Does alcohol-related desire thinking predict in-the-moment drinking behaviours?

Ian P. Alberyand Marcantonio M. Spada

Centre for Addictive Behaviours Research, School of Applied Sciences, London South Bank University, London, UK

Author Note

Correspondence to: Professor Ian P. Albery, Centre for Addictive Behaviours Research, School of Applied Sciences, London South Bank University, alberyip@lsbu.ac.uk.

Abstract

Desire thinking (voluntary thinking involving a perseverative focusing on desired target-related memories, images, and information), is an important factor in the experience of drinking urges and cravings. Research has not examined the relationship between desire thinking, behavioural intention and the implementation of that behaviour into action, nor how one’s past repeated behaviour *in situ* (expressed as habit) may moderate these relationships. We employed an *ad libitum* drinking paradigm to provide indirect measures of in-the-moment drinking behaviours (amount poured [mls] and amount consumed [mls]) in a group of eighty-eight self-defined social drinkers immediately after measuring self-reported drinking habit, drinking-related desire thinking, and general drinking behaviour. Results confirmed the predicted positive relationship between desire thinking and *in-the-moment* drinking behaviour with the effects increasing as a function of rising drinking habit strength. We also observed a dissociation between desire thinking components (verbal perseveration and imaginal prefiguration) in the moderating effects of habit strength on drinking behaviour. For imaginal prefiguration (thoughts related to construction of mental images of a desired target or of its context for consumption) a direct effect on drinking behaviour was shown. In comparison, the effect for verbal perseveration (repetitive self-talk regarding the need to achieve a desired target) was not shown to independently predict drinking-related behaviour but was significantly moderated by increasing drinking-related habit strength. Future work should formulate the nature of this moderating influence on preservative goal-directed thinking.

 *Keywords*: Desire thinking; verbal perseveration; imaginal prefiguration; drinking intention; drinking behaviour; habit; in-the-moment.

Does alcohol-related desire thinking predict in-the-moment drinking behaviours?

 Desire thinking is a voluntary thinking style which involves the perseverative focusing on memories, images and information related to a desired target (Caselli & Spada, 2011). Desire thinking operates on a verbal and imaginal level. The verbal level (termed ‘verbal perseveration’) is characterised by repetitive self-talk regarding the need to achieve a desired target. The imaginal level (termed ‘imaginal prefiguration’) is characterised by the construction of mental images of a desired target or of its context for consumption (Caselli & Spada, 2011). The objective of engaging in desire thinking is to shift attention away from current craving in an attempt to lessen the discomfort produced by this experience (Caselli & Spada, 2010, 2013; 2015; 2016). Engaging in desire thinking, however, has the paradoxical effect of increasing the salience of craving because the desired target is perseveratively fixated upon but not achieved. This, in turn, leads to the desired target being perceived as the only route to attain relief from escalating distress (Caselli & Spada, 2011; 2015).

Both cross-sectional and longitudinal work has focused on establishing the importance of desire thinking in more problematic use and across numerous addictive behaviours. These include alcohol (Caselli, Ferla, Mezzaluna, Rovetto, & Spada, 2012; Caselli, Gemelli, & Spada, 2017; Caselli & Spada, 2010), nicotine (Caselli, Nikčević, Fiore, Mezzaluna, & Spada, 2012; Caselli & Spada, 2010), food (Spada, Caselli, Fernie, et al., 2015), gambling (Caselli & Spada, 2010; Fernie et al., 2014), problematic Internet (Spada, Caselli, Slaifer, Nikčević, & Sassaroli, 2014), social media use (Marino et al., 2019), and pornography (Allen, Kannis-Dymand, & Katsikitis, 2017; for a recent systematic review and meta-analysis see Mansueto et al., 2019). Similarly, the limited amount of experimental work undertaken has shown the importance of desire thinking in reported drinking urges and cravings, and beliefs important in guiding goal-directed plans and action. For example, in those with a diagnosis of alcohol use disorder, brief exposure to alcohol-related thoughts plus desire thinking induction versus brief exposure to alcohol-related thoughts plus distraction resulted in a significant increase in distress and urge to use alcohol when compared to a behavioural assessment test and a distraction task (Caselli, Gemelli, & Spada, 2017). In another study with a group not presenting with psychological disorders, it was found that desire thinking had a significant effect on craving post-manipulation. Importantly, this effect appeared to be independent of baseline levels of craving and desire thinking as well as perceived stress changes during the manipulation (Caselli, Soliani, & Spada, 2013). Finally, recently it has also been shown that the induction of drinking-related desire thinking led to an increase in current beliefs reflecting the acceptability of drinking despite potential negative effects, so-called permissive beliefs, in an alcohol use disorder group but not a social drinking group. Importantly, these effects occurred when craving change pre- and post-manipulation were controlled for indicating that while desire thinking and craving are related, they function independently (Caselli, Gemelli, Ferrari, Beltrami, Offredi, Ruggiero, Sassaroli & Spada, 2020).

It is clear from this brief overview that very little work has examined the effects of desire thinking in non-problematic populations or those without diagnostic indicators. This is problematic to the extent that desire thinking is not an all or nothing concept and should be apparent for *all* those individuals who are currently experiencing perseverative thoughts about undertaking a particular behaviour in context. Theoretically, when people engage in desire thinking they are, in effect, thinking perseveratively especially about objects/behaviours for which there are psychological barriers. It is to this formulation that previous evidence to date talks. It may, however, be a reasonable assumption that desire thinking per se is not just *negatively* perseverative in nature. People may undertake a more *positive* desire-based thinking process directed at the achievement of hedonistically pleasurable activities and not necessarily to try to overcome the negative feelings associated with one’s craving. Individuals may exhibit intrusive desire-based thoughts for many different activities/objects for which they have no pathological need, and these intrusive thoughts could be experienced as a form of desire thinking. Again, the literature, as it stands, does not explicitly talk to this possibility. It is only by studying such thinking processes in non-problematic groups that answers may be more forthcoming (see Martino et al, 2017). For instance, in one study of non-problematic chocolate eaters, increasing desire thinking was shown to inhibit so-called challenge (i.e., when one’s resources outweigh demands) when participants were anticipating that their cravings would be fulfilled, and to encourage it during the process of craving fulfilment (Frings, Eskisan, Caselli, Albery, Moss, & Spada, 2019).

Desire thinking work has also been restricted to examining behaviours via retrospective self-report proxies (not validated against observed behaviour) with no evidence concerning the relationship between ongoing desire thinking and actual behavioural enactment nor the immediate preparatory formation of a related behavioural intention. This, of course, begs the question as to whether desire thinking may act as an *immediate* precursor for both the formulation of plans and intentions to do something as well as actual behavioural enactment. This, in turn, gives rise to a related issue, whether the imaginal prefiguration and verbal perseveration systems are important for both planning and implementation of behaviour.

The current study examines these conjectures by *observing* in-the-moment behavioural enactment. Importantly, we did not rely on self-report intentions and past drinking behaviour but adopted a more indirect approach, using the amount poured and amount consumed of an alcoholic drink as proxies for drinking-related behaviour. This paradigm has been utilised successfully across a number of experimental studies examining the effect of different factors (e.g. alcohol related expectancies, implicit and explicit drinking-related beliefs/attitudes, drinking habit strength, drinker identities, dyad decision-making, alcohol labelling effects, public health interventions, etc.) on drinking behaviour but remains underutilised compared to those that rely on self-reports (see Lindgren, Baldwin, Ramirez, Olin, Peterson, Wiers, Teachman, Norris, Kaysen & Neighbors, 2019; Albery, Collins, Moss, Frings, & Spada, 2015; Frings, Melichar, & Albery, 2016; Vasiljevic, Couturier, Frings, Moss, Albery & Marteau, 2018; Frings, Albery, Rolph, Leczfalvy, Smaczny, & Moss, 2017; Morrison, Noel, & Ogle, 2012; Fernie, Christiansen, & Cole, 2012; Jones, Cole, Goudie, & Field, 2011; Christiansen, Cole & Field, 2012). This approach allows us to “glance” at what people do in the immediate aftermath of forming an intention to behave in a particular way and also how cognitive and motivational processes may influence in-the-moment behaviour. Aside from the obvious advantages of adopting this approach for overcoming biases associated with self-report (e.g., self-presentational biases, memory-based biases, etc) (see Del Boca & Darkes, 2003), our theoretical understanding of drinking behaviour (and indeed other behaviours) is invariably grounded in attempting to explain why people “choose” to consume (or do) what they consume (or do) in context which, of course, includes one’s immediate experience of their situation (e.g., Moss & Albery, 2009; Wiers, Ames, Hofmann, Krank & Stacy, 2010; Strack & Deutsch, 2004). As such, discerning the effects of cognitive (e.g., desire thinking) and motivational (e.g., habit) factors on drinking behaviours requires evidence that does not rely on reports of what people say they have done, or what they will do in the future, but an examination of in-the-moment behavioural enactment, which the task used in the current study permits.

Whilst the relationship between the operation of desire thinking and the experience of subjective self-reported craving has been demonstrated (e.g., Caselli and Spada, 2015), research to date has not considered how one’s past behaviour *in situ* may moderate the relationship between desire-based thinking and related behaviour. The argument that an important predictor of what one will do in the future is what one has already done in the past (Reich, Below & Goldman, 2010; Norman, 2011; Gardner, de Bruijn & Lally, 2012), points to the idea that for non-novel tasks habit-based thinking and motivations play a fundamental role (Carden & Wood, 2018). The argument goes that the more a behaviour is undertaken in a stable context with reward via the attainment of an expected goal, the greater the likelihood that intentions to perform that same behaviour will become less influential (Jensen, John, Freeman, Carcioppolo & Pokharel, 2019; Gardner, 2015; Cushman & Morris, 2015). Instead, aspects of behavioural self-regulation will be passed to a habit-based system that is characterised by more non-conscious cognitive activity (Wood, 2017; Rebar, Gardner, Rhodes & Verplanken, 2018) and one more motivational in nature (Baumeister & Nadal, 2017). Baumeister and Nadal (2017) propose as part of their *motivated habit of pleasure model* of addiction that doing something pleasurable acts to reinforce a response based on wants and desires. Repetition of the act serves to strengthen these responses such that the desire to undertake a behaviour and receive the expected reinforcement becomes increasingly strong. In other words, one’s desire to engage in a behaviour to receive pleasure-focussed reinforcement requires that the behaviour be repeated time and again. In this way, the likelihood of continuing doing a behaviour is predicated on one’s increasing desire to do so but that this relationship is moderated by how habitual the behavioural response has become. The current study directly addresses this idea by proposing a positive relationship between desire thinking (imaginal prefiguration and verbal perseveration) with drinking-related behaviours (pouring and consumption). Importantly, however, this incremental positive relationship is predicted to be moderated by self-reported strength of drinking habits such that the effect of desire thinking becomes increasingly positive as a function of increasing habit.

Method

Participants

 Eighty-eight participants, 51 (58%) females and 37 (42%) males (mean age 25.32 years, SD = 6.99, range = 18 - 49) were recruited using a research participant scheme (course credit for experimental participation) at a UK university in London, UK. AUDIT-C scores ranged from 2 to 11 (*M* = 5.35, SD = 2.3). Fifty-three participants (60.2%) recorded scores ≥ 5, the cut off for shown as indicative of moderate and severe AUD in a general drinking population (see Moehring, Rumpf, Hapke, Bischof & Meyer, 2019).

Design

 A correlational design was employed with desire thinking overall and its subcomponents (imaginal prefiguration [DRQ-IP] and verbal perseveration [DTQ-VP]), self-reported level of drinking habit, pouring behaviour (alcohol ml poured prior to consumption), and consumption behaviour (alcohol mls consumed) as the key measures.

Materials

In-the-Moment Drinking Behaviour. In-the-moment drinking behaviour was measured using an *ad libitum* pouring and drinking task (see Albery et al, 2015) that required participants to voluntarily pour and consume as much alcohol as they wished from two 275 ml bottles of (non-alcohol) beer. Amount poured (mls) was measured by calculating the amount of beer left in the bottles (mls total bottle volume – mls remaining in the bottles) and amount consumed (mls) by calculating the difference between the amount poured (mls) and the amount remaining in the glass (mls) (ml poured – mls remaining in the glass).

 General Drinking Behaviour*.* AUDIT-C (see Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) comprises three questions concerning frequency of drinking in past year (“Never”, “Monthly or less”, “Two to four times a month”, “Two to three times a week” and “Four or more times a week”), number of drinks on a typical drinking day in past year (“None, I do not drink”, “1 or 2”, “3 or 4”, “5 or 6”, “7 to 9” and 10 or more”), and frequency of occasion-based heavy drinking in past year (“Never”, “Less than monthly”, “Monthly”, “Weekly” and “Daily or almost daily”). Scoring is 0 to 4 for each question with a minimum score of 0 and a maximum of 12. Visual representation of different types of drinks and the number of units contained in each was presented as a guidance to help participants calculate the number of units.

 Components of Habitual Behaviour. To measure habit strength for drinking alcohol the 12 item Self-report Habit Index (SRHI) was used. This measure has been shown to predict behavioural frequency for many activities (e.g., dietary consumption, physical activity, food hygiene) (see Gardner, 2015), and substance use in particular (see Morean, DeMartini, Foster et al., 2018) with the strength of the relationship being confirmed by meta-analysis (Gardner et al., 2011). This scale is designed to reflect key components of psychological habit; history of repetition (e.g. “drinking alcohol is something I do frequently”), automaticity (e.g., “drinking alcohol is something I do automatically”), lack of awareness and conscious intent (e.g. “drinking alcohol is something I so without thinking”), lack of control (e.g. “drinking alcohol is something I would find hard not to do”), mental efficiency (e.g. “drinking alcohol is something I have no need to think about doing”) and expressing identity (e.g. “Drinking alcohol is something that feels typically ‘me’”) (Verplanken & Orbel, 2003). Response options for each item ranged from (strongly disagree) to (strongly agree), scored 1 – 5 such that increasing scores reflect increasing self-report habit. Cronbach’s α = .78, *M* = 36.17, SD = 12.58, range 13 - 57.

 Drinking-related Desire Thinking. The Desire Thinking Questionnaire (DTQ) (Caselli & Spada, 2011) comprises a total of 10 questions across two factors of five items measuring (i) verbal perseveration (DTQ-VP) - the perseveration or prolonging of verbal thoughts about desire-related content/experiences (e.g., “When I begin to think about the drinking alcohol I find it difficult to stop.”; “ When I begin to think about drinking alcohol I continue until I manage to engage in it.”) - and (ii) imaginal prefiguration (DTQ-IP) - the tendency to prefigure images about desire-related content/experience (e.g., “I imagine myself drinking alcohol.”; “I begin to imagine drinking alcohol every time it comes to my mind.”). Response are made on four-point scales labelled “Almost Never”, “Sometimes”, “Often” and “Almost Always”. Higher scores on both factors and on the total measure indicated higher levels of desire thinking (possible score range = 10 to 40). Cronbach’s α = .95, DTQ-Total): *M* = 25.76, SD = 7.58, range 10 - 37; DTQ-IP: *M* = 12.50, SD = 4.24, range 5 - 18; DTQ-VP: *M* = 13.26, SD = 3.62, range 5 -19.

Procedure

 Testing took place between 15:00 – 19:00 hours on Wednesdays, Thursdays, and Fridays each week in a bespoke bar-lab located in the experimental laboratory complex of a large London-based university. This purpose-built facility is designed to simulate a UK public house where alcohol cues are numerous and far-reaching. For instance, in addition to the authentic public house decor, there is a 3.6 m long bar dressed with beer taps, stools positioned against the bar, a fruit machine, optics, other various forms of seating, etc. Consenting participants were seated on a stool in front of the bar upon which were placed two unlabelled 275 ml bottles of beer (non-alcoholic) and a pint glass. They were told that they would be asked to complete a few questions regarding their alcohol use and drinking patterns and beliefs, and then do two quick word search puzzles. Participants were also told that during the word search phase they could, if they wished, pour as much of or as little of the beer in the bottles into the glass and drink. At this point, the pack comprising AUDIT-C, SRHI and DTQ were presented for completion in that order. Upon completion of the DTQ, the experimenter presented two 14 x 14-word searches (one related to breed of dogs e.g., “bulldog”, “collie”, “terrier”, etc., and the other related to Olympic sports e.g., “volleyball”, “luge”, “diving”, etc.) for completion, and reminded the participant that they could pour themselves a drink from the bottles during these tasks. (Participants were able to pour and consume as much of the non-alcoholic beverage as they wished such that they could repour as often as they desired and consume as much as they liked.). At that point the experimenter left the bar-lab under the ruse that (s)he was going to greet and brief the next participant and that (s)he should be no more than 10-15 minutes. After 15 minutes the experimenter returned, removed the drinking apparatus from the vicinity, debriefed and released the participant. The remaining contents of the beer bottles and glass were retrieved to enable calculations of amount poured (mls) and amount consumed (mls) by each participant during the 15 minutes the experimenter was away from the bar-lab. On average participants poured themselves 184.35 mls of beer (SD = 80.79, range 75 - 373) and consumed on average 167.01 ml (SD = 84.69, range 40 - 370).

Results

Initial Pearson r correlational coefficients between predictor variables showed Audit-C and Habit shared significant variability (r = .88) and as such Audit-C was removed from consideration as a covariate in subsequent analyses. Correlations also showed that the amount poured, and the amount consumed were highly significantly associated, (r = .97, *p* < .001) and may be masquerading as a single index measuring general in-the-moment drinking-related behaviour. The amount poured and the amount consumed were then combined by calculating the multiplicative product (increased scores indicating increased drinking-related behaviour).

Pearson’s r correlation coefficients between general in-the-moment drinking-related behaviour with desire thinking (DTQ total [DTQ-total], imaginal prefiguration [DTQ-IP] and verbal perseveration [DTQ-VP])) [predictors] and drinking habit (D-SRHI) [moderator] were then calculated to ascertain significant relationships for inclusion in subsequent analyses. All variables correlated significantly with the criterion factor, .70 < *r* < .83, *p*s < .001, and correlations between predictor variables were shown to be .74 > r < .79 (*p*s < .001).

To test whether the relationship between (a) DTQ-total and (b) both imaginal prefiguration [DTQ-IP] and verbal perseveration [DTQ-VP]) with drinking-related behaviour (poured x consumed) was moderated by the effects of self-reported drinking habit level (D-SRHI), two regression analyses were used. For DTQ-total the PROCESS version 3.2 model 1 with 5000 bootstrapped samples was utilised (Hayes, 2018) (see Figure 1 for generic specified model). For DTQ-IP and DTQ-VP a single multiple regression with 5000 bootstrapped samples was performed with the main effects of DTQ-IP, DTQ-VP and D-SRHI and the two interaction terms (DTQ-IP x D-SRHI and DTQ-VP x D-SRHI) entered simultaneously. All predictor variables in both regressions were mean centred. In both regressions simple slopes analyses was used to explore any significant interactions with the categories + 1SD, average, and – 1SD.

Prior to analyses data were subject to assumption testing. First, a sample size of 89 is sufficient given a maximum of five predictor variables (including the covariate) across the two regressions. Collinearity statistics were within acceptable limits for multicollinearity (Tolerance >.10 [.15 - .78], VIF range, 1.27 – 6.51). Mahalanobis distance scores, Cook’s distance and centred leverage scores identified one significant multivariate outlier (which was removed from analysis) and residual analysis (including Loess line fitting and Q-Q plots) and scatterplots showed normality, linearity and homoscedasticity assumptions were adhered to.

Figure 1 about here

Predicting drinking-related behaviour (millilitres poured x millilitres consumed): DTQ-total

 The model including DTQ total (IV) and habit score (moderator) was significant, *F* (3, 84) = 101.45, *p* < .001, R2 = .78, adjusted R2 = .77, Cohen’s *f* *2* = 3.55 (see Table 1).

Table 1 about here

Significant main effects for DTQ score, *b* = 1565.26, t (84) = 4.08, *p* < .001, and D-SRHI, *b* = 1649.74, *t* (84) = 7.64, *p* < .001, and the DTQ-total x D-SRHI interaction, *b* = 111.14, *t* (84) = 5.76, *p* < .001, were shown. Simple slopes analysis showed that when habit score was average, *b* = 1565.26, 95% CIs [803.03, 2327.49], *t* (84) = 4.08, *p* < .001, and high, *b* = 2962.87, 95% CIs [1922.43, 4003.304], *t* (84) = 5.66, *p* < .001, there was a significant positive relationship between DTQ-total and drinking-related behaviour. No effect was shown when habit scores were low, *b* = 167.66, 95% CIs [-570.92, 906.23], *t* (84) = .45, *p* = .65. As habit increases, the relationship between DTQ-total and drinking-related behaviours become more positive (see Figure 2, Panel A).

Figure 2 about here

Predicting drinking-related behaviour (millilitres poured x millilitres consumed): DTQ-IP and DTQ-VP.

The model for DTQ-IP (IV1), DTQ-VP (IV2) and habit score (moderator) was significant, *F* (5, 82) = 55.33, *p* < .001, R2 = .77 adjusted R2 = .76 , Cohen’s *f2 =* 3.35 (see Table 2).

Table 2 about here

Main effects for DTQ-IP, *b* = 1764.21, *t* (82) = 2.23, *p* < .05, and D-SRHI , *b* = 1801.341, *t* (82) = 7.85, *p* < .001, were shown but not for DTQ-VP (*p* = .36). In addition, the DTQ-VP x DSRHI interaction was also found to be significant, *b* = 857.205, *t* (82) = 3.09, *p* < .01. Simple slopes analysis showed that when habit score was average, *b* = 2775.21, 95% CIs [1159.25, 4391.16], *t* (82) = 3.42, *p* < .001, and high, *b* = 5650.55, 95% CIs [3457.94, 7843.1721], *t* (82) = 5.13, *p* < .001, there was a significant positive relationship between DTQ-VP and drinking-related behaviour. No effect was shown when habit scores were low, *b* = 100.14, 95% CIs [-1641.41, 1441.13], *t* (82) = .13, *p* = .89 (see Figure 2, Panel B). As habit increases, the relationship between DTQ-VP and drinking-related behaviours become more positive. The DTQ-IP x D-SRHI interaction was not shown to be significant (*p* = .38)*.*

Discussion

This study examined whether *curren*t perseverative thoughts based on self-relevant verbalisms and object-orientated imagery about a desired target are associated with drinking-related behavioural enactment. In addition, we also sought to examine the potential moderating effects of drinking habits on this relationship. We extended previous work, which has invariably concentrated on establishing the operation of desire thinking in clinical populations, by focussing on a group of self-defined social drinkers. It must be pointed out that ~60% of the sample achieved in this study reported AUDIT-C scores indicative of moderate or severe AUD in a general drinking population. This suggests that our sample comprised a proportion of out-of-treatment heavier drinkers. Indeed, mean desire thinking scores across participants were fairly consistent with those shown in other work in clinical samples (e.g., Caselli & Spada, 2015).

Unlike other desire thinking work, we were not concerned with what people told us about their drinking intentions and retrospective drinking behaviours, we measured both indirectly by using a pouring and drinking behavioural task in the immediate aftermath of reporting their thoughts about drinking in-the-moment. In other words, we were able to examine the relationship between desire thinking and actual behaviour. Finally, unlike the vast majority of studies that have measured actual drinking behaviour in an experimental set-up, we conducted the work in our bar-lab facility which provides a more ecologically valid alcohol cue rich environment for consumption-based work *in situ*.

Our first prediction was that the relationship between desire thinking and behaviour would be positive. Our results confirmed these predictions. First, for the product of the behavioural measures, increased desire thinking score was associated with both increased millimetres of beer poured and increased millimetres of consumed. In other words, the more one is continuously thinking about drinking, the more one pours and consumes. Desire thinking per se is, as such, related to *in situ* behaviour. Is this true for the imaginal prefiguration and verbal perseveration components of desire thinking? Our initial correlations showed these relationships to be both positive and significant. However, when included as part of the model that included drinking habit as a moderator there was a degree of differentiation in the pattern of direct associations. Specifically, while imaginal prefiguration was positively and significantly associated with drinking behaviour, verbal perseveration was not. In other words, it appears that variability in pouring and consuming behaviour is directly associated with increasing perseverative thoughts based on positive imagery associated with the act and not with prolonged self-talk about reasons for undertaking the behaviour.

We also predicted that the positive relationship between desire thinking and behaviour would increase as a function of increasing habit. Before addressing this point specifically, it is worth pointing out that whilst some previous work has utilised frequency and regularity of occurrence of a behaviour as a measure of habit behaviour (e.g., Aarts & Dijksterjuis, 2000; Sheeran et al, 2005; Ji & Wood, 2007), we were concerned with examining process components of habit (e.g., lack of awareness and conscious intent) which operate to result in more habitual behaviour. To this end the SRHI was chosen to measure habit strength (Verplanken & Orbel, 2003; Gardner et al., 2011).

Returning to the moderating effect of habit strength on the relationship between desire thinking and drinking behaviour, our results confirmed that the effects of general desire thinking as well as the subcomponent verbal perseveration, but not imaginal prefiguration, were moderated by habit. So, what does this pattern of moderation look like? The general pattern is that as habit increases, the relationship between desire thinking (total and verbal perseveration) and amount poured/consumed becomes more positive. This was confirmed by simple slopes analysis with habit strength moderating general desire thinking and verbal perseveration *only* at sample average and high levels of habit and *not* when habit was low. In other words, habit is increasingly important for describing the positive relationship between desire thinking and drinking behaviours but only when habitual patterns are increased relative to decreased. It seems, therefore, that both general perseverative thoughts and, most particularly, the core characteristic of repetitive self-talk regarding the need to achieve a desired target, are influenced by habit level. This suggests that habit is important to *qualify* the effects of generic desire thinking and, in particular, verbal perseveration on behaviour. It seems in this context that the term *qualify* may be synonymous with *strengthen* but only at increased levels of habit. If this were the case, then future work should examine aspects of this strengthening process to further validate such moderating effects. For example, one prediction would be that a strong association between desire drinking (total and components) and drinking behaviour at high levels of habit should be reflected in indices that measure variability in the accessibility and salience of drinking and/or alcohol-related cognitions (e.g., measures of attentional preference resource allocation, memory-based association biases, etc.). Whilst some evidence has been presented showing increasing levels of habitual behaviour serving the accessibility and saliency for processing of alcohol-related information (e.g. Petzel & Noel, 2020; Noel, Petzel & Mulderig, 2019; Sheeran, Aarts, Custers, Rivis, Webb, & Cooke, 2005; Sharma, Albery & Cook, 2001), no work has directly measured changes in the processing of alcohol-related information as a function of desire thinking let alone as moderated by habitual mechanisms.

How might this pattern of dissociation between desire thinking components in predicting behavioural enactment be explained? One understanding is that our results imply that repetitive self-talk about one’s desire to drink is characteristic of habit-based thinking in a way that the propensity to engage in positive imagery for drinking is not. That there was no main effect of verbal perseveration on actual drinking in this model just adds to this explanation. It suggests that the relationship between verbal perseveration and how much is poured/consumed in-the-moment is explained *predominantly* by how it interacts with habit strength and, importantly, is apparent only when habit levels are increased. Future work should unpack how desire thinking shows it impact on actual behaviour as a function of habit strength by highlight key possible cognitive functions which may determine this moderation effect. An example is to consider the effects of increasing the saliency and/or accessibility of goal-directed but less consciously experienced thoughts as are predicted by intrusive and perseverative desire-based cognition and habit-based thinking. Another avenue would involve exploring whether desire-based thinking becomes subsumed under the habit banner. In this way, habit-based processes (both cognitive and motivational in nature) come to actually incorporate the operation of desire-based thoughts for behavioural enactment. One possibility, for instance, is that once a behaviour becomes habit-based (i.e., explicit intentions are not required for it to proceed in stable contexts), related desire-based thoughts (i.e., self-talk about the positiveness of the behaviour [verbal perseveration]) are more likely to be experienced automatically. According to our findings, in the case of verbal perseveration this will only become apparent under conditions of high habit strength.

In line with these ideas, recent work has argued that habit may play a number of distinct roles in any single behaviour, loosely defined as either preparatory or performance-based (Gardner, Phillips, & Judah, 2016; Kaushal, Rhodes, Meldrum, & Spence, 2017). This distinction has generated the concepts of (i) preparation habit (preparatory actions) (Kaushal et al., 2017), (ii) habitual instigation (the urge to “do the behaviour” when cued and experienced automatically) (Gardner et al., 2016) and (iii) habitual execution (progression through a number of sub-activities required for completion of a behaviour) (Phillips & Gardner, 2016). Where and, fundamentally, whether desire thinking becomes subsumed into these habit types and acts as a preparatory mechanism, instigator or even involved in ongoing execution are questions for future work. Our work has shown, however, that increasing habit and increasing desire thinking do interact to produce both increased pouring (preparatory behaviour) and consumption (performance behaviour).

Whilst these findings suggest the important role of habit in moderating the effects of desire thinking on observed drinking-related behaviours, several limitations are apparent. First, our measure of desire thinking (the DTQ [Caselli & Spada, 2010]) was designed more as a general measure of voluntary cognitive elaboration of goal contents. As such, the DTQ as it stands may not fully reflect desire thinking immediately preceding behavioural choice. Future work should test the possibility by comparing a more nuanced measure of in-the-moment desire thinking against the DTQ to ascertain a dissociation in their relationship with the enactment of (drinking) behaviours and how any relationship is moderated by pre-existing habit strength. As second issue is that the adopted consumption paradigm was limited to the extent that participant’s choice with respect to type of beverage was restricted to (non-alcoholic) beer and as such variability in drinking practices may have been influenced as a function of beverage preference. Future work should address this issue by adopting an indirect measure of consumption provided by a shame taste preference task (e.g., Stautz, Frings, Albery, Moss, & Marteau, 2017). Third, that our achieved sample comprised both potentially problematic and non-problematic drinkers (as measured through AUDIT-C scores) suggests that the observed moderating effects of habit on the relationship between desire thinking and drinking-related behaviours may reflect such differences. Future work is required to explicitly test how non-problematic and problematic self-defined social drinkers differ in their in-the-moment drinking practices as a function of components of desire thinking and habit strength. This would allow us to explore further any differences in the nature of the relationship between components of desire thinking and drinking behaviour in social drinkers.

In terms of the applied significance of this work, if desire thinking predicts consumption and that this relationship is only significant at increased levels of habit strength, changing how habitual drinking practices are should be reflected in decreased desire-based thoughts. An alternative it that making people increasingly aware of their in-the-moment desires may serve to minimise the impact of habit per se on behaviour. That desire thinking can be manipulated to impact “permissive” beliefs has been demonstrated in clinical samples (see Caselli et al., 2020; Caselli, et al, 2017). Whether or not such manipulations generalise to non-problematic use remain a question for future investigations.

In summary, we have shown in a sample of self-defined social drinkers that there is a positive relationship between desire thinking and *in-the-moment* drinking behaviours. We also showed that these effects increased as a function of rising drinking habit strength. Future work is needed to formulate the nature of this moderating influence on preservative goal-directed thinking.

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 Table 1. *Regression statistics for predicting drinking-related behaviours (amount poured [mls] x amount consumed [mls]) from general drinking-related desire thinking (DTQ-Total) and drinking-related habits* (D-SRHI).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Effect | b [SE] | β | *t* | *p* | 95% CIs | sr2 |
| DTQ-Total | 1565.26 [383.30] | .37 | 4.08 | < .001 | 803.04, 2327.49 | .15 |
| D-SRHI | 1649.75 [215.928] | .64 | 7.64 | < .001 | 1220.36, 2079.15 | .04 |
| DTQ-Total x D-SRHI | 111.14 [19.303] | .33 | 5.76 | < .001 | 72.75, 149.52 | .08 |

Table 2. *Regression statistics for predicting drinking-related behaviours (amount poured [mls] x amount consumed [mls]) from imaginal prefiguration (DTQ-IP) and verbal perseveration (DTQ-VP) desire thinking and drinking-related habits* (D-SRHI).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Effect | b [SE] | β | *t* | *p* | 95% CIs | sr2 |
| DTQ-VP | 971.58 [1061.208] | .11 | .92 | = .36 | -1139.50, 3082.66 | .00 |
| DTQ-IP | 1764.21 [791.554] | .23 | 2.23 | < .05 | 189.56, 3338.86 | .01 |
| D-SRHI | 1801.34 [229.397] | .70 | 7.85 | < .001 | 1344.99, 2257.69 | .18 |
| DTQ-VP x D-SRHI | 111.14 [19.303] | .42 | 3.09 | < .01 | 305.049, 1409.36 | .03 |
| DTQ-IP x D-SRHI | 857.20 [277.561] | -.12 | .88 | = .38 | -770.89, 299.74 | .00 |

Figure 1. *Proposed predicted moderation of desire thinking by degree of habitual drinking behaviour for the prediction of drinking-related behaviour (amount poured [mls] x amount consumed [mls]).*

Drinking

Habit

Levels

+

+

Drinking Behaviour: Pouring and Consuming

Drinking-Related

Desire Thinking

Figure 2. *Simple slopes for moderating effects of drinking habit score (D-SRHI) on desire thinking - total (Panel A) and desire thinking – verbal perseveration sub scale (Panel B) on drinking behaviour (poured x consumed).* Note: \**p* < .001.

 Panel A: Desire Thinking - Total

Panel B: Desire Thinking: Verbal Perseveration