# The Social Life of Persuasive Health Messages: How Alcohol-Craving is Affected by a Complex Information Environment

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# Abstract

Persuasive messages have largely unexplored "social lives" in which they compete and interact with other related and possibly contradictory messages in the information environment. Communication science extensively studied individual message types, such as pro- or anti-alcohol information, but has rarely compared different types directly to each other, leaving open questions about differences and similarities in the effectiveness of competing messages and in the mechanisms underlying their effects. Across three studies, we directly compared a diverse set of alcohol-related messages to their real-world competitors (pro-, anti-, and non-alcohol(ic) messages from professional and peer sources) in order to understand the relative impact of these messages on alcohol craving as well as the mechanisms that drive these effects. We found that, although both pro- and

anti-alcohol information are linked to craving in expected ways, the effects of pro-alcohol information are substantially larger, especially among frequent binge drinkers. Emotional responses and perceived familiarity of the alcohol content emerged as relevant mechanisms of the effects of both pro- and anti-alcohol information, but relationships between these responses and alcohol craving tended to be stronger in pro- compared to anti-alcohol messages. Our work highlights that studying the real-world competition and interactions between different types of persuasive messages is crucial to understanding and predicting the effectiveness of any given persuasive message.

*Keywords:* alcohol craving, anti-alcohol messages, persuasion, alcohol marketing, emotions, familiarity

# The Social Life of Persuasive Health Messages: How Alcohol-Craving is Affected by a Complex Information Environment

Persuasive messages live largely unexplored "social lives". Within rich information environments a message interacts and competes with its "peers", that is other messages that are relevant to the same attitude or behavior and may or may not be congruent with the focal message (Hendriks et al., [2018;](#_bookmark16) Scholz et al., [2019;](#_bookmark37) Stautz et al., [2016;](#_bookmark40) Young

et al., [2018).](#_bookmark43) This competition is poorly understood, but likely creates interference between message effects. This creates a significant barrier to our ability to predict the impact of any given persuasive message. For instance, like most daily choices, alcohol consumption has pros and cons. It is a social catalyst, associated with good friends and fun times (Duckworth et al., [20](#_bookmark11)21), but also a leading cause of death and disease across many countries when used irresponsibly (OECD, [2016)](#_bookmark33). In line with this ambiguity, diverse stakeholders, from alcohol brands, to public health officials, to party-loving friends and concerned family members, have strong interests in influencing alcohol consumption. Their voices create a rich information environment which facilitates frequent exposures to

alcohol-related information of different types which vary in valence (pro/anti-alcohol) and source (peers or professionals). Extensive research has examined and optimized individual information types (e.g. pro-alcohol messages; Jernigan et al., [2017;](#_bookmark20) Stautz et al., [2016](#_bookmark40) and anti-alcohol messages; Young et al., [2018),](#_bookmark43) but has rarely compared them to each other directly. How do alcohol-related messages differing in valence and source compare in their effects on alcohol craving and do they impact their target audience through similar or different psychological mechanisms? Across three exploratory studies, we present initial evidence highlighting the importance and potential of research across competing message types.

# Persuasion in Complex Information Environments

How do people make health decisions in complex, ambiguous information environments such as that surrounding alcohol consumption? The human brain is capable

of seamlessly considering and weighting myriad factors relevant to a decision at high speeds (Busemeyer et al., [2019).](#_bookmark7) Fitting with this neural choice architecture, value-based models of human behavior and decision-making such as the Reasoned Action Approach (Fishbein and Ajzen, [2010)](#_bookmark13) and the Identity-Value Model (Berkman et al., [2017)](#_bookmark2) describe an integration process where diverse information relevant to a choice at hand (e.g. social norms and attitudes) is integrated and weighed before feeding into a final signal (e.g. behavioral intention) which encodes the overall value of a given choice option (Levy and Glimcher, [2011)](#_bookmark27) and, subsequently, influences choice behavior (for a review, see Falk and Scholz, [2018).](#_bookmark14) In other words, theory suggests that target groups of persuasive messaging about alcohol likely consider and integrate multiple types of alcohol-related information (e.g. both pro- and anti-alcohol information from friends and professionals) when making drinking decisions. Given the lack of research that considers a variety of competing persuasive messages relevant to the same decision, we know little about this integration process in complex persuasion contexts.

One research tradition in communication science has actively considered interactions between related information types and has demonstrated the potential of such approaches. Specifically, Katz and Lazarsfeld’s Two-Step Flow model (Katz, [1957;](#_bookmark22) Katz and Lazarsfeld, [1955)](#_bookmark23) posits that mass media messaging does not influence its target group directly, but through the gate-keeping efforts of so-called opinion leaders who further distribute and help interpret mass media information within their network. Extending these ideas, more recent work has shown that social interactions about mass media content cannot only influence who is exposed to these messages, but how these messages impact their receivers (Jeong and Bae, [2017;](#_bookmark21) Southwell and Yzer, [2007).](#_bookmark39) The outcomes of such interference depend, among others, on the type of social interactions (e.g. their valence). Conversation partners could help each other contextualize and thereby increase the self-relevance of a campaign message, enhancing campaign effects (e.g. van den Putte et al., [2011),](#_bookmark42) or ridicule or otherwise derogate the campaign message, causing boomerang effects (e.g. David et al.,

[2006).](#_bookmark9) In the context of alcohol consumption, effects of anti-alcohol messaging has been found to be partially mediated by the valence (pro- or anti-alcohol) of subsequent interpersonal conversations (e.g. Hendriks et al., [2012).](#_bookmark15) Another study found that the strength of risky peer influence (in the form of daily pro-alcohol conversations) on drinking behavior was moderated by neural responses to anti-alcohol messaging (Scholz et al., [2019).](#_bookmark37)

In sum, theory and (severely limited) empirical evidence suggest that contradictory types of alcohol information from different sources interact with each other in their effects on alcohol consumption. Yet, apart from a relatively small literature on one specific type of interference effect (namely social interactions about persuasive messages), persuasion research remains split into somewhat disconnected fields and direct comparisons are lacking. For instance, research on social influences on alcohol consumption (e.g. Borsari and Carey, [2001)](#_bookmark6) rarely intersects with work on professionally produced messaging (e.g.

Jeong and Bae, [2017;](#_bookmark21) Jernigan et al., [2017)](#_bookmark20) and work on pro-alcohol messages rarely also considers anti-alcohol message effects. This results in incomparable data using different outcome variables, different operationalizations of key concepts, and different theoretical foundations and a knowledge gap regarding the nature of the real-world competition between message types:

Research Question (RQ)1: What are the relative effects of alcohol-related messages varying in valence (pro- vs. anti-alcohol vs. non-alcoholic) and source (professionally vs. peer-produced) on alcohol craving?

We first test two basic assumptions about the effects of pro- and anti-alcohol information within the general information environment :

H1: Exposure to pro-alcohol messaging compared to messages about non-alcoholic drinks will lead to higher alcohol craving, and craving will be higher in response to

non-alcoholic compared to anti-alcohol messages.

H2: Exposure to pro-alcohol messaging compared to anti-alcohol messaging is specifically associated with an increase in alcohol craving, as opposed to craving for any

beverage.

Given the absence of direct comparisons, the existing literature base is uninformative with regards to the relative size of the pro- vs. non-alcoholic and the non- vs. anti-alcohol effects. In order to reduce (risky) alcohol consumption, is it more effective to add more anti-alcohol messaging to the environment or remove pro-alcohol messaging?

Similarly, source effects in this space are relatively unexplored. Are well-designed and well-funded campaigns more successful in influencing alcohol craving or do relatable peer-produced messages outperform professional campaigns? We will explore these questions here.

# Drivers of Alcohol Craving

In order to design reliable, and generalizable interventions, it is crucial to understand the psychological mechanisms that underlie a message effect (e.g. Scholz et al., [2023).](#_bookmark38) While mechanisms of specific message effects are a frequent target of inquiry [CITES NEEDED], it remains an open question whether these mechanisms are similar or different across competing messages relevant to the same behavior. Understanding the relative importance of a mechanism may help to predict the likelihood and nature of interference between two message types. For instance, both pro- and anti-alcohol messages frequently target emotional responses (Stautz et al., [2017).](#_bookmark41) If encountered in close proximity (e.g. within the same session on a social media feed), which message type has a stronger impact on alcohol craving or consumption through this emotional mechanism? To give another example, familiarity perceptions (e.g. self-relevance) of persuasive messages are known to be important drivers of persuasive effects. Is it more or less important for the effectiveness of anti-alcohol (compared to pro-alcohol) messages to depict a scenario that is familiar to viewers?

RQ2: Is alcohol craving in response to alcohol-related messages varying in valence and source driven by similar or different psychological mechanisms?

It is impossible to consider the full breadth of potential mechanisms of persuasion in

a single study. Here, we examined RQ2 on the example of two particularly central mechanisms in the context of the alcohol information environment: emotions and familiarity.

## Emotions

Affective responses are frequent targets of persuasive messages across diverse behavioral domains (Dillard and Seo, [2012;](#_bookmark10) Hornik et al., [2016;](#_bookmark19) Nabi, [2017;](#_bookmark31) Poels and Dewitte, [2019)](#_bookmark34) and, importantly, they are often the focus of both pro- and anti-alcohol messaging. One of the few direct comparisons between pro- and anti-alcohol messaging suggests that pro-alcohol messages are more likely to evoke positive affective responses whereas anti-alcohol messages are more focused on negative affective responses (Stautz et al., [2017).](#_bookmark41)

Negative affect is targeted by professional anti-alcohol messaging by emphasizing diverse negative outcomes of (excessive) alcohol consumption such as catastrophic accidents (fear) caused by drunk drivers (shame/guilt) or awkward or otherwise inappropriate social situations (shame; Becheur et al., [2007;](#_bookmark1) Duhachek et al., [2012).](#_bookmark12)

Although the majority of affective appeals in anti-alcohol messaging target negative emotions, some work has examined the potential utility of positive emotions such as humor (Lee, [2018;](#_bookmark26) Previte et al., [20](#_bookmark35)15).

Professional pro-alcohol messaging often targets positive emotions by highlighting positive aspects of alcohol consumption. For instance, partying and relaxation are among the major themes in US TV advertising (Morgenstern et al., [2015).](#_bookmark30) Common messages depict individuals consuming specific products in enjoyable, often social situations where indivdiuals are shown laughing, relaxing, being successful, and generally, experiencing positive emotions. Positive affect in response to messages is related to message effectiveness (Chen et al., [2005).](#_bookmark8)

The literature on the effects of emotions in peer-produced alcohol content is limited, but early content analyses are suggestive. Peer-produced messages generally do not have a

clear persuasive intent (Hendriks et al., [2017)](#_bookmark17) and, as a result, are likely less strategic and less consistent in their use of emotional appeals. While peer-produced pro-alcohol messages generally seem to mimic professional pro-alcohol content in that they often express positive emotions related to drinking alcohol, peer-produced anti-alcohol messages may be more emotionally ambiguous. For instance, a social media post may depict a negative outcome of drinking not unlike those displayed in professional anti-alcohol campaigns (e.g. a bike accident), but display it in a humorous light as the unfortunate, yet funny outcome of an epic night. Generally, the strong pro-alcohol norm among young adults disincentivizes purely negative peer-produced anti-alcohol content (Beullens and Schepers, [2013).](#_bookmark3) Given the state of the literature, it is difficult to predict the relationship between emotional responses to peer-produced alcohol content and alcohol craving.

Based on the existing knowledge, we expect the following:

H3: The extent to which message receivers experience H3a: positive [H3b: negative] emotions in response to alcohol-related information will be H3a: positively [H3b: negatively] related to alcohol craving.

H4: The effect hypothesized in H3a [H3b] will be stronger (H4a; i.e. more positive) [H4b: /weaker; i.e. less negative] for professional and peer-produced pro-alcohol compared to professional anti-alcohol information.

Next to the potentially special role of anti-alcohol peer-produced content, the existing literature does not support clear hypotheses about potential source effects. It is possible, for instance, that peer- and professionally produced messages differ quantitatively in the extent to which they elicit the same emotions or systematically target different types of emotions. It is also possible that the relationship between alcohol craving and emotional responses differs between source types. For instance, peer-produced messages may lead to a higher relevance of authentically induced emotions for craving. We will explore these relationships here.

## Familiarity

Familiarity is defined here as an index of perceptions that the characters displayed in a message are ’like me’, and that the displayed situation is one I’m ’familiar with’. The literature on professionally designed persuasive messaging discusses these types of familiarity under terms such as audience-character similarity (Bochner, [1994;](#_bookmark4) Kim et al., [2016)](#_bookmark24) and self-relevance (of the message to the target group). Generally, the persuasion literature views familiarity as a positive driver of persuasion effects by enhancing receivers attention and the perceived relevance of the messages. In fact, creating familiar scenarios and characters are popular tailoring strategies that are linked to message effectiveness across domains (Lustria et al., [2013;](#_bookmark28) Noar et al., [2007).](#_bookmark32) Similarly, self-relevance is positively associated with persuasive effects (for a review see Falk and Scholz, [2018).](#_bookmark14)

On average, content analyses of alcohol-related posts on social media, the most accessible way of quantifying the information environment, confirm the idea that

pro-alcohol content is much more prevalent than anti-alcohol (REFS). Moreover, general self-serving biases (Mezulis et al., [2004)](#_bookmark29) and third-person effects [CITE] likely bias recipients of anti-alcohol information to underestimate their own similarities and familiarity with characters who are experiencing negative outcomes from drinking alcohol. Based on the existing literature, we expect the following:

H5: Pro-alcohol information will be perceived as more familiar than anti-alcohol information.

H6: The relationship between familiarity and alcohol craving will be moderated by valence so that the slope will be positive (leading to more craving) for pro-alcohol messages and negative (leading to less craving) for anti-alcohol messages.

Exemplifying the siloed nature of the literature on different types of

alcohol-messaging, the concepts of familiarity and self-relevance are not as well defined in work on peer-produced messaging. Social influence research does suggest that peers who are like us have a stronger impact on our behavior [cite], also in the specific context of alcohol

consumption [cite]. Suggesting that, especially pro-alcohol peer-produced information may be among the most familiar content types studied here whereas anti-alcohol peer-produced information is likely to be the least familiar. We will further explore these relationships.

# Method

We conducted three online studies to directly compare the impact of different types of alcohol-related information on alcohol craving and to explore mechanisms of these effects. The goal of Study 1a was to establish craving responses to professional and

peer-produced pro- and anti-alcohol information in a large sample of messages. In Study 1b, we added professional- and peer-produced information about non-alcoholic drinks as a comparison condition. Study 2 represents a conceptual replication of Studies 1a/b using a subset of the same stimuli, new participants and a slightly different task design. All participants provided informed consent and all procedures were approved by the ethical review board at [UNIVERSITY ANONYMIZED FOR REVIEW] (2020-PC-12672).

# Participants

Study 1a and 1b participants were recruited on Prolific. For Study 2, we recruited from our university’s subject pool, which is largely made up of students. Demographic characteristics are are described in Table [1.](#_bookmark44)

Using two survey items recommended by the NIAAA’s "Task Force on Recommended Alcohol Questions" (adjusted for European drink sizes) Study 1a and 1b participants reported the frequency of alcohol consumption and binge drinking. The largest group of participants in Study 1a reported to drink *twiceaweek* (N=73, range = *Ineverdrankanyalcoholinmylife*-*Everyday*) and binge drink

1*to*2*daysinthepastyear*)(*N* =51*, range* =Never)*−*Every day)*.InStudy*1*b, thelargestgroupof participantsreportedtodrink*twice a

week(*N* =28*, range* =I never drank any alcohol in my life*−*Every day)*andbingedrink*2 to 3 days a month(*N* =19*, range* =Never*−*Every day*.*

Study 2 participants completed the Alcohol Use Disorder Identification Test

(AUDIT, Bohn et al., [1995).](#_bookmark5) Their scores ranged from 1 to 25 (Mean = 8*.*18, SD = 4*.*95) where scores 8-14 are generally considered to indicate hazardous and harmful consumption and higher scores indicate a risk of alcohol dependence.

# Stimuli

A set of 160 alcohol-related stimuli were created for Study 1a. A subset of Study 1a stimuli were re-tested in Study 1b and 2. In addition, Study 1b tested 30 non-alcoholic stimuli. All stimuli consisted of a still image depicting one or more individuals consuming or holding alcoholic or non-alcoholic drinks and a hashtag. Still images were purposefully sampled from public Instagram posts and an online search in order to manipulate valence and source. Hashtags were manipulated to reinforce and disambiguate image condition. To manipulate valence, we chose pro-alcohol images which showed alcohol or alcohol consumption in a positive context (e.g. portraying positive outcomes of drinking) and a set of anti-alcohol images which portrayed alcohol or alcohol consumption in a negative context (e.g. showing negative outcomes of drinking). Non-alcohol messages portrayed information about non-alcoholic drinks in a positive light. Post source was manipulated by choosing pro-, anti- and non-alcohol images from public Instagram accounts of everyday users, namely images with relatively few likes at the time of sampling that were not posted by a professional organization, business, or influencer account (peer-sources), or from a professional source. Professional pro-alcohol images were sampled from professional Instagram accounts of businesses and brands (e.g. bars and alcohol brands) and include marketing materials for specific types of alcohol and alcohol-related, branded events.

Professional anti-alcohol images were sampled from global, English-language public health campaigns advocating against (excessive) drinking, derived from an online search and prior research (Scholz et al., [2019).](#_bookmark37) Neither source nor valence were explicitly communicated to participants during stimulus exposure.

Each image was paired with one manipulated hashtag in order to standardize the amount of text shown in each condition and to clearly identify each image as related to

alcohol or not. For peer-produced posts, we used hashtags that were frequently used on Instagram for the types of images used in this study. For professional pro-alcohol posts, we used hashtags that were frequently used by the businesses and brands from which posts were sampled (e.g. brand or event names). For professional anti-alcohol stimuli we used hashtags related to the content of the campaigns, often the (abbreviated) campaign slogan.

Finally, in Studies 1a and 1b, images and hashtags were placed into a template mimicking an Instagram post. In Study 2, the Instagram template was used for half of the trials. For the other half of trials, we placed images and hashtags in a template mimicking a Google search result. The purpose of this manipulation was to test the specificity of any results to the context of social media as opposed to online environments more generally.

Note that, because we did not find any significant effects of this exploratory online platform factor, we are reporting results collapsing across these conditions.

Figure [1A](#_bookmark49) shows example images for each condition and Figure [1B](#_bookmark49) shows the Instagram and Google templates. All stimuli are available on our project OSF page (ADD ANONYMOUS LINK).

# Procedures

Participants in all three studies completed within-subject designs with multiple trials per person (Trial N Study 1a: 12, Study 1b: 12, Study 2: 88). Participants in Study 1a and Study 2 exclusively saw alcohol-related stimuli. Alcohol-related stimuli were randomly chosen per participant from a list of 160 stimuli in Study 1a (40 per valence\*source condition) so that all stimuli were presented evenly. A sub-sample of 88 alcohol-related stimuli were chosen for inclusion in Study 2 (22 per valence\*source condition) and all stimuli were shown to all participants. Study 1b participants saw 8

non-alcoholic stimuli per person which were not part of the other two studies and 4 alcohol-related stimuli that were randomly chosen for each participant out of the full set of

Study 1a stimuli. In Study 1a, each stimulus was rated by an average of 24*.*52 (SD = 0*.*95) participants. In Study 1b, each non-alcoholic stimulus was rated an average of 24*.*53 (SD =

4*.*14) times.

Per stimulus, participants in Study 1a and 1b rated alcohol craving in response to the stimulus, followed by two manipulation checks for the valence and source manipulations (see Supplementary Materials) and familiarity with the portrayed scene. In Study 2, participants completed a task in which each stimulus was shown for 6 seconds, followed by a brief fixation period and, subsequently, a standardized alcohol or non-alcohol cue which was shown for 4 seconds. Standardized (non-)alcohol cues were sampled from the Amsterdam Beverage Picture Set Pronk et al., [2015.](#_bookmark36) After viewing the alcohol (72 trials/person) or non-alcohol (16 trials/person) cue for 2 seconds, a rating scale appeared on the screen, asking participants to rate their current craving for the beverage on the screen (Figure [2).](#_bookmark50)

# Measures

**Beverage Craving.** Study 1a and 1b participants rated their alcohol craving using the following question immediately after exposure to each stimulus: "Looking at this post makes me want to drink alcohol today." on a 7-point Likert-type scale (1 = Not at all; 7 = very much). Study 2 participants rated their craving for a specific alcoholic or

non-alcoholic beverage in response to standardized beverage cues shown directly after exposure to each stimulus on a 5-point Likert-type scale [(2).](#_bookmark50) Given the differences in rating scales, beverage craving was z-scored within study for all analyses including data from both Studies 1a/b and 2.

**Emotional Responses (Study 1a/b).** Study 1a and 1b participants rated: "To what extent does this post make you feel the following? [amused, sad, scared, jealous, shocked, happy, embarrassed (for someone else), positive, negative]" on 7-point Likert-type scales (1 = Not at all; 7 = very much).

**Familiarity (Study 1a/b).** Study 1a and 1b participants rated different aspects of familiarty with the scene portrayed in each stimulus: "To what extent do you agree or disagree with the following statements? This post ... [shows people that are like me/shows

a situation I’m familiar with]" on 7-point Likert-type scales (1 = Totally disagree; 7 = totally agree) on a 5-point Likert-Type scale (1 = Not at all; 5 = Very much). We created a familiarity index by computing the average of the two ratings for each trial.

# Data Analysis

Although the existing literature supports a set of directional hypotheses (see theoretical background), the analyses presented here should be interpreted as exploratory and were not pre-registered.

Before hypothesis testing, we confirmed that the stimuli were perceived as intended using the two manipulation checks measured in Study 1a and 1b (see Supplementary Materials for details). We then conducted two types of analyses. First, we estimated condition effects on beverage craving using multi-level mixed regression models as implemented in R’s lmerTest package (Kuznetsova et al., [2019)](#_bookmark25) to account for the nested structure of the data. Second, we conducted stimulus-level analyses, aggregating over participants.

# Results

RQ1: What are the RELATIVE effects of alcohol-related messages varying in valence (pro- vs. anti-alcohol vs. non-alcoholic) and source (professionally vs.

peer-produced) on alcohol craving?

# Information valence (H1), but not source, influences alcohol craving

Next, we examined whether stimulus valence and perceived source impacted alcohol craving by estimating within-person effects of valence condition, source condition on (standardized) alcohol craving ratings in a multi-level regression model of Study 1a and Study 2 data controlling for age, gender, binge-drinking and drinking frequency, and accounting for random intercepts across participants and messages. Across both studies,

Table [2](#_bookmark45) shows main effects of stimulus valence condition on alcohol craving so that

pro-alcohol posts lead to stronger alcohol craving than anti-alcohol posts. We did not find a main effect of source. Re-fitting the two models with an additional interaction term

between valence and source conditions revealed no differences in valence effects depending on stimulus source (see Supplementary Materials for details).

The size of the valence effect is somewhat larger in Study 1a. This could be due to differences in the task design. Study 1a participants responded directly to the stimulus while Study 2 participants provided craving ratings after seeing standardized images of alcoholic drinks. Further, Study 1a participants were asked whether looking at the stimulus makes them want to drink alcohol today whereas Study 2 participants were asked about their craving for one specific type of alcohol. As such, the Study 1a effect size may be seen as a closer estimate of real-world effects.

Next, we explored whether the observed differences in alcohol craving (Table **??**) are primarily driven by increases in craving in response to pro-alcohol information (compared to non-alcohol information) or due to decreases in craving in response to anti-alcohol information. To this end, we conducted an additional stimulus-level (i.e.

between-participant) analysis combining Study 1a and Study 1b data in order to compare alcohol craving in response to pro- and anti-alcohol information to alcohol craving in response to information about non-alcoholic drinks. As shown in Figure [4,](#_bookmark52) pro-alcohol information strongly enhances alcohol craving as compared to non-alcoholic information (T(108)=16*.*878, p *< .*001. In contrast, alcohol craving in response to anti-alcohol information is very similar to the responses given to non-alcoholic stimuli ((T(108)=1*.*136, p = 0*.*259), which could indicate a floor effect. As such, H1 is partially supported in that we find significantly enhanced alcohol craving in response to pro-alcohol compared to

non-alcoholic stimuli. However, we do not find an additional reduction in craving in response to anti-alcohol stimuli.

## Exploratory: Drinking habits are associated with message receptivity

Our results suggest that anti-alcohol content did not lead to substantially lower alcohol craving than non-alcoholic stimuli. This could be due to a floor effect so that

non-alcoholic information was already associated with a minimum level of alcohol craving

in this sample. One plausible conclusion is that the amount of pro-alcohol content on social media is more consequential than the amount of anti-alcohol content. A contradicting viewpoint is that anti-alcohol messages may be more impactful for some participants than for others. For instance, many anti-alcohol campaigns are targeted at high risk (binge) drinkers and thus do not (and are not intended to) resonate with those who drink to a lesser extent. To explore this possibility, we examined associations between individual differences in drinking habits and the size of the effect of information valence on drinking urge for each participant in Study 1b.

Results show that those who reported to binge-drink more often, on average, reported higher alcohol craving and a higher sensitivity to pro-alcohol (compared to non-alcoholic) stimuli, but not to anti-alcohol stimuli (Table [3;](#_bookmark46) Figure [3).](#_bookmark51)

# H2: Valence of alcohol information specifically affects alcohol craving

Next, we tested whether exposure to pro- vs. anti-alcohol information was specifically associated with an increase in alcohol craving rather than a general appetite for beverages (H2). Study 2 results show that the main effect of valence is specific to trials in which participants rated their craving for alcoholic (rather than non-alcoholic) drinks, confirming H2 (see Figure [4).](#_bookmark52) In fact, pro-alcohol messaging actually decreased craving for non-alcoholic drinks compared to anti-alcohol messages.

# Drivers of Alcohol Craving

RQ2: Is alcohol craving in response to alcohol-related messages varying in valence (pro- vs. anti-alcohol vs. non-alcoholic) and source (professional vs. peer) driven by similar or different psychological mechanisms?

## Emotions

We examined emotional responses to different types of alcohol-related information (rated by Study 1 a/b participants). We found meaningful condition differences in the experienced emotions in response to the stimuli tested across Studies 1a & 1b. For instance, in line with prior work, anti-alcohol stimuli compared to pro-alcohol stimuli

evoked more negative and less positive emotions. Differences between professional and social stimuli were substantially smaller than differences between valence conditions and mostly visible for anti-alcohol stimuli (Figure [5).](#_bookmark53) Specifically, for anti-alcohol stimuli, professional sources led to slightly more scared, shocked, sad and negative responses, while peer-produced sources were more likely to be rated as amusing and causing second-hand embarrassment. This supports the intuition that peer-produced anti-alcohol messages play a special role within the alcohol information environment.

How are these emotional responses linked to alcohol craving for pro- and

anti-alcohol content? Prior literature supports the hypothesis that the effect of positive [/negative] emotions will be positively [/negatively] associated with alcohol craving (H3) and that these effects would be moderated by stimulus valence so that positive emotions are more tightly coupled with craving in response to pro-alcohol stimuli and negative emotions matter more in response to anti-alcohol information. A key underlying assumption here is that there should be little variance in positive (/negative) emotions in response to anti-alcohol (/pro-alcohol) stimuli and any positive (/negative) emotion that is evoked should serve the message intent (i.e. lower (/heighten) alcohol craving).

This intuition is partially supported by the data. The standard deviation of the strength of positive emotional responses to professional anti-alcohol stimuli (SD = 1*.*36) is indeed somewhat smaller than that in response to pro-alcohol stimuli (SD = 1*.*82). In contrast, the standard deviation of the strength of negative emotional responses to professional anti-alcohol stimuli (SD = 2*.*06) is larger than that in response to pro-alcohol stimuli (SD = 1*.*2). However, these data are not in line with the idea that there is no variance in the experience of positive or negative emotions in response to some message types.

Figure [6](#_bookmark54) and Table [4](#_bookmark47) show linear relationships between positive and negative emotional responses to the four types of messages and alcohol craving. In line with H3, positive emotional responses to alcohol information are generally positively associated with

alcohol craving and vice versa for negative emotional responses (see main effects model in [4).](#_bookmark47) Further, in accordance with H4, we did find that valence condition significantly moderated the effect of emotional responses to alcohol information on craving, but not always in the expected direction (see full model in Table [4](#_bookmark47) and Figure [5).](#_bookmark53) Confirming H4a, positive emotions showed stronger positive relationships with alcohol in pro-alcohol compared to anti-alcohol stimuli. However, in contrast to H4b, negative emotional responses were also more strongly (negatively) coupled with craving for pro- compared to anti-alcohol information. That is, even for professional anti-alcohol information, positive emotions significantly impact craving responses in message-inconsistent ways. In other words, emotional responses were generally more impactful in response to pro-alcohol compared to anti-alcohol stimuli.

Note that despite the differences in average emotional responses to professional and peer-produced anti-alcohol information (Figure [5),](#_bookmark53) we do not observe pronounced differences in the ways in which these emotional responses are linked to alcohol craving.

The Supplementary Materials provide further details about the relationship between several discrete emotions and alcohol craving by condition.

# Familiarity

Finally, we examined whether and how familiarity impacted alcohol craving across pro- and anti-alcohol messages in Study 1a and 1b. Figure [7](#_bookmark55) displays means and 95% confidence intervals across conditions.

Supporting H5, pro-alcohol stimuli were perceived as substantially more familiar than anti-alcohol stimuli (Mean difference on the 7-point scale=1*.*54, T(140*.*09)=*−*12*.*9, p

*< .*001), likely due to a lower occurrence of anti-alcohol information in natural social media environments (Alhabash et al., [2022)](#_bookmark0) and elsewhere. Participants even reported similar levels of familiarity with peer-produced pro-alcohol information as with non-alcoholic information (Figure [7.](#_bookmark55)

What role does familiarity play in message effects on alcohol craving? Across Study

1a and 1b, participants, on average, reported higher alcohol craving in trials when they perceived alcohol-related information to be more familiar (see main effects model in Table [5).](#_bookmark48) This effect was moderated by valence condition so that familiarity was more strongly positively associated with alcohol craving in pro- compared to anti-alcohol messages (see full model in Table [5).](#_bookmark48) However, in contrast to H6, familiarity did not universally enhance message effectiveness as the effect of familiarity on alcohol craving remained positive in response to anti-alcohol messages. We did not find significant differences in the effects of familiarity on craving between professional and peer-produced sources for either pro- or anti-alcohol messages (see Supplementary Materials).

# Discussion

The information environment around alcohol is complex and ambiguous, complicating the prediction of persuasive message effectiveness in complex real-world situations. Because different research lines have focused on individual types of information (e.g. only anti-alcohol information), we currently know little about the relative effects of contradictory alcohol information from different sources and about differences or similarities in terms of the psychological mechanisms that underlie these message effects. Across three studies, we directly compared a diverse set of alcohol-related information to its real-world competitors in order to understand the relative impact of these messages on alcohol craving as well as the mechanisms that drive these effects. We considered anti- and pro-alcohol information from both professional and peer-sources.

First, we found expected, pronounced effects of message valence on alcohol craving so that pro-alcohol information led to substantially higher craving for alcoholic and lower craving for non-alcoholic drinks than anti-alcohol information. Interestingly, when comparing alcohol-related information to information about non-alcoholic drinks,

pro-alcohol messages led to a pronounced increase in craving while we observed no changes for anti-alcohol information. Especially those who show risky drinking patterns outside the lab (indexed by self-reported binge drinking frequency) showed increased receptivity to

pro-alcohol, but not anti-alcohol information. This may suggest that public health interventions focused on the removal of pro-alcohol rather than the addition of anti-alcohol content to the information environment would likely be more impactful. The ineffectiveness of anti-alcohol information in this study may be explained by a floor effect, suggesting that the impact of anti-alcohol messaging may depend on the timing of message exposure (e.g. on the baseline level of craving at the time of exposure). In sum, these findings highlight the importance of direct comparisons between contradictory persuasive messages within a study. To further substantiate and test our preliminary conclusions, we need additional research with greater variance in the type of non-alcoholic content studied and greater ecological validity.

Second, we examined emotional responses and perceived familiarity as drivers of alcohol craving across the different message types. Aligning with prior work [CITE] we showed that, on average, the broad set of pro-alcohol stimuli included here evoked more positive and less negative emotional responses than the set of anti-alcohol messages in our sample. Emotions were further strongly linked to alcohol craving so that positive emotions increased craving and negative emotions decreased craving, irrespective of message valence. These relationships were universally stronger for pro- than for anti-alcohol information, suggesting that craving is more strongly based on emotions for pro- compared to

anti-alcohol information, even though the average strength of emotionality in response to the messages was comparable across conditions. One avenue ripe for future exploration is that emotionality in response to persuasive messaging may actually be the cause of interference with competing message types. For instance, one study has shown that certain emotional appeals may be useful in generating peer-conversations about persuasive

anti-alcohol messages (Hendriks and Madelijn Strick, [2020).](#_bookmark18)

Our results further show that pro-alcohol content was substantially more familiar to participants than anti-alcohol content with peer-produced pro-alcohol content even feeling as familiar as content about non-alcoholic drinks. This is in line with content analyses of

subsets of the information environment on social media which show that anti-alcohol content is relatively rare [CITE]. Interestingly, familiarity was only positively associated with message effectiveness in the context of pro-alcohol messages. The expectation that familiarity with anti-alcohol messages would lead to lower craving was not supported, although the effect was significantly less positive than that for pro-alcohol information. This may explain the earlier finding that frequent binge drinkers showed heightened sensitivity to pro- but not anti-alcohol information. To summarize, both emotional and familiarity mechanisms showed stronger links with alcohol craving in response to pro- rather than anti-alcohol messages. Based on these data, one may hypothesize that, in direct competition (e.g. when located in close proximity on a social media feed), an emotional pro-alcohol messages would out-perform an equally emotional anti-alcohol message in terms of their effects on alcohol consumption. As such, these preliminary findings highlight the importance of follow-up work which evaluates message effectiveness in the context of real-world, complex information environments.

Strikingly, across all analyses reported here, we did not find pronounced effects of message source. Expensive and carefully designed pro- and anti-alcohol content from professional sources did not outperform peer-produced content in this study, even though the peer produced content was perceived to be of significantly lower quality than the professional content. One possible explanation is that peer-produced content was perceived as more relatable or trustworthy, making up for other deficits like lower quality, but we do not have data to support this idea. Originally, we had expected that peer-produced

anti-alcohol content would play a special role in the alcohol information environment, because of a greater ambiguity in the persuasive intention and emotionality of these messages. Although we found some differences in participants emotional responses to professional and peer-produced anti-alcohol content, peer-produced content was still perceived in a way that was much more similar to other anti-alcohol rather than

pro-alcohol messages. It is possible that our sample of peer-produced anti-alcohol content

is biased in that we purposefully selected content that would serve well as a manipulation of content valence and reinforced that interpretation through hashtags. Thereby, we may have disambiguated some of the peer-produced anti-alcohol messages. Moreover, it is important here to note that the peer-produced content shown here was produced by people who were not known to the participants. One may expect substantially larger effects of known and liked others, but more work examining and directly comparing a broader range of stimuli is needed to test such assumptions.

The conclusions that can be drawn from these exploratory studies are limited in the sense that we relied on a non-representative sample of messages in each category and exposed participants to these messages in a highly artificial context. Nevertheless, these data do provide a strong indication that a further examination of direct comparisons of (contradictory), naturally competing message types is worthwhile and likely important for the improvement of the prediction of message effectiveness.

# Declaration of Interest Statement

The authors declare no relevant financial or non-financial competing interests.

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# Table 1

*Participant Characteristics*

|  |  |  |  |
| --- | --- | --- | --- |
| Demographic | Study 1a | Study 1b | Study 2 |
| N | 327 | 92 | 51 |
| N Females | 107 | 58 | 37 |
| N Males | 216 | 34 | 13 |
| N Non-binary | 3 | 0 | 0 |
| N "Prefer not to say" | 1 | 0 | 0 |
| Age (M (SD), Range) | 23*.*75 (4*.*13), 18-35 | 24*.*73 (4*.*06), 19 - 36 | 20*.*04 (1*.*99), 18-25 |

# Table 2

*Condition effects on standardized alcohol craving in response to diverse alcohol-related information (Note=The study 2 model only includes trials in which standardized alcohol cues were shown., Freq. = Frequency, pID = participant ID; sID = stimulus ID)*

|  |  |  |  |
| --- | --- | --- | --- |
| effect | term | Study 1a | Study 2 |
| fixed | Intercept | -0.46 [-0.57;-0.36], p = <.001 | -0.65 [-0.91;-0.40], p = <.001 |
| fixed | Valence: pro-alcohol | 1.05 [ 0.97; 1.14], p = <.001 | 0.89 [ 0.81; 0.97], p = <.001 |
| fixed | Source: professional | -0.03 [-0.11; 0.06], p = 0.519 | 0.01 [-0.08; 0.09], p = 0.859 |
| fixed | Age | -0.02 [-0.03; 0.00], p = 0.030 | 0.00 [-0.07; 0.06], p = 0.913 |
| fixed | Gender: Male | -0.17 [-0.31;-0.02], p = 0.022 | 0.18 [-0.10; 0.47], p = 0.206 |
| fixed fixed fixed fixed | Gender: Non-Binary Binge Drinking Freq. Drinking Freq.  AUDIT | -0.13 [-0.75; 0.49], p = 0.680  0.09 [ 0.05; 0.13], p = <.001  0.03 [-0.02; 0.08], p = 0.175 | 0.02 [-0.01; 0.04], p = 0.228 |
| ran\_pars | pID Intercept | 0.50 | 0.43 |
| ran\_pars | sID Intercept | 0.22 | 0.15 |
| ran\_pars | Residual | 0.62 | 0.76 |

a Note. The study 2 model only includes trials in which standardized alcohol cues were shown. Continu predictors were grand mean-centered., Freq. = Frequency, pID = participant ID; sID = stimulus ID, Th equation used to fit the two models in this table was Standardized craving ~ valence

+ source + control variables +(1|participant ID) + (1|stimulus ID)

# Table 3

*Effect of valence and binge-drinking habits on alcohol craving in Study 1b; ID = participant ID; sID = stimulus ID)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| effect | term | estimate | 95% CI | p.value |
| fixed | Intercept | 1.59 | [ 1.36;1.81] | p = <.001 |
| fixed | Binge Drinking Frequency (BD) | 0.09 | [ 0.02;0.16] | p = 0.017 |
| fixed | Valence 1: Anti- vs. Non-Alcoholic | -0.10 | [-0.40;0.20] | p = 0.524 |
| fixed | Valence 2: Pro- vs. Non-Alcoholic | 2.36 | [ 2.06;2.66] | p = <.001 |
| fixed | BD x Valence 1 | 0.00 | [-0.09;0.09] | p = 0.982 |
| fixed | BD x Valence 2 | 0.18 | [ 0.09;0.27] | p = <.001 |
| random | sID | 0.47 |  |  |
| random | pID | 0.59 |  |  |
| random | Residual | 1.12 |  |  |

# Table 4

*Relationship between grand mean-centered positive and negative emotions and alcohol craving by condition, pID = participant ID; sID = stimulus ID)*

|  |  |  |  |
| --- | --- | --- | --- |
| effect | term | Main Effects Model | Full Model |
| fixed | Intercept | 2.45 [2.34, 2.56], p < .001 | 2.24 [2.13, 2.35], p < .001 |
| fixed | Positive emotions (PosEmo) | 0.47 [0.45, 0.5], p < .001 | 0.33 [0.29, 0.36], p < .001 |
| fixed | Negative emotions (NegEmo) | -0.05 [-0.08, -0.03], p < .001 | -0.05 [-0.08, -0.03], p < .001 |
| fixed  fixed | Valence: pro-alcohol  PosEmo x Valence | 0.83 [0.71, 0.94], p < .001 | 0.89 [0.77, 1], p < .001  0.23 [0.18, 0.27], p < .001 |
| fixed | NegEmo x Valence |  | -0.09 [-0.14, -0.05], p < .001 |
| random | pID Intercept | 0.76 | 0.76 |
| random | sID Intercept | 0.24 | 0.22 |
| random | Study intercept | 0 | 0 |
| random | Residual | 1 | 0.98 |

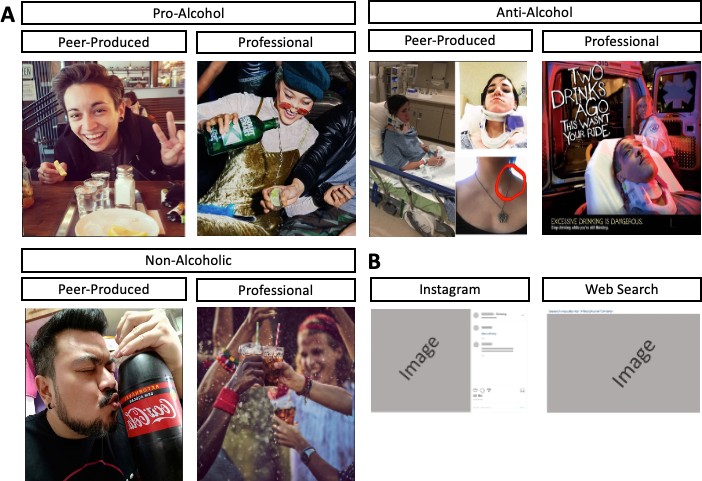
# Table 5

*Relationship between grand mean-centered perceived message familiarity and alcohol craving by condition, pID = participant ID; sID = stimulus ID)*

|  |  |  |  |
| --- | --- | --- | --- |
| effect | term | Main Effects Model | Full Model |
| fixed | Intercept | 2.06 [1.94, 2.18], p < .001 | 1.86 [1.74, 1.98], p < .001 |
| fixed | Familiarity Index (FI) | 0.39 [0.37, 0.42], p < .001 | 0.23 [0.2, 0.27], p < .001 |
| fixed fixed  random | Valence: pro-alcohol FI x Valence  pID Intercept | 1.41 [1.28, 1.54], p < .001  0.81 | 1.45 [1.32, 1.58], p < .001  0.27 [0.23, 0.32], p < .001  0.79 |
| random | sID Intercept | 0.33 | 0.33 |
| random | study Intercept | 0 | 0 |
| random | Residual | 1.08 | 1.06 |

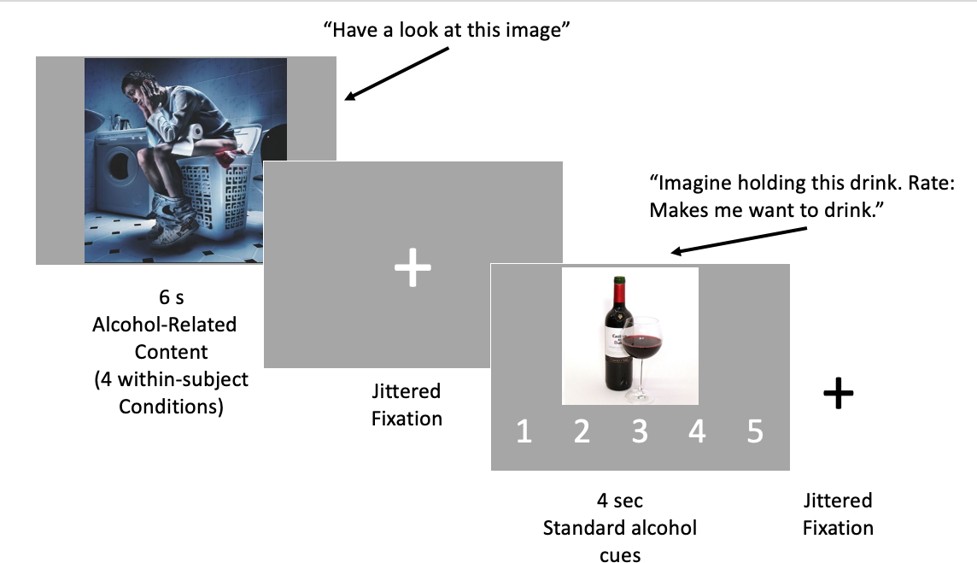
# Figure 1

*Stimuli. A) Example Stimulus per Experimental Condition; B) Templates for Manipulation of Online Platform in Study 2*



# Figure 2

*Example Trial Study 2 Task*



5

4

3

Binge Drinking Habits

Alcohol Craving

<=Median

>Median

2

1

0

# Figure 3

anti−alcohol non−alcoholic pro−alcohol

Valence Condition

*Relationship between binge drinking habits and effects of pro- and anti-alcohol information compared to non-alcoholic information on alcohol craving*

Study 1a/b (Craving scale: 1−7) Study 2 (Craving Scale 1−5)

7

alcoholic cues

non−alcoholic cues

5

6

4

5

4

Average Beverage Craving

3

3

2

2

1

1

anti−alcohol non−alcoholic pro−alcohol

Valence Condition

# Figure 4

Study Study 1a Study 1b

anti−alcohol pro−alcohol anti−alcohol pro−alcohol

Valence Condition

*Stimulus-Level Relationship between Stimulus Valence (pro- vs. anti-alcohol) and Beverage Craving; Error bars represent 95% confidence intervals.*

4

amused

embarrassed (for someone else)

happy

3

2

1

0

4

jealous

negative

positive

Average Emotion Rating (1−7)

3 Source

peer−produced

2

professional

1

0

4

sad

scared

shocked

3

2

1

0

anti−alcohol

pro−alcohol

anti−alcohol

pro−alcohol

anti−alcohol

pro−alcohol

# Figure 5

Valence Condition

*Emotional Responses to Alcohol Information (Study 1 a/b)*

6

negative

positive

5

4

Alcohol Craving (1−7)

Condition

Anti − Professional Anti − Peer−Produced Pro − Professional

3 Pro − Peer−Produced

2

1

# Figure 6

2 4 6 2 4 6

Strength of experienced emotion (1−7)

*Relationship between the strength of experienced emotions in response to message exposure and alcohol craving by message type (Study 1a/b)*

5

4

3

Familiarity Index (1−7)

Valence

anti−alcohol non−alcoholic pro−alcohol

2

1

0

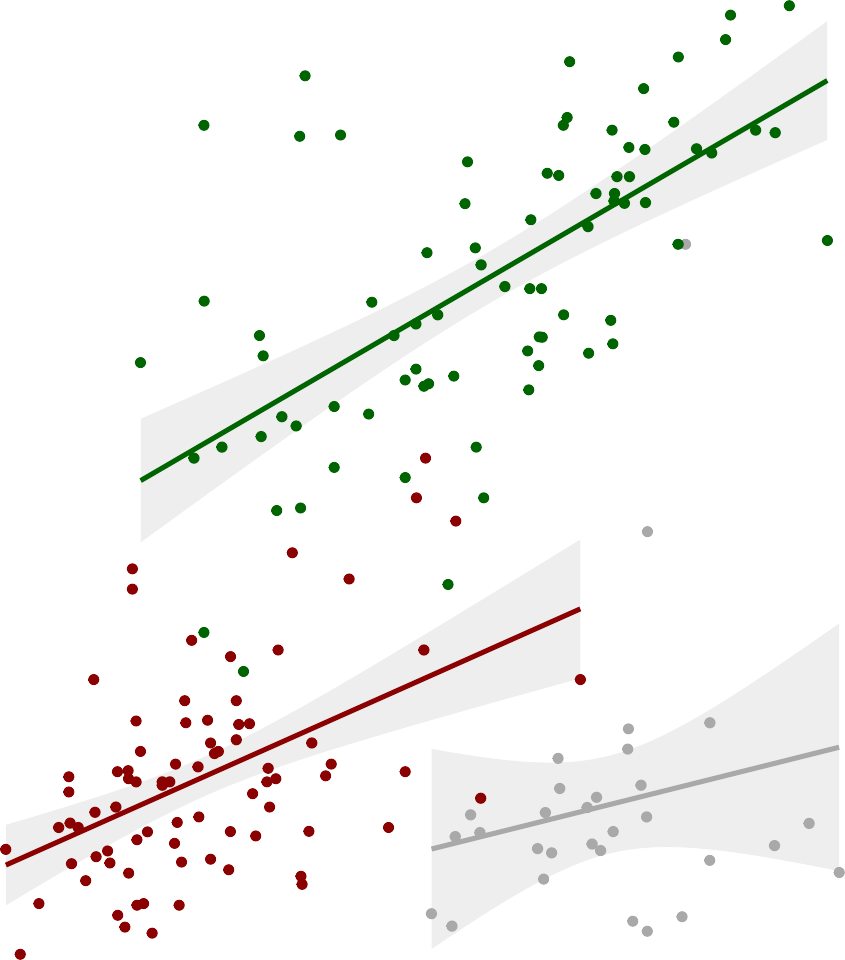
# Figure 7

peer−produced professional

Source

*Familiarity Ratings by Condition (Study 1a/b). Error bars represent 95% confidence intervals*

5



4

Valence

Alcohol Craving

anti−alcohol

3 non−alcoholic

pro−alcohol

2

1

# Figure 8

2 3 4 5 6

Familiarity Index

*Stimulus-level relationship between perceived message familiarity and alcohol craving by valence condition*