bias

Results for attentional bias are reported in Table 5. There was no observed effect of either intervention group against the control group (as a whole), or effects observed for the intervention groups against the framed control groups. No effects of framing were observed (i.e., gain-intervention vs. loss-intervention). An interaction between motives and message framing was observed for coping motives and loss-framed messages. The effect of loss-framing relative to the control condition on attentional bias scores was lower among participants endorsing coping motives than those endorsing enhancement motives, indicating a greater reduction in attentional bias towards alcohol-related stimuli (see appendix B). Additionally, using coping motives as the reference group, also showed when viewing the loss-frame message those endorsing coping motives recorded lower attentional bias scores relative to the control condition, than participants endorsing social motives (PoE = 98.2%) and conformity motives (PoE = 87.6%) (see appendix D for full results). This finding suggests loss-framed messages may have altered cognitive processing of alcohol-related stimuli among individuals who primarily drink to cope, potentially reducing the attentional salience of alcohol stimuli within this group.

Further information and support

Results for seeking additional information and support highlighted no overall differences between the intervention groups and the control; these can be found in appendix C.

Discussion

The current study assessed if tailoring health persuasion messages framed in terms of gains or losses to drinking motive preferences, can impact both motivations to drink less (intentions and self-efficacy to reduce consumption), and cognitive responses linked to alcohol use (attentional bias to alcohol-related stimuli). Effects on intentions for both gain and loss-framed intervention groups were observed, and effects of the gain-framed intervention group were found for self-efficacy. Whilst overall no effects were observed for either intervention group for attentional bias, those who endorsed coping motives recorded slower reactions to the alcohol stimuli when viewing loss-framed messages. Furthermore, the results are consistent with suggestions that individual motivational and psychological characteristics may influence responses to persuasive alcohol messages [15]. The observed motive-by-framing interactions suggest that drinking motives may shape how individuals respond to gain- and loss-framed health messages, supporting their potential value as a basis for message tailoring.

Table 2 Group Scores for Intentions, Self-Efficacy and Attentional bias depending on the message frame. [1] scores for a single participant

Message frame						
		Intervention-Gain	**Intervention-Loss**	**Control-Gain**	**Control-Loss**	**Control-Total**
Intentions M (SD)	Total	7.17 (4.47)	7.53 (4.25)	6.38 (4.47)	5.82 (4.86)	6.16 (4.62)
	Motive					
	Enhancement	7.25 (4.34)	6.92 (4.54)	7.03 (4.38)	4.77 (4.67)	6.19 (4.58)
	Social	6.32 (4.55)	8.22 (3.94)	4.96 (4.56)	5.53 (4.79)	5.17 (4.60)
	Coping	8.12 (4.72)	7.72 (3.96)	7.08 (4.25)	8.30 (4.88)	7.64 (4.48)
	Conformity	9.50 (0.71)	11 ([1])	9.50 (3.54)	6.67 (6.11)	7.80 (4.92)
Self-Efficacy M (SD)	Total	12.11 (4.71)	11.73 (4.80)	11.42 (5.14)	10.68 (5.52)	11.13 (5.28)
	Motive					
	Enhancement	12.65 (3.88)	11.53 (4.96)	10.97 (5.29)	10.64 (5.34)	10.85 (5.27)
	Social	14.10 (3.44)	13.40 (3.12)	13.44 (3.66)	11.87 (5.48)	12.88 (4.40)
	Coping	7.72 (5.72)	9.44 (5.86)	8.17 (6.01)	7.80 (5.87)	8.00 (5.81)
	Conformity	11.00 (1.41)	7 ([1])	12.00 (5.66)	14.67 (2.31)	13.60 (3.58)
Attentional bias M (SD)	Total	-155.65 (791.29)	-195.47 (1044.40)	-224.22 (1097.83)	-129.18 (604.06)	-187.10 (934. 71)
	Motive					
	Enhancement	-60.52 (569.56)	-286.99 (1152.65)	-191.22 (622.61)	-93.23 (452.37)	-154.68 (563.02)
	Social	-169.97 (791.77)	-224.27 (906.44)	-36.70 (1221.35)	-190.92 (612.74)	-91.78 (1039.11)
	Coping	-226.16 (805.91)	112.12 (980.68)	-880.44 (1618.02)	-31.90 (912.99)	-494.74 (1384.04)
	Conformity	-1841.83 (3654.56)	-732.34 ([1])	-571.09 (1960.28)	-408.45 (452.45)	-16.64 (1162.27)

Table 3 Estimated effects on intentions to reduce alcohol consumption

Primary Analyses	**Estimate**	**Probability**
Gain vs. Control	0.17 (-0.05; 0.38)	93.2%
Loss vs. Control	0.31 (0.09; 0.52)	99.7%
Secondary Analyses	**Estimate**	**Probability**
Gain vs. Gain-Control	0.07 (-0.19; 0.31)	69.7%
Loss vs. Gain-Control	0.21 (-0.03; 0.46)	95.4%
Gain vs. Loss-Control	0.34 (0.05; 0.63)	98.8%
Loss vs. Loss-Control	0.48 (0.19; 0.77)	> 99.9%
Framing Effects	**Estimate**	**Probability**
Loss vs. Gain	0.14 (-0.07; 0.36)	90%
Interactions	**Estimate**	**Probability**
Gain	0.14 (-0.17; 0.46)	81.3%
Loss	0.20 (-0.11; 0.51)	89.9%
Social x Gain	0.09 (-0.28; 0.73)	80.9%
Social x Loss	0.69 (-0.01; 0.99)	97.2%
Coping x Gain	-0.03 (-0.74; 0.43)	71.2%
Coping x Loss	0.01 (-0.77; 0.40)	73.5%
Conformity x Gain	-0.34 (-1.61; 0.66)	79.2%
Conformity x Loss	0.02 (-1.25; 0.90)	62.4%

Estimate – Median of the posterior distribution of mean difference of standardized scores with 95% compatibility intervals represented by the 2.5 and 97.5 percentiles of the posterior distribution.**Probability** – Proportion of the posterior distribution in the direction of the median, i.e., the probability of any effect.**Interactions** – Enhancement motives scores used as the reference group

Effects on intentions to reduce consumption, versus control, were more pronounced in the loss-intervention group than the gain-intervention group. These findings are consistent with literature that found loss-framed messages are more effective for increasing intentions to reduce consumption [14]. This effect may have been driven by how they potentially influenced attitudes towards reducing consumption, i.e., by eliciting negative affect. Negative affect has been shown to have a positive relationship with attitudes to limit consumption [39] and it may have influenced attitudes by heightening both emotional salience and risk perceptions [40, 41], resulting in a greater sense of urgency or desire to change behaviour (reflected in greater intentions to reduce consumption). Current evidence has shown that loss-messages eliciting negative affect (e.g., fear, disgust, shame and regret) are more effective for reducing drinking

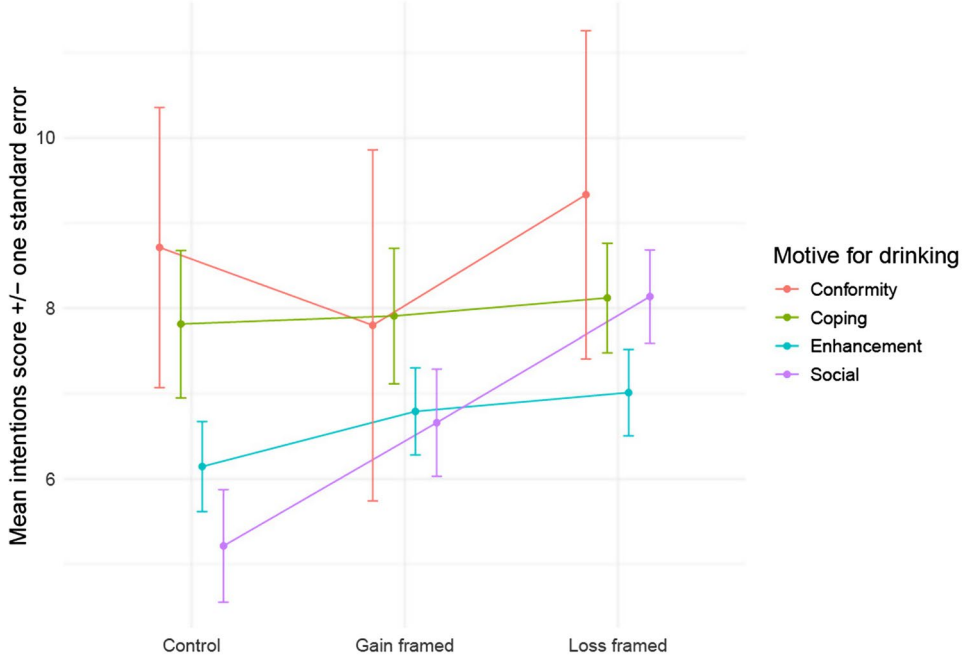

Fig. 2 Interaction of message frame and motives on Intentions

Table 4 Estimated effects on self-efficacy to reduce alcohol consumption

Primary Analyses	**Estimate**	**Probability**
Gain vs. Control	0.19 (0.01; 0.37)	98.0%
Loss vs. Control	0.07 (-0.12; 0.24)	76.0%
Secondary Analyses	**Estimate**	**Probability**
Gain vs. Gain-Control	0.17 (-0.03; 0.37)	95.1%
Loss vs. Gain-Control	0.05 (-0.15; 0.25)	68.3%
Gain vs. Loss-Control	0.22 (0.03; 0.47)	95.6%
Loss vs. Loss-Control	0.06 (-0.15; 0.27)	72.1%
Framing Effects	**Estimate**	**Probability**
Loss vs. Gain	-0.13 (-0.31; 0.05)	92.1%
Interactions	**Estimate**	**Probability**
Gain	0.23 (-0.03; 0.49)	95.7%
Loss	0.07 (-0.18; 0.33)	71.0%
Social x Gain	0.21 (-0.44; 0.40)	53.2%
Social x Loss	0.03 (-0.45; 0.36)	58.7%
Coping x Gain	0.21 (-0.50; 0.47)	51.9%
Coping x Loss	0.30 (-0.25; 0.72)	82.8%
Conformity x Gain	-0.43 (-1.60; 0.29)	91.3%
Conformity x Loss	-0.93 (-1.94; -007)	98.2%

Estimate – Median of the posterior distribution of mean difference of standardized scores with 95% compatibility intervals represented by the 2.5 and 97.5 percentiles of the posterior distribution.**Probability** – Proportion of the posterior distribution in the direction of the median, i.e., the probability of any effect.**Interactions** – Enhancement motives scores used as the reference group

intentions than gain-messages eliciting positive affect (e.g., relief, pride, dignity) [14, 42–44].

Motives also interacted with message frame to impact intentions. All the interaction models highlighted that participants endorsing social motives recorded a stronger response to the loss-framed messages than those with any other motive, when exposed to the same message in comparison to the control. Individuals who drink primarily for social reasons may be particularly responsive to messages emphasising the social consequences of excessive drinking. The loss-messages may have caused social drinkers to reassess their alcohol-use, as the losses highlighted the potential for damaging relationships from excess drinking. This sentiment is at odds with the underlying external source of motivation for social motives, (i.e., the desire for social belonging) [18], hence they may

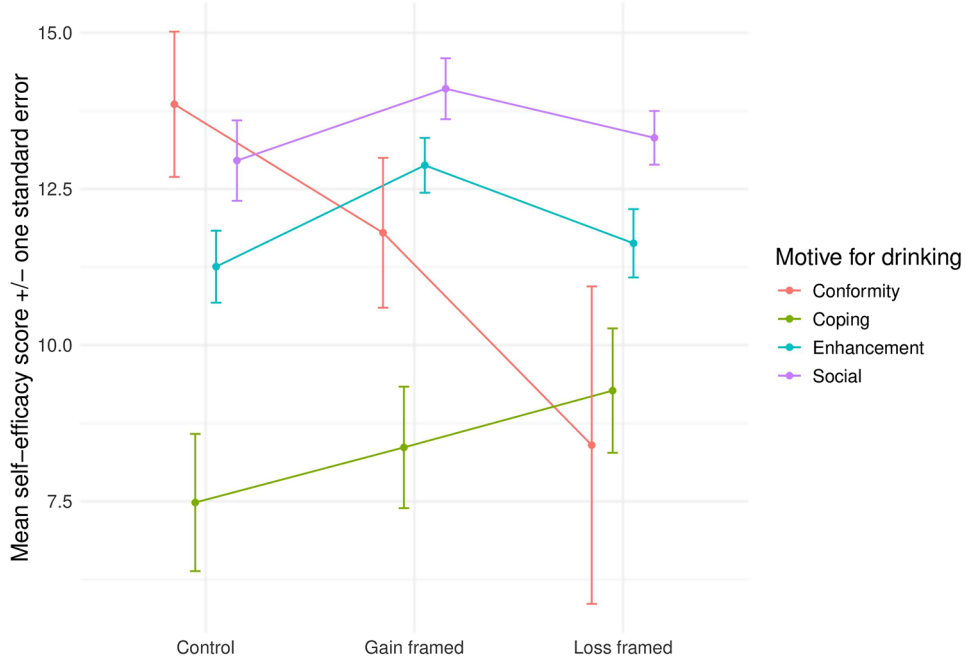

Fig. 3 Interaction of message frame and motives on self-efficacy

Table 5 Estimated effects of attentional bias

Primary Analyses	**Estimate**	**Probability**
Gain vs. Control	0.03 (-0.22; 0.28)	59.6%
Loss vs. Control	-0.04 (-0.29; 0.20)	63.3%
Secondary Analyses	**Estimate**	**Probability**
Gain vs. Gain-Control	0.06 (-0.22; 0.36)	66.7%
Loss vs. Gain-Control	-0.01 (-0.29; 0.28)	52.1%
Gain vs. Loss-Control	-0.05 (-0.38; 0.28)	60.8%
Loss vs. Loss-Control	-0.15 (-0.48; 0.19)	80.3%
Framing Effects	**Estimate**	**Probability**
Loss vs. Gain	-0.1 (-0.35; 0.15)	78.4%
Interactions	**Estimate**	**Probability**
Gain	0.07 (-0.29; 0.42)	64.7%
Loss	-0.17 (-0.52; 0.18)	82.6%
Social x Gain	-0.18 (-0.67; 0.45)	65.1%
Social x Loss	-0.17 (-0.55; 0.55)	50.3%
Coping x Gain	0.22 (-0.38; 0.96)	80.5%
Coping x Loss	0.66 (0.16; 1.50)	99.2%
Conformity x Gain	-1.79 (-3.52; -0.24)	98.8%
Conformity x Loss	-0.74 (-2.55; 1.36)	71.3%

Estimate – Median of the posterior distribution of mean difference of standardized scores with 95% compatibility intervals represented by the 2.5 and 97.5 percentiles of the posterior distribution.**Probability** – Proportion of the posterior distribution in the direction of the median, i.e., the probability of any effect.**Interactions** – Enhancement motives scores used as the reference group

have experienced cognitive dissonance from the loss-messaging, leading to an increase in intention to reduce consumption. Effects may have been similar for enhancement drinkers, with the messages highlighting how excess drinking results in negative-affective states, which again may be at odds with the internal motivation driving enhancement. However, as these effects were personal (i.e., internal) in nature the effect on decision-making may not have been as pronounced as the social-loss messages (i.e., external), as these personal consequences may have needed longer to be internalised. Further exploration in studies exploring behavioural outcomes and longer follow-up periods would be helpful to explore this finding.

A motive-tailored messaging approach should take into account the emotional valence underlying the motive.

Specifically, positive affect motives (social and enhancement) drove the interactions with loss-framed messages, whereas negative affect motives (coping) showed no such pattern in this context. This distinction suggests that the direction of the emotional mismatch between a motive and a message frame may be relevant when developing motive-tailored alcohol messages.

Effects on self-efficacy to reduce consumption were observed for the gain-intervention group, whilst no effects were found for the loss-intervention group. This suggests that messages emphasising the benefits of drinking less may be more effective for increasing an individual's confidence in ability to reduce consumption, than messages emphasising the costs of continued drinking. The gain-messages may have elicited positive affect, which may account for these results. Positive affect is an important factor for increasing confidence in ability and shaping self-efficacy beliefs [45]. In addition, the gain-frame messages provided an upward social comparison of individuals who had successfully changed drinking behaviour, which may have further enhanced self-efficacy by influencing behavioural beliefs regarding the value of reducing consumption [46]. Existing findings highlight positive social comparisons on social media, can help reinforce the notion of moderate drinking or abstinence as socially acceptable, hence helping to reinforce beliefs [47]. The results suggest that gain-framed emphasising the personal benefits of drinking less may be particularly useful for increasing confidence to change. Furthermore, the findings also suggest that gain-frame messages incorporating positive social comparisons may support self-efficacy for reducing consumption. Nonetheless, as self-efficacy was assessed immediately following message exposure, future studies should determine whether these effects persist overtime and translate to changes in drinking behaviour.

The self-efficacy results also highlighted a potentially different pattern for conformity drinkers, with interactions highlighting lower self-efficacy scores across both message frames. Individuals who drink for conformity reasons are often motivated by a desire to avoid social exclusion and may experience greater sensitivity to perceived drinking norms [19]. Nonetheless, the models estimating the effects contained low sample numbers (8 for loss-messages and 12 for gain-messages), resulting in substantial uncertainty around these estimates. Accordingly, findings for this motive group should be regarded as exploratory and interpreted with caution. Whilst the results indicate that the message formats were less responsive to the needs of individuals who drink for conformity reasons, replication in a larger sample is required before conclusions can be drawn regarding motive specific message effects in this group.

No overall effects were observed for either intervention group for attentional bias, suggesting the messages had limited impact on attentional processing of alcohol-related stimuli. Whilst the messages were designed to increase the personal relevance of alcohol-related consequences, a single brief exposure may not have been sufficient to alter attentional responses to alcohol stimuli. Attentional bias is influenced by a range of cognitive, motivational and contextual factors [48, 49], and these influences may not be readily modified through a brief message-based intervention.

Coping motives interacted with loss-messaging to impact attentional bias. All the interaction models highlighted that, those endorsing coping motives who received a loss-framed message demonstrated lower attentional bias towards alcohol-related stimuli than any other motive group, in comparison to the control. This suggests that messages highlighting the personal consequences of alcohol use may reduce the attentional salience of alcohol-related stimuli among individuals who drink to cope. This effect may have been driven by the impact of the loss-messages on heightening risk perceptions regarding alcohol. Individuals who drink for coping reasons may be less sensitive to risk as the expectancy of immediate relief from negative affect alcohol provides is often salient in comparison to the longer-term consequences of alcohol-use [18, 24]. By focusing on the short-term personal consequences of alcohol use, the loss-framed message may have temporarily increased the accessibility of negative alcohol outcome expectancies, which have previously been linked to attentional responses to alcohol-related stimuli [50]. This finding should be considered exploratory as the study did not expressly assess expectancies; however, the interaction does raise the possibility that motives-tailored loss-framed messages may influence attentional processing of alcohol-related stimuli among a particular set of drinkers. Future studies should explore if such changes in attentional processing are associated with subsequent changes in alcohol-related behaviour.

Limitations

The vignettes used in the study presented hypothetical scenarios and hence could not realistically capture the dynamics of real-world decision-making. Whilst the vignettes can only offer an approximation of reality, the outcome measures for motivation to drink less were proxies for behaviour, hence reflected hypothetical responses rather than observed behaviour. The outcomes assessed (intentions, self-efficacy, and attentional bias to alcohol stimuli) are proximal, theoretically meaningful indices that precede behaviour change; they should not be taken as evidence of direct effects on alcohol consumption. Replication using behavioural outcomes (e.g.,

alcohol diary data, ecological momentary assessment) is needed before conclusions about real-world efficacy can be drawn. Accordingly, the findings should be viewed as an early step in understanding how motive-tailored health messages influence motivational and cognitive responses associated with reduced consumption. Nonetheless, evidence suggests individuals' reports of behaviour in vignette studies are comparable to behaviour recorded in real-world settings [51].

Furthermore, the study used aggregated, dispositional motive scores to assign participants to message conditions. Whilst accounting for multiple motives was impractical within the current design, assignment based on a single dominant domain may have attenuated observed effects, as individuals with closely competing motives may not have been best served by their allocated message content. Future studies could adopt a more precise approach, such as latent profile analysis, to identify subgroups with distinct versus mixed motive profiles prior to allocation. This would also allow for a direct test of whether motive-message congruence moderates message effects.

The age of the sample limits the findings generalisability, with most individuals being middle aged. Nonetheless, there is a lack of evidence pertaining to this age group and current findings suggest this group has increased their consumption over the last decade in both Sweden and the UK [2, 3]. A further strength of the study is that the sample contained a substantial proportion of individuals reporting risky drinking. As these individuals are likely to represent an important target group for alcohol reduction interventions, the findings may be particularly informative for understanding how tailored health messages influence motivational and cognitive responses among drinkers already at elevated risk.

Younger and higher-risk populations may exhibit different patterns of motive-framing interactions, and replication across these groups is needed to assess the breadth of intervention effects. Additionally, whilst the dual-country design (Sweden and the UK) increases external validity relative to a single-country study, Sweden and the UK differ in their drinking cultures, alcohol pricing policies, and public health approaches to alcohol [1]. Similarly, a standard drink differs between countries as 8 g in UK and 12 g in Sweden. Findings may therefore not generalise readily to other national contexts, and we invite other researchers to replicate this inquiry and report on their findings to facilitate an understanding across a broader range of populations and cultural contexts [2, 3].

Conclusion

The current study explored whether tailoring gain, and loss-framed health persuasion messages to drinking motives could influence motivational and cognitive responses linked to alcohol reduction. Both gain, and loss messages influenced motivations to drink less, with loss-framed message producing stronger effects on intentions to reduce consumption and gain-framed message had stronger effects on self-efficacy. Overall, no effects were observed for attentional bias, however motive-by-framing interactions suggest that different motive groups may respond differently to framed health messages. The results of the study can be viewed as an early step in understanding how motives-tailored health messages influence motivational and cognitive responses associated with alcohol reduction. Future research should determine whether these immediate responses translate into meaningful changes in drinking behaviour and if tailoring content for drinking motives can enhance the effectiveness of alcohol interventions.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13011-026-00778-7.

Supplementary Material 1

Supplementary Material 2

Author contributions

JC: Conceptualisation, data analysis, lead writing, editing manuscript. KUG: editing manuscript. RC: Editing manuscript. GWS: Editing manuscript. MB: data collection, data analysis, editing manuscript, funding acquisition.

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Data availability

Data is available upon reasonable request.

Declarations

Ethical approval

Swedish Ethical Review Authority (Dnr. 2023-06474-01).

Competing interests

MB owns and operates a private company 'Alexit AB' that provided the software platform for conducting the study. Alexit AB did not influence the design, analysis or writing of the study manuscript.

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