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Tests of the Elaborated Intrusion Theory of craving and desire

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Tests of the Elaborated Intrusion Theory of craving and desire:

Features of alcohol craving during treatment, and preliminary development of a new measure

Abstract

Objectives: We tested predictions from the Elaborated Intrusion (EI) Theory of Desire, which distinguishes intrusive thoughts and elaborations, and emphasizes the importance of imagery.

Secondarily, we undertook preliminary evaluations of the Alcohol Craving Experience (ACE) questionnaire, a new measure based on EI Theory.

Methods: Participants ($n = 232$) were in correspondence-based treatment trials for alcohol abuse or dependence. The study used retrospective reports obtained early in treatment using the ACE, and daily self-monitoring of urges, craving, mood and alcohol consumption.

Results: The ACE displayed high internal consistency and test-retest reliability and sound relationships with self-monitored craving, and was related to Baseline alcohol dependence, but not to consumption. Imagery during craving was experienced by 81%, with 2.3 senses involved on average. More frequent imagery was associated with longer episode durations and stronger craving. Transient intrusive thoughts were reported by 87% of respondents, and were more common if they frequently attempted to stop alcohol cognitions. Associations between average daily craving and weekly consumption were seen. Depression and negative mood were associated with more frequent, stronger and longer lasting desires for alcohol.

Conclusions: Results supported the distinction of automatic and controlled processes in craving, together with the importance of craving imagery. They were also consistent with prediction of consumption from cross-situational averages of craving, and with positive associations between craving and negative mood. However, this study's retrospective reporting and correlational design require that its results be interpreted cautiously. Research using ecological momentary measures and laboratory manipulations is needed before confident inferences about causality can be made.

Key words: Alcohol use disorders; craving; cognition; motivation; treatment

In recent years there has been a surge of research interest in craving following the development of related pharmacological interventions and of growth in understanding its neurobiological basis. However, little remains known about the phenomenology of craving and cognitive processes that underpin it. Development of more effective psychological treatments should be informed by detailed understanding of these processes.

Elaborated Intrusion (EI) Theory (Figure 1, Kavanagh, Andrade, & May, 2005) synthesises existing data on craving or desire and develops new predictions about its nature. Within this theory, desires are seen as cognitive and affective events with frequency and duration, which can be described on a continuum of affective or motivational intensity and are distinguishable from physiological withdrawal symptoms. Craving is viewed as an intense desire or urge rather than a qualitatively different phenomenon. Desires to obtain appetitive targets are distinguished from intentions, and from thoughts about negative consequences of consumption (e.g. social approval or health enhancement).

Insert Figure 1 about here

A characteristic of EI theory is its distinction of automatic or associative and controlled or elaborative processes underlying desires (Figure 1). Subjectively, craving episodes typically begin with apparently spontaneous thoughts about wanting or needing an appetitive target, often in the form of affectively charged image fragments about targets or their consumption (May et al., 2004). Intrusive thoughts about desired targets are typically triggered by processes outside awareness (e.g. semantic priming, physiological deficits, or conditioned associations with external cues or thoughts). Intrusive thoughts are associated with anticipatory pleasure, or relief of physiological deficits or negative affect. If their affective correlates are sufficiently strong, and competing demands allow, processing space is allocated to further elaboration in working memory.

Since intrusive thoughts tend to trigger elaboration, and since associations are also elicited during elaboration, obtaining evidence that intrusive thoughts are distinct from of elaboration remains challenging. One test involves examining whether fleeting intrusive thoughts are sometimes reported to occur without substantial elaboration.

The contention that desire-related cognitions are often experienced as intrusive thoughts invites consideration of parallels with the wider literature on intrusive thoughts (Wegner, 1994). For example, suppression of desire-related thoughts in the laboratory increases their subsequent frequency (Salkovskis & Reynolds, 1994). Observations of an association between attempted suppression in other contexts would provide additional data in support of a role for intrusive thoughts in craving.

A unique contribution of EI Theory is its emphasis on the importance of imagery, which can be elicited associatively, but is further articulated in elaboration (Figure 1). Imagery has long been used to elicit craving (Tiffany & Drobles, 1990) and items related to imagery (e.g. "...can almost taste it") have sometimes been included in assessment instruments (Clark, 1994). However until EI Theory, imagery was not a major theoretical focus. While the theory does not exclude verbal elaboration, sensory imagery, and incorporation of anticipatory physical responses such as salivation into the image (e.g. of drinking), endow emotional and motivational "bite". Desires of greater affective intensity are therefore expected to be characterised by more frequent and more vivid imagery. Evidence is emerging that greater imagery is associated with more intense desire, both across and within subjects (May et al., 2008). Furthermore, competing imagery reduces craving (Panabokke, 2004; Harvey, Kemps, & Tiggemann, 2005; Versland & Rosenberg, 2007), and craving is associated with patterns of brain activation that are consistent with the production of visual imagery (Wang et al., 2007). However, research on the nature of the subjective experience of craving has not typically tested the role of imagery in people who are trying to control problematic alcohol or other drug use. Evidence from such a group is essential to test EI

Theory's assertion that similar imagery processes are at play in a context of substance misuse as in everyday desires.

In contrast with Tiffany's (1990) cognitive model of craving, which holds that conscious craving is epiphenomenal to drug-use behaviour, EI Theory holds that desires have a causal role in target acquisition, but within the context of other determinants. Specifically, their predictive power is limited by competing desires (e.g. to address negative effects of alcohol use), availability of the target, and relevant skills and self-efficacy. There may also be less common effects that limit predictions from conscious desires, because of relationships with consumption that occur outside awareness (e.g. overlearned responses to conditioned cues or semantic priming). However, we contend that such effects are typically restricted to simple behaviours (e.g. reaching for a drink), where the desire is weak, and concurrent tasks capture attention. Predictions from a specific episode to consumption over an extended period are subject to variations in the frequency and intensity of craving over that period. Correlations between desires and acquisition or consumption are more likely to emerge when data from multiple craving episodes are used to predict overall consumption over the same period, since those aggregations reduce the impact of any transitory situational moderators of the relationship.

In common with several other theories of craving (e.g. Baker et al., 2004; Koob & Le Moal, 1997), EI theory proposes that negative affect results in an activation of attention to an target that is associated with alleviation of that affect (e.g. a psychoactive drug). Greater activation of the negative affect increases the likelihood that a conscious desire is experienced. In consequence, craving is expected to be more frequent and intense in people who are more prone to depressive mood. Within EI theory, associations with negative affect are because it can be a consequence as well as a trigger of craving. Although elaboration of the desired object or activity accentuates anticipatory reward or relief, it also increases awareness of current physiological or affective deficits. If the deficit is significant (e.g. severe

thirst or alcohol withdrawal), the target is salient and there is no immediate prospect of its acquisition, related thoughts become highly aversive. Like the legendary Tantalus, the person keenly anticipates both the desired experience and its current impossibility.

The current study tested predictions of EI Theory within people who were undergoing treatment for alcohol abuse or dependence and had recently started an attempt to control consumption. Some of the participants also fulfilled diagnostic criteria for Major Depression. We focussed on assessments mailed out early in the intervention, when we expected desire for alcohol to be high. We examined retrospective reports of a recent episode of high craving and of craving during the previous 24 hours, together with self-monitored craving and alcohol consumption during the same week.

Predictions unique to EI theory were that: (1) a higher frequency of sensory imagery about alcohol would be associated with more intense alcohol craving, and (2) elaborative craving could be distinguished from related intrusive thoughts—specifically, that at least some alcohol-related thoughts would be experienced as fleeting intrusions. Both EI theory and the general body of research and theory on intrusive thoughts predicted that: (3) attempts to suppress thoughts would be associated with more intrusions. In common with several other theories of craving, EI theory also predicted that: (4) greater average intensity and frequency of craving over a week would be associated with greater alcohol consumption over the week, and that: (5) people with depression or with more negative self-monitored mood would have stronger and more frequent craving. A secondary objective of the study was to conduct a preliminary psychometric evaluation of a new questionnaire to assess craving, Alcohol Craving Experience (ACE) questionnaire, which places greater emphasis on imagery than do previous assessments.

Methods

Participants

Participants were taking part in randomised controlled trials on management of alcohol abuse or dependence using a correspondence-based version of a CBT intervention, similar to ones successfully tested in previous trials (Kavanagh et al., 1999). They were referred by their general practitioner (GP), or volunteered in response to media coverage about alcohol and its treatment. They were aged 18 or above, reported at screening that their usual weekly consumption over the previous 3 months was > 28 alcohol units (each 10g ethanol) per week for men or > 14 units for women, and fulfilled DSM-IV criteria for an alcohol disorder on a telephone administration of the Composite International Diagnostic Interview (CIDI, Version 2.1; World Health Organisation, 1997). They did not display abuse or dependence on other substances (except caffeine or nicotine), were not in concurrent psychological treatment for alcohol or depression at Baseline, and were not at the same address as another participant. They showed sufficient oral and written English to participate without translation, had no history of psychotic disorder and were not currently suicidal. Participants who were streamed into a trial of treatment for alcohol and depression also had to fulfil criteria for a current DSM-IV Major Depressive Episode on the CIDI.

The Alcohol Craving Experience Questionnaire (ACE).

The ACE was based on questionnaires used in previous studies with undergraduate students (May et al., 2004, 2008). While it was primarily designed to allow a test of the hypotheses for the current study, we undertook a preliminary examination of its psychometric characteristics.

The ACE asked questions about two time periods. One was the last time they had a strong craving or urge for alcohol. We refer to this as the *focal* craving episode. Participants reported how long the episode lasted (< 1 s, 1-5 s, 5-60s, 1-10 min, > 10 min), the strength of

craving (0, weak to 4, intense)¹, and how much they tried to stop thinking about drinking (0, not at all, to 4, as much as I could)¹. They reported the frequency of sensory imagery during the episode (Table 1), from 0, not at all, to 4, all the time, together with the frequency of thoughts about drinking that were without images or sensations. The questionnaire also asked contextual questions about the focal episode—when it occurred, how long they resisted the craving before drinking (not at all, seconds, minutes, hours)¹, and how much alcohol they consumed before and after the episode¹.

The second time period in the ACE was the previous 24 hours. Participants reported how often (0, not at all, to 4, all the time) they thought about drinking, how often they tried to stop thinking about drinking, and how often they experienced transient intrusive thoughts.

Procedure

Potential participants who reported having alcohol-related problems contacted the research office, and were screened by telephone for fulfilment of inclusion criteria. An assessment pack was mailed, including forms for consent, demographic details, and for consent by their GP (who was asked to provide information on treatment and progress). An Alcohol Timeline Follow-Back (Sobell & Sobell, 1992) provided event-cued recall of alcohol consumption over the previous 2 weeks. Other mailed assessments included the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993), the Severity of Alcohol Dependence Questionnaire-Form C (SADQ-C; Stockwell et al., 1994), and Kessler 10 (K10; Kessler et al., 2002) to assess symptoms of psychological distress. Participants began daily self-monitoring of alcohol consumption (in 10 g units), together with daily ratings of how often they had urges to drink (0, not at all, to 10, most of the day), their strongest craving (0, none, to 10, extreme), and the worst they felt each day (0, delighted, through 5, neutral to 10, unbearable).

Using diagnostic and symptom measures, participants were streamed into a randomised controlled trial for major depression plus alcohol use disorders, or to a trial on people without a current depressive episode. Each trial compared GP management plus 3-month delayed correspondence treatment, with GP management plus immediate correspondence treatment. The depression trial also had a condition where treatment covered both alcohol and depression. In both trials, participants elected an abstinence or moderation drinking goal. The current project used the ACE, sent in the second mailing (in Week 2, or on return of earlier assessments). At this point, participants had undertaken Baseline assessments and had begun daily self-monitoring. The only substantive difference between conditions at that time was between Immediate and Delayed correspondence treatment. Only those in Immediate conditions had received segments on motivation enhancement and goal setting. Along with the ACE, the second mailing also gave participants in Immediate treatment an introduction to cognitive therapy, particularly related to alcohol expectancies.

Results

Sample characteristics

A total of 469 volunteers inquired about the project, 433 were mailed the Baseline questionnaires, and 283 returned assessments, fulfilled all selection criteria and were randomly allocated to conditions. The allocated group did not differ from the remainder on gender and age, but was more likely to have had a treated episode of depression (59% vs 27% $\chi^2 = 45.14, p < .001$).

Fifty-five percent of respondents (128) were women. Only 3 (1%) did not attend high school, 45 (19%) had completed a trade, and 72 (31%) had a university degree. Two-thirds (154) were currently employed, and 42 (18%) were retired or on a pension. Ages ranged from 21 to 80, with a mean of 46.9 years (SD = 10.5). Most were currently married or with a partner (158, 68%); only 38 (16%) were single. Average SADQ-C (11.3, SD = 8.3) and

AUDIT scores at Baseline (23.3, SD = 6.4) indicated moderate alcohol dependence and high levels of alcohol problems. Average weekly consumption at Baseline was 15-240 units (10 g alcohol), with a mean of 66.6 for men (SD = 36.1) and 43.5 for women (SD = 21.3; $F(1, 275) = 45.0, p < .001, \eta^2 = .141$). There were no significant differences between depressed and nondepressed participants or between Delayed and Immediate conditions.

The ACE questionnaire was returned by 232 (82% of the allocated sample)², 91 of whom (39%) had a current Major Depressive Episode, and 102 of whom (44%) were in delayed treatment. The median time of ACE completion was Week 3 (Mean = 4.1, SD = 2.5). There were no differences in ACE responses related to week of completion. There were no significant differences between the sample completing the ACE and the remainder of allocated participants on demographic characteristics or previous depression treatment, but those who did not complete it had greater alcohol dependence on the SADQ-C (M, SD = 15.3, 11.1 vs. 11.3, 8.3; $F(1, 281) = 8.8, p = .003, \eta^2 = .030$), and trended towards higher AUDIT scores (M, SD = 25.0, 6.3 vs. 23.3, 6.4; $F(1, 281) = 3.0, p = .084, \eta^2 = .011$), and more Baseline alcohol consumption (M, SD = 61.4, 40.6 vs. 52.5, 28.5; $F(1, 281) = 3.5, p = .064, \eta^2 = .012$).

In the week of ACE completion, weekly alcohol use averaged 47.2 units for men (SD = 27.6) and 31.1 units for women (SD = 18.3; $F(1, 221) = 28.87, p < .001, \eta^2 = .051$). Most (172, 77%) were drinking below Baseline levels, although only 8 (4%) were abstainers. There were no differences between conditions in degree of change to that point. Average daily mood was close to neutral (M = 4.6, SD = 1.7) on the 0-10 scale. Weekly averages of daily urge frequency were 3.6 (SD = 2.0) on the 0-10 scale, and daily strength of craving had a mean of 4.6 (SD = 2.0). Mood and craving did not significantly differ across Gender, marital status, education or treatment. Participants with higher alcohol dependence at Baseline had more frequent self-monitored urges to drink ($r = .45, p < .001$), stronger craving ($r = .30, p < .001$) and more negative mood ($r = .28, p < .001$).

Insert Table 1 about here

Psychometric characteristics of the ACE

We initially examined the extent that the ACE items on craving or desire cohered into a scale. An initial analysis of internal consistency found that one of the twelve items (the frequency of alcohol-related thoughts without images or sensations) had a corrected item-total correlation of only .04. When this item was omitted, alpha rose to .79, with all item-total correlations being above .30 (Table 1).

The resulting 11-item scale had a mean of 18.9 (SD = 7.6, Range = 3-44, Deciles = 9, 12, 15, 17, 18, 21, 23, 26, 29), and was without significant skew or kurtosis. Younger participants showed a slight tendency to have higher scores than older participants ($r = -.19$, $p = .005$). The effect was most marked in the 40% of participants who were 43 or younger. There were no significant differences in total scores due to gender, marital status or immediacy of treatment.

ACE scores at 3 weeks correlated $.59$, $p < .001$ with those at 6 months, despite the occurrence of different interventions between those time points, although this result was limited to the 87 people completing both assessments. The total score at 3 weeks correlated $.53$, $p < .001$ ($n = 218$) with the maximum self-monitored urge frequency and $.44$ ($p < .001$, $n = 220$) with the maximum self-monitored craving strength over the week of completion. ACE scores were positively associated with more severe alcohol dependence on the SADQ-C ($r = .42$, $p < .001$) and higher AUDIT scores at Baseline ($r = .40$, $p < .001$), but there was no relationship with weekly alcohol consumption at Baseline ($r = .09$, n.s.).

The scale was then subjected to a principal components analysis, with pairwise deletions of missing item data. An initial analysis resulted in three components, but had one item (“How often did you think about drinking”) with substantial cross-loadings. After

omission of that item, there were three components with eigenvalues > 1 , accounting for 33.1%, 17.1% and 10.0% of the variance respectively. After oblimin rotation, all items had a loading $\geq .50$ on a component, with no substantial cross-loadings (Table 1). The first component was tentatively named “Imagery”, the second “Thought suppression and intrusions”, and the third, the “Intensity and duration”.

For the current paper, we had a particular interest in the first subscale, which is used for subsequent analyses involving frequency of imagery. It had an internal consistency of .76, with all item-total correlations being above .40. The other subscales also had satisfactory item-total correlations, but their length constrained their internal consistency (the alpha coefficient for the 3-item thought suppression and intrusions scale was .69, and for the 2-item intensity and duration scale was .60).

Nature of the focal episode

The focal episode of high craving selected by participants was most commonly in the afternoon (12-5pm, 97/219, 44%) or evening (5pm-5am, 79, 36%). For most people, it lasted more than a minute (146/219, 67%), and 40% (87) said it lasted more than 10 minutes. There were no differences in timing due to Gender, marital status or treatment condition. As suggested by previous analyses, strength of craving during the episode was positively associated with longer duration (Symmetric Somers' $d = .395$, $p < .001$, $n = 139$).

Sensory imagery was experienced by 81% of participants during the craving episode (186/231), with an average of 2.3 senses involved ($SD = 1.6$). The most commonly reported sense was taste (70%, 161/229), followed by vision (59%, 136/229) and imagined swallowing (57%, 132/230). Auditory (19%, 43/229) and olfactory images (28%, 65/231) were rare. Greater numbers of sensory elements were associated with a longer episode duration, consistent with the idea that complex imagery was elaborative (Symmetric Somers' $d = .133$, $p < .02$, $n = 218$). However, 77% of participants (174/227) also had at least some

alcohol thoughts without sensory or imaginal components. Consistent with the principal components analysis, frequencies of imagery and non-imagery thoughts were independent ($r = -.04$, $n = 227$).

Insert Table 2 about here

Association of imagery with craving intensity (Hypothesis 1)

As Table 2 shows, higher average image frequency (i.e. higher average scores on the ACE Imagery subscale) was related to stronger craving during the focal episode ($r = .35$, $p < .001$, $n = 148$). The effect remained when a binary comparison (no imagery/some imagery) was made ($F(1, 146) = 4.68$, $p < .05$). Inspection of results for individual sensory elements showed that all senses except imagined sounds significantly contributed to the relationship, with strongest correlations on visual and taste imagery (each $r = .33$, $p < .001$, $n = 147$). However, the frequency of non-imaginal thoughts was also associated with stronger craving ($r = .29$, $p < .001$, $n = 145$).

More frequent imagery was related to a longer focal episode (Symmetric Somers' $d = .216$, $p < .001$, $n = 218$), with strongest relationships involving imagined swallowing (Somers' $d = .224$, $p < .001$, $n = 217$) and visual imagery (Somers' $d = .214$, $p < .001$, $n = 216$). Non-imaginal alcohol thoughts were not associated with episode duration (Somers' $d = .054$, n.s., $n = 216$).

Image frequency during the episode was also associated with maximum self-monitored craving or urges over the same week (Urge Frequency: $r = .40$, $p < .001$, $n = 217$; Craving Strength: $r = .31$, $p < .001$, $n = 219$). All sensory elements contributed to the prediction of maximum urge frequency, and all but sounds contributed to strongest craving. The frequency of imagined pictures was the strongest predictor (Urge Frequency: $r = .38$, $p < .001$, $n = 216$; Craving Strength: $r = .32$, $p < .001$, $n = 218$). Alcohol thoughts without

images or sensations had a somewhat weaker prediction of self-monitored craving than did imagery (Urge Frequency: $r = .19, p < .01, n = 214, Z = 2.41, p < .01$; Craving Strength: $r = .19, p < .01, n = 216, Z = 1.31, p < .10$).

Intrusive thoughts (Hypotheses 2 and 3)

Despite high levels of craving, some transient intrusive thoughts about drinking were seen. In fact, 87% of respondents had some of these thoughts in the previous 24 hours. These thoughts were significantly associated with the number of sensory elements in an episode, $r = .17, p < .01, n = 231$, and with the duration of episodes, $r = .22, p = .001, n = 218$. Since both multiple senses and longer episodes are likely to reflect the presence of elaboration, the relatively small size of these correlations support the separability of fleeting intrusions from elaborative craving.

In the previous 24 hours, the more frequently participants tried to stop thinking about alcohol, the more intrusive thoughts about drinking they had ($r = .34, p < .001, n = 230$). In the focal episode, the extent they tried to stop thinking about drinking was also associated with a longer episode duration (Symmetric Somers' $d = .212, p < .01, n = 138$) and with stronger craving ($r = .25, p < .01, n = 146$). The more participants tried to stop thinking about alcohol over the previous 24 hours, the more often they had craving episodes during the week ($r = .25, p < .001, n = 216$).

Prediction of consumption from craving (Hypothesis 4)

As expected, average daily alcohol consumption over the week was significantly associated with self-monitored daily craving frequency ($r = .47, p < .001, n = 218$) and strength ($r = .43, p < .001, n = 220$), and with more frequent alcohol thoughts in the 24 hours before the focal episode ($r = .26, p < .001, n = 220$).

However, the ACE showed no relationship with consumption, either over the week of completion ($r = .01, n = 223$), or after the focal episode ($r = -.01, n = 141$). Only one item

predicted consumption after the focal episode: How much participants attempted not to think about drinking was associated with *longer* drinking latencies ($r = .39, p < .001, n = 142$) and *lower* subsequent consumption ($r = -.26, p < .01, n = 136$).

Relationship between negative mood or depression and craving (Hypothesis 5)

Participants with concurrent depression had significantly higher scores on the ACE ($M = 21.5, SD = 7.3$) than did those without depression ($M = 17.3, SD = 7.3; F(1, 230) = 18.66, p < .001, \eta^2 = .075$). In particular, they had longer episodes of craving ($\chi^2 = 13.13, p = .01, n = 219$) and stronger craving during the focal episode ($M = 2.8$ vs $2.4; F(1, 147) = 5.71, p < .05, \eta^2 = .037$). In self-monitoring over the week, they had more frequent urges ($M = 4.2$ vs $3.3; F(1, 216) = 10.70, p < .001, \eta^2 = .047$) and stronger craving ($M = 5.2$ vs $4.2; F(1, 218) = 11.73, p < .001, \eta^2 = .051$). Across the whole sample, self-monitored negative mood was associated with monitored urge frequency ($r = .54, p < .001, n = 218$), and monitored craving strength ($r = .54, p < .001, n = 219$), and with stronger craving during the focal episode ($r = .37, p < .001, n = 143$).

Discussion

The current study was the first to test predictions from EI Theory in a population with an alcohol use disorder. Although the data are correlational and the study design is therefore unable to identify the direction of associations, the findings are consistent with some key implications of EI Theory. Alcohol imagery was a prominent feature of the focal craving episode, and was typically multi-sensory. As predicted, image frequency was associated with stronger craving during the focal episode, and with maximum urge frequency and craving strength over the same week. The relationship between imagery and greater intensity of alcohol craving was consistent with previous research on the relationship between imagery and strength of both desires for food or non-alcoholic drinks, and desires for sport (May et

al., 2004; 2008). Image frequency was also related to duration of the focal episode, consistent with EI Theory's contention that complex imagery is articulated during elaboration of desire-related thoughts.

Non-imaginal thoughts about alcohol were also commonly experienced. Their frequency was independent of imagery, suggesting that both types of alcohol thoughts may coexist within most craving episodes, rather than one type of craving excluding the other. 'Non-imaginal' thoughts may have been verbal (semantic associations or mental verbalisations), or may indicate difficulties retrieving the nature of the experience. We intend to elucidate the nature of these thoughts in future research. Whether there is a parallel with the long-established distinction between people who approach tasks using verbalization vs. visualization or imagery (Bartlett, 1932; Paivio, 1971) remains to be seen. Non-imaginal thoughts about alcohol were positively associated with strength of craving during the focal episode, but not with episode duration. They had a somewhat weaker relationship with self-monitored urges during the week than did imagery.

Despite the fact that the ACE was administered in the early stages of an attempt to decrease alcohol consumption, transient intrusive thoughts about alcohol were common. Their occurrence provides support for the contention in EI Theory that intrusive thoughts are separable from episodes of more extended, controlled craving they often evoke. The observation may also have importance clinically—the fact that not all thoughts about alcohol lead to extended craving episodes may help patients to avoid catastrophizing about their occurrence. However, while these transient thoughts did not predict alcohol use in the current study, some of these thoughts may be intense, or lead to impulsive drinking. Obtaining a better understanding of them may prove critical to designing more effective treatments.

Additional evidence on intrusive thoughts was provided by their relationship with attempted suppression. This was consistent with EI Theory, and with previous reports that attempted thought suppression increases intrusions (Salkovskis & Reynolds, 1994; Wegner,

1994). Trying not to think about drinking was associated with more frequent craving, not only during the episode, but also across the whole week, suggesting that attempted suppression may have been a generalised coping strategy. Thought suppression was also associated with stronger craving and with a longer episode duration. However, this study could not distinguish causal direction. When thoughts are more frequent and episodes are longer, there are more opportunities for cognitive control. More frequent and intense craving may also trigger a greater perceived need for control.

As predicted, indices of craving derived from multiple episodes were related to alcohol consumption. Average self-monitored frequency of urges and craving strength over the week were associated with that week's alcohol consumption, and a significant (albeit weaker) prediction of weekly consumption was even obtained from frequencies of alcohol thoughts in the 24 hours before the focal episode. EI Theory sees effects of a single craving episode as being subject to situational factors (alcohol availability, difficulty of the situational challenge, level of distress). During a control attempt, variations in the salience of motivations to control consumption and in confidence and ability to apply coping skills can also occur. Averaging of craving and behavioural indices allows the impact of random variations in these factors to be reduced, although systematic influences from both these factors and any influences outside awareness will continue to constrain the degree of correlation between conscious craving and related behaviour. However, the current study could not isolate the direction of any causal influence—for example, alcohol consumption could have triggered craving (cf. Kavanagh et al., 2006).

In the current study, craving during the focal episode was not associated with either the latency or amount of immediately subsequent drinking. Given the association between averaged measures of craving and consumption, this result is more consistent with the multiple determinism hypothesis of EI Theory than with a contention that craving is epiphenomenal to consumption (Tiffany, 1990). We predict that if the ACE were

administered at random intervals over several days, substantial associations with consumption will be seen.

We were initially surprised to find that attempts to suppress alcohol thoughts were linked to less subsequent drinking, despite the fact that suppression was associated with greater craving. Attempts to suppress thoughts may have little success, but they may index the effort exerted to control drinking and related cognition. Other foci of this effort (e.g. behavioural control) are likely to be producing the reduced consumption. Alternatively, some participants may have interpreted not thinking about alcohol as a choice to think about other things, rather than a request to suppress thoughts. Giving attentional preference to other thoughts does not require monitoring for alcohol-related thoughts, and may not trigger ironic increases in those thoughts (Wegner, 1994). EI Theory predicts that most effective control of craving is achieved when people neither suppress nor elaborate intrusions: This approach is consistent with giving attentional preference to other thoughts, as long as suppression is avoided.

The current study also undertook preliminary development of a new measure of alcohol craving, the ACE. After omission of one item on alcohol thoughts without imagery, the questionnaire had good internal consistency and test-retest reliability and sound relationships with self-monitored craving. Apart from problems with cross-loading of an item on the frequency of thoughts about alcohol, items formed three interpretable factors (imagery, thought suppression and intrusions, intensity and duration). The ACE was positively associated with higher levels of alcohol dependence, although it was not associated with alcohol consumption. These results provide a basis for further development and refinement of the measure.

Limitations of the study include its reliance on retrospective self-reports, which may have led to participants' expectations affecting the obtained results. For example, they may have expected that imagery would be more prominent in more intense or long-lasting

episodes of craving. Retrospective ratings may have biased the results towards a role of imagery because elaborated, emotive and vivid representations are more memorable than shallowly processed verbal items (e.g., Craik & Lockhart, 1972; Pavio, 1971). Respondents may already have forgotten instances of craving that did not involve imagery. Against this interpretation are findings on everyday cravings that show a clear role for imagery even when ratings are made at the time of craving (May et al., 2004; 2008). Indeed, there is preliminary evidence to suggest that people may overestimate general factors such as mood and habit, at the expense of imagery, when rating craving retrospectively (Panabokke, 2004). These findings warrant further investigation with clinical populations. In future research, repeated ecological momentary assessments of craving using the ACE (cf. Ericsson & Simon, 1984; Shiffman et al., 1997) would increase confidence in the results.

However, a consistency of the current results with laboratory data provides support for our interpretation of them. For example, desires for cigarettes can be reduced by concurrent imagery (Versland & Rosenberg, 2007), supporting the involvement of imagery (and visuospatial working memory) in craving. Instructions to suppress cigarette-related thoughts in the laboratory is associated with increases in subsequent intrusive thoughts about smoking (Salkovskis & Reynolds, 1994). Increases in intrusive thoughts about food have been shown to reflect increased cognitive accessibility (Berry, Andrade & May, 2007). Our subsequent research is manipulating imagery and intrusive thoughts within laboratory studies and is refining the ACE. We are also applying EI theory (and in particular, its predictions about imagery and intrusive thoughts) to develop and test a new intervention for substance-related craving (Kavanagh et al., 2004). This body of work is providing additional confirmation that a cognitive level of analysis can shed new light on craving and support the development of innovative clinical treatments.

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Footnotes.

1. These items were added partway through the study, and were completed by 141-149 respondents.
2. Unless otherwise specified, numbers in analyses involving the ACE are 232.

Table 1. The Alcohol Craving Experience Questionnaire (ACE).

	M (SD)	N	Corrected item-total correlation	Rotated Component Matrix		
				“Imagery”	“Thought suppression and intrusions”	“Intensity and duration”
Part A. Think of the last time you had a strong craving or urge for alcohol.						
How long did it last? ²	3.87 (1.18)	219	.40	.10	.13	.81
How strong was this craving? ³	2.53 (0.94)	149	.50	.19	.25	.74
During this craving episode, how often...						
Did a picture of a drink come to mind? ¹	1.35 (1.35)	229	.56	.58	.25	.28
Did you imagine tasting the drink? ¹	1.67 (1.32)	229	.53	.72	.06	.26
Did you imagine swallowing alcohol? ¹	1.28 (1.33)	230	.46	.75	-.04	.31
Did you imagine the smell of alcohol? ¹	0.48 (0.90)	231	.39	.76	.03	.05
How much did you try to stop thinking about drinking?	2.04 (1.46)	148	.35	.01	.88	.06
Part B. Over the past 24 hours, how often...						
Did you try to stop thinking about drinking? ¹	1.77 (1.36)	230	.53	.15	.85	.13
Did thoughts about drinking just pop in and vanish without trying? ¹	2.04 (1.18)	231	.40	.05	.51	.29
Did you think about drinking? ^{1,4}	2.03 (0.90)	229	.53			

1. Rated from 0, not at all, to 4, all the time.

2. Rated 0, < 1 sec; 1, 1-5 secs; 2, 5-60 secs; 3, 1-10 mins; 4, > 10 mins.

3. Rated from 0, weak, to 4, intense.

4. This item was omitted from the final exploratory principal components analysis because of cross-loading.

Table 2. Relationships between craving and craving features

	Average imagery during the focal episode	Thoughts about drinking without images or sensations
Features of craving during the focal episode		
Strength of craving (<i>r</i>)	.35***	.29***
Duration of craving (Somers' d) ¹	.22***	.05
Average daily self-monitoring		
Frequency of urges (<i>r</i>)	.35***	.17*
Maximum strength of craving (<i>r</i>)	.30***	.15*

1. Duration of craving was recorded in categories only, requiring the use of the non-parametric test, Somer's d.

a $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Figure 1. Core features of the Elaborated Intrusion (EI) Theory of Craving and Desire. Faint lines reflect associative processes, and bold lines reflect processes involved in elaboration. Ovals indicate potential triggers of craving episodes; rectangles indicate components of the craving experience.