

Arne Garvik Janssen

# A metacognitive model of alcohol use: A cross-sectional study examining the role of metacognitions and desire thinking

Hovedoppgave i Profesjonsstudiet i psykologi

Veileder: Stian Solem

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Norges teknisk-naturvitenskapelige universitet  
Fakultet for samfunns- og utdanningsvitenskap  
Institutt for psykologi

 **NTNU**  
Norwegian University of  
Science and Technology



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*A cross-sectional study examining the role of  
metacognitions and desire thinking*

Supervisor: Stian Solem

Co-supervisor: Roger Hagen

December 2019

## Preface

This graduate thesis is a major milestone when approaching the end of the 6-year clinical psychology programme at NTNU. Addiction and substance abuse, as well as metacognitive theory, are topics I have long found interesting. In December 2017 came an opportunity to write a thesis that involved both topics, and in early 2018 it was decided that Stian Solem would supervise me in this task. The initial work consisted of gathering data for the survey, a task that demanded creativity and determination in order to achieve a high number of respondents. Because data was gathered from several different sources, I had to be adaptable with regards to recruitment. Luckily, this resulted in a good number of responses. We considered distributing the survey in clinical populations, and although this part of the study was ultimately left out I learnt a great deal about the relevant ethical considerations and about communicating with institutions for research purposes. Data analyses were carried out in cooperation with Stian. It was fascinating to explore a subject so thoroughly through a series of analyses. At the same time, it was a challenging learning process, especially considering some analyses were beyond the study curriculum. This field of research is still relatively young, which made for a challenging writing process since existing findings are quite scarce. However, it was exciting to contribute in this pioneering field of research. I have made efforts to highlight the relevance and possible applications of the findings from the study, in the genuine hope that it can benefit people who suffer from alcohol use disorder in the future.

I want to thank Stian for all the guidance and encouragement he has provided throughout the work with the thesis. His feedback has been thorough and constructive, and he has been important in making this process such a positive experience. I also want to thank my co-supervisor Roger Hagen for providing important help and an additional perspective on the thesis, and my fellow student and friend Fredrik Hagen who gave me valuable input when finishing the thesis. Finally, I want to thank my parents for their help and support.

### **Abstract**

Metacognitive theory has proven itself useful in the conceptualization and treatment of common mental disorders such as anxiety and depression. A growing body of research has demonstrated that metacognitive beliefs and related thinking styles are also closely associated with alcohol use and other addictive behaviours. A consequence of metacognitive beliefs about alcohol is the increased likelihood for the individual to engage in desire thinking. Desire thinking is a form of extended thinking known to cause craving for alcohol. Despite indications that metacognitions about alcohol and desire thinking both are involved in alcohol use, these phenomena have yet to be examined together in the same study. In the present study, a survey including measures for positive and negative alcohol metacognitions as well as desire thinking was conducted on a convenience sample ( $N = 588$ ). Conducting correlational, regression, and path analyses, the results from the present study supported previous findings regarding alcohol metacognitions and desire thinking with respect to impact on alcohol use levels. Path analysis lead to a metacognitive model of alcohol use, metacognitions, and desire thinking, with good model fit. The model proposes a path that is initiated when positive alcohol metacognitions become active. Positive alcohol metacognitions seem to directly stimulate alcohol use, and also to trigger imaginal and verbal desire thinking which could enhance likelihood of alcohol use further. Lastly, alcohol use and desire thinking may lead to negative alcohol metacognitions. In this manner, the model demonstrates the interaction between alcohol metacognitions and desire thinking, and the outcome it has on alcohol use. Implications of the findings, limitations of the present study and suggestions for further research are discussed.

*Keywords:* Alcohol, Addiction, Metacognitions, Metacognitive beliefs, Desire thinking

## Introduction

Consumption of alcohol is associated with harmful consequences, ranging from socioeconomic challenges, to injury, mental health problems and death (FHI, 2018; Rehm et al., 2017). The World Health Organization (WHO; 2018) report that 3 million deaths in 2016, 5.3% of all worldwide deaths that year, were a result of alcohol use. A review of studies regarding health risks from alcohol use concluded that alcohol use is the 7<sup>th</sup> highest risk factor for death and disability-adjusted life years globally in 2016 (Griswold et al., 2018). Both globally and among the Norwegian population, alcohol is the leading risk factor for death among people aged 15 – 49 years (Griswold et al., 2018; Øverland et al., 2018). The Norwegian Institute of Public Health reports that alcohol use was registered as a direct cause of death in 339 cases in Norway in 2017 (FHI, 2018). However, the report points out that alcohol use is a contributing factor for many other causes of death and injury, e.g. traffic accidents and acts of violence. In addition, alcohol use has important socioeconomic consequences, such as causing a considerable amount of work absence (FHI, 2018). Furthermore, WHO (2018) estimate that more than a quarter billion people are suffering from alcohol use disorders worldwide. The term *alcohol use disorder* (AUD) describes high-risk alcohol consumption ranging from harmful use, to abuse, and further on to dependence, the most severe form of AUD (Schuckit, 2009; WHO, 2018).

## Current treatment options

The National Institute for Health and Care Excellence (NICE) and guidelines from the American Psychiatric Association (APA) recommend that treatment for AUD should start with a psychological intervention, such as cognitive behavioural therapy (CBT), behavioural therapy and environment-based therapies (Kleber et al., 2007; NICE, 2011). APA also recommends motivational interviewing (MI), psychodynamic therapies, and self-help groups such as Twelve Step Facilitation (TSF, i.e. Alcoholics Anonymous; Kleber et al., 2007). In spite of the broad selection of treatment methods, there are important limitations to the existing interventions. Although CBT has been regarded as an effective treatment of AUD, meta-analysis has demonstrated that the effect is short-lasting, resulting in high relapse rates (Magill & Ray, 2009). A Cochrane review of TSF intervention concluded that although TSF is among the most widely used AUD treatments, it lacks data evidence supporting its effectiveness (Ferri, Amato & Davoli, 2006). A Cochrane review of MI found effects on alcohol use to be small and concluded that evidence for the efficacy of MI was weak (Foxcroft et al., 2016). Another review of treatment methods concluded that psychodynamic



therapy and environment-based therapies were ineffective (Miller & Wilbourne, 2002). In summary, the evidence underlying the existing recommended treatment options indicates that there is considerable room for improvement in treatment outcomes for AUD.

Researchers have argued that current conceptualizations and treatments have not sufficiently established the aetiology and maintaining factors of AUD (Caselli et al., 2018). Later years have seen an interest in the role of a metacognitive approach in addiction disorders such as AUD. Since metacognitions are not addressed in existing recommended treatments, they will remain a persistent risk for further alcohol use even in individuals who have undergone treatment (Caselli et al., 2018; Martino et al., 2019; Spada et al., 2015). One example is found in a study by Spada, Caselli, & Wells (2009) who investigated problem drinkers who had completed a course of CBT for their alcohol use: the study found that dysfunctional metacognitions remained after treatment, constituting a risk factor for relapse.

### **The metacognitive theory and its applicability in AUD**

The Self-Regulatory Executive Function (S-REF) model (Wells and Matthews, 1994; 1996), emphasizes the role of metacognitions in psychological distress. According to Spada, Caselli, Nikčević & Wells (2015) the S-REF model illustrates how a dysfunctional cognitive style can lead to psychological stress and addictive disorders. The S-REF model is made up of three interacting systems (Spada et al., 2015; Wells, 2011): (1) a low-level processing system, (2) the S-REF, and (3) the meta-system. The low-level processing system is stimulus-driven, operates unconsciously, and is the origin of impressions that come into conscious awareness. Such impressions can be affective, cognitive and somatic in nature (e.g. feelings of anxiety, negative thoughts and painful sensations). The S-REF is the active process of self-regulation; a voluntary, online and conscious processing of cognition and behaviour. The system's purpose is to achieve and maintain a desired state of the self. Intrusion into conscious awareness that causes the individual to experience a deteriorated state of self is dealt with by the S-REF. When the S-REF functions adequately this activity is brief and effective, as the individual copes with the intrusion appropriately.

However, under maladaptive conditions the desired state of self is not restored. This is caused by a pattern of coping that leads to sustained S-REF activity. Both the low-level processing system and the metacognitive system are critical in initiating and ceasing S-REF activity. The meta-system comprises metacognitions, a term used to describe an individual's beliefs, knowledge, and strategies regarding cognition and cognitive control (*meta* meaning

*awareness of itself or self-referential*). As a top-down control mechanism, metacognitions have great influence on the self-regulatory function (i.e. how one copes with intrusions).

According to the S-REF model, metacognitive beliefs are central in development and maintenance of psychological distress. Wells & Matthews (1994) argue that this is because metacognitions can lead to a cognitive style termed the Cognitive Attentional Syndrome (CAS). CAS include coping styles such as extended thinking, threat monitoring, thought suppression and avoidance of certain thoughts. These coping styles are intended to assist self-regulation, but paradoxically cause negative thoughts and emotions to persist.

Wells (2011) defines two main categories of metacognitive beliefs that cause the CAS: positive metacognitive beliefs and negative metacognitive beliefs. Positive metacognitive beliefs refer to a conviction that worry, rumination, threat monitoring, extended thinking, substance use, and similar strategies, are useful and beneficial (e.g. 'Worrying will help me prepare' and 'Drinking alcohol makes me think more clearly'). These beliefs make the individual prone to engage in such activity. Negative metacognitive beliefs concern the conviction that executive functions, thoughts and emotions can be uncontrollable or dangerous (e.g. 'I have no control over my drinking' and 'I cannot stop thinking about alcohol once I start '). This prevents the individual from attempting to control their thinking, leading to prolonged CAS. *Alcohol metacognitions* are positive and negative metacognitive beliefs concerning alcohol, and research have found alcohol metacognitions to be prevalent among people with AUD (Hamonniere & Varescon, 2018).

Based on this, the metacognitive theoretical framework is less concerned with the content of intrusions, concentrating instead on the mechanisms that generate, monitor and maintain the intrusions, namely the metacognitive system (Wells, 2011). Wells (2011) argues that psychological distress and disorder is the result of a faulty S-REF process wherein a maladaptive coping style is consistently used to handle intrusions. This causes frequent and prolonged exposure to the distressing emotional responses triggered by the intrusions. Spada et al. (2015) argues that the S-REF model offers a conceptualization of addictive behaviours such as nicotine dependence, pathological gambling, and problematic internet use, in addition to AUD.

Spada, Caselli & Wells (2013) presented a metacognitive conceptualization of problem drinking. This conceptualization describes how metacognitions influence the initiation and maintenance of problem drinking. The researchers argue that alcohol related triggers activate positive alcohol metacognitions, which is followed by desire thinking.

This causes increased craving for alcohol, and also triggers negative alcohol metacognitions. In the aftermath of drinking alcohol, the individual experiences increased negative affect and negative alcohol metacognitions, such as perceiving themselves as unable to control alcohol related thoughts. The outcome of this process is an increased likelihood of using alcohol as a means to self-regulate at a later time, thus preserving a harmful drinking pattern (Spada et al., 2013).

Metacognitive therapy (MCT) is a treatment method that derives from the S-REF model (Wells, 2011). MCT targets metacognitive beliefs and related thinking styles, so that they can be challenged and interrupted in order to reduce or modify them, thus disrupting the CAS. The treatment method has been applied for over a decade for depression as well as a number of anxiety disorders, including generalized anxiety disorder, obsessive-compulsive disorder, post-traumatic stress disorder and social anxiety disorder (Normann, van Emmerik & Morina, 2014; Wells, 2011). Meta-analysis supports the efficacy of MCT in anxiety and depression treatment (Normann et al., 2014), and the first complete course of MCT for AUD-patients was recently conducted by Caselli et al. (2018). The case study included only 5 patients, but researchers reported substantial decline in metacognitions about alcohol, and an associated decline in alcohol use, concluding MCT had the potential of becoming a valuable option for the treatment of AUD (Caselli et al., 2018).

### **Desire thinking**

A key element to the phenomenon of addiction is craving (Caselli & Spada, 2010). Craving is defined as a strong subjective sensation of anticipation and desire for the effect of an activity or a substance (Marlatt, 1987). Research on AUD and other addiction disorders have demonstrated that craving is important in maintenance and relapses in addictive behaviours (Bottlender & Soyka, 2004; Caselli & Spada, 2010; Gordon et al., 2006; Schneekloth et al., 2012). One metacognitive strategy that appears to be an important cause for craving is desire thinking. Desire thinking is a process of voluntary engagement in mental elaboration of a desired target (Caselli, Ferla, Mezzaluna, Rovetto & Spada, 2012). The Elaborated Intrusion Theory of Desire suggests that desire thinking can be activated by a range of cues, such as withdrawal symptoms and negative mood, as well as environmental or cognitive associations (Kavanagh, Andrade & May, 2005; May, Kavanagh & Andrade, 2015). Desire thinking is assumed to evoke sensations similar to actual engagement in the desired activity (e.g. drinking alcohol), which generate pleasurable feelings or relief from discomfort. However, these sensations are brief. The short-lasting experience leads to reinforced awareness towards

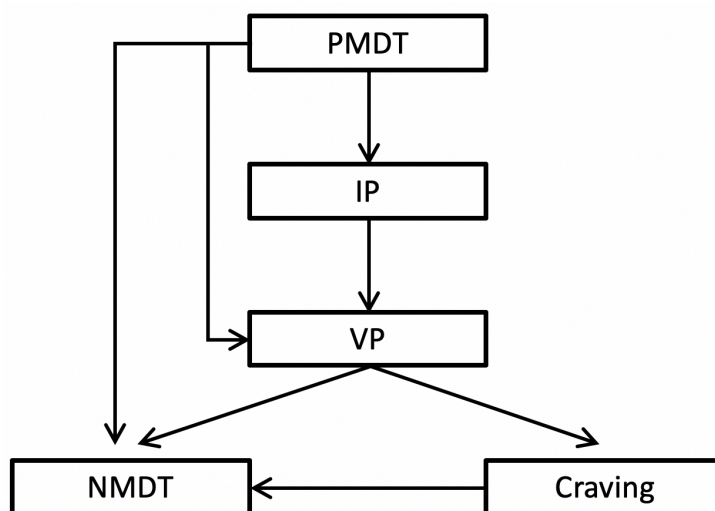
deprivation of the desired activity, causing negative affect, a sense of physiological need for the desired activity, and more attention directed to the stimuli that triggered the intrusive desire thought. This in turn generates elaboration, i.e. a controlled cognitive process in which information is retrieved and retained in working memory. Through elaborative desire thinking, the pleasurable or relieving sensations are repeated briefly, but ultimately only lead to further awareness of desire. Continued elaborative desire thinking will lead to more and more craving, which increases likelihood that the individual engages in the desired activity (Kavanagh, Andrade & May, 2005; May, Kavanagh & Andrade, 2015).

In the context of the S-REF model, desire thinking is classified as a form of extended thinking, and is considered a key element to the CAS with regard to addictive behaviours (Spada et al., 2015). Two forms of desire thinking have been identified: *verbal perseveration* (VP) and *imaginal prefiguration* (IP; Caselli & Spada, 2011). Verbal perseveration is defined as self-talk elaborating on the need to achieve the desired target, while imaginal prefiguration involves the construction of mental sensory images of the desired target, typically involving taste, vision or inebriation in the case of alcohol (Caselli & Spada, 2010; Kavanagh, May & Andrade, 2009). The individual engages in desire thinking to manage the craving process. This can be an effective short-term strategy, but over time it will have the paradoxical effect of escalating craving, because the imaginal target stimuli are persistently exposed to the individual, but not actually achieved (Caselli & Spada, 2011). Thus, the desired target will be perceived as an increasingly compelling means of achieving relief from craving and discomfort.

The Desire Thinking Questionnaire (DTQ) is a self-report instrument developed and validated by Caselli & Spada (2011). The DTQ has been applied in several studies, through which desire thinking has been found to be a significant predictor of alcohol use and alcohol craving levels (Caselli et al., 2012; Caselli et al., 2013; Caselli & Spada, 2011; Caselli & Spada, 2015; Martino et al., 2019). Desire thinking has also been found to predict other addictive behaviours, such as smoking (Caselli et al., 2012; Caselli & Spada, 2015), gambling (Ferne et al., 2014), problematic internet use (Caselli & Spada, 2015) and problematic internet pornography use (Allen, Kannis-Dymand & Katsikitis, 2017). There are indications that imaginal prefiguration and verbal perseveration predict different aspects of addiction, with imaginal prefiguration being closer linked to craving and verbal perseveration to behavioural enactment, i.e. relapsing and severity of alcohol use (Martino et al., 2019). In order to investigate the role metacognitive beliefs has on desire thinking, the Metacognitions about Desire Thinking Questionnaire (MDTQ; Caselli & Spada, 2013) was developed.

MDTQ has been found to be associated with desire thinking and craving in individuals with alcohol use disorder, gambling disorder, nicotine addiction, problematic internet use and problematic internet pornography use (Allen et al., 2017; Caselli & Spada, 2013; Caselli & Spada, 2015).

Researchers note that desire thinking may become an important factor in future conceptualization and treatment of addictive disorders such as AUD (Caselli et al., 2012; May, Kavanagh & Andrade, 2015). A metacognitive model of desire thinking and craving was proposed by Caselli & Spada (2015). The model (see Figure 1) aims to explain how desire thinking unfolds and lead to craving. In the proposed model, positive metacognitions about desire thinking (PMDT) are associated with imaginal prefiguration (IP) which in turn generates verbal perseveration (VP). Further on, verbal perseveration brings about craving for the desired goal. Additionally, verbal perseveration, PMDT and craving all cause increase in negative metacognitions about desire thinking (NMDT). PMDT can also generate verbal perseveration independently of imaginal prefiguration. The model is presented in Figure 1.



*Figure 1.* A metacognitive model of desire thinking and craving (Caselli & Spada, 2015).

PMDT = Positive Metacognitions About Desire Thinking, IP = Imaginal Prefiguration, VP = Verbal Perseveration, NMDT = Negative Metacognitions About Desire thinking

### **Current findings about metacognitions and addictive behaviours**

Toneatto (1999) carried out an exploratory study of metacognitive beliefs among substance (predominantly alcohol) abusers, with results indicating that metacognitive beliefs could potentially be of clinical importance during treatment of substance use. Later, Spada & Wells (2005) reported a significant association of positive and negative metacognitive beliefs and

alcohol use, in particular beliefs about the need to control thoughts. In a series of interviews with 10 AUD patients, the researchers identified metacognitions explicitly regarding alcohol use, and argued that the results were consistent with the S-REF model (Spada & Wells, 2006). Ensuing studies replicated these findings in larger samples, showing that metacognitions predict level of alcohol use, problem drinking and/or alcohol dependency (Clark et al., 2012; Hoyer, Hacker & Lindenmeyer, 2007; Spada, Moneta & Wells, 2007; Spada & Wells, 2010; Spada, Zandvoort & Wells, 2007). Spada & Wells (2008) developed clinical assessment tools of metacognitive beliefs specifically concerning alcohol use, two questionnaires named the Positive and Negative Alcohol Metacognitions Scale (PAMS and NAMS).

Metacognitive beliefs have also been found to play a role in addictive behaviours other than alcohol use. Research have found signs of both positive and negative metacognitive beliefs about nicotine use (Nikčević & Spada, 2010; Nikčević et al., 2017) and gambling disorder (Spada, Giustina, Rolandi, Fernie & Caselli, 2015). In addition, there are elevated levels of metacognitive beliefs among problem internet users (Spada, Langston, Nikčević & Moneta, 2008). Spada et al. (2015) argues that the research evidence sufficiently demonstrates the applicability of the S-REF model in understanding and treating addictive behaviour, suggesting that MCT should be considered as a treatment option for addiction disorders. A pioneering case study of MCT in AUD patients by Caselli et al. (2018) supports this argument. A systematic review by Hamonniere & Varescon (2018) identified 38 studies that examined metacognitive beliefs and addictive behaviours. The researchers concluded that metacognitive beliefs have a significant positive association with addictive behaviours, and that results from the review support the argument that metacognitions should become a target for treatment in patients presenting with addictive behaviours

### **Aims and Hypotheses**

Desire thinking and alcohol specific metacognitions have both been found to predict alcohol use, but existing studies have investigated these phenomena separately. Based on the close relationship between them, and the fact that both factors are associated with alcohol use, the present study aimed to investigate how well a model incorporating both measures predicted alcohol use. The applied model was similar to the one presented by Caselli & Spada (2015; see Figure 1), however craving was replaced with alcohol use, and PMDT/NMDT were replaced by PAMS/NAMS respectively.

Moreover, the present study will be the first study that explores metacognitions in alcohol use on a Norwegian sample. Lastly, as research on metacognitions in addictive behaviours has provided promising results, researchers have requested further investigation into the role of metacognitions in addictive behaviours (Caselli et al., 2018; Caselli & Spada, 2015; Hamonniere & Varescon, 2018; Mansueto et al., 2019; Martino et al., 2019; Spada et al., 2015). The present study aims to contribute to this field of research.

Two hypotheses were formulated: 1) Positive and negative alcohol metacognitions (PAMS & NAMS), and desire thinking (VP and IP), will be positively associated with level of alcohol use, 2) The suggested metacognitive model of metacognitions and desire thinking in alcohol use will demonstrate a good model fit.

## Methods

### Participants and procedure

Prior to data collection, the study was reported to and registered by the Norwegian Centre for Research Data (ref. nr. 53698). The study was not required to report to the Regional Committees for Medical and Health Research Ethics (REC) because anonymity was adequately ensured with the use of a voluntary, anonymous online survey. Invitation to the online survey about alcohol use was presented on multiple platforms: through social media, in university lectures and via e-mail to all students attending Institute of Psychology at NTNU. The addiction treatment centre Unicare also shared the survey through their Facebook page. Required minimum age for respondents was 18 years. Relevant information about the study was presented along with the survey for the participants to read before responding.

A total of 598 respondents were registered, 10 of whom were excluded from the dataset as they had not completed the survey. After exclusions, a total of 6 values were missing from measures of alcohol use, metacognitions, desire thinking and mental health. Missing items were compensated by applying mean item value for the relevant subscale. Of the 588 respondents in the final sample, 62.1% were females, and mean age was 35.1 ( $SD = 15.2$ ). With regards to relationship status, 33.3% reported being single. A majority of 96.1% reported being in active work or a student. Further descriptive data are presented in Table 2.

### Measures

*The Alcohol Use Disorders Identification Test* (AUDIT; Babor, Higgins-Biddle, Saunders & Monteiro, 2001) is a screening tool designed to assess an individual's alcohol

consumption and its consequences. Information gathered with the AUDIT can be used to identify harmful or high-risk patterns of alcohol consumption, as well as fully developed alcohol dependence. The questionnaire was developed by WHO and has seen widespread use in both alcohol research and health work (Babor et al., 2001). The instrument is made up of 10 questions about alcohol use that explore three domains: (1) hazardous and (2) harmful alcohol use, and (3) dependence symptoms. For each question, there are five possible responses, and the respondent is asked to choose the alternative that best describes their alcohol use. Responses are scored from 0 to 4, where a higher score indicates problematic alcohol use. Total score can range from 0 to 40, where 0 indicates abstinence from alcohol and no signs of problematic use, while 40 indicates a high level of consumption, probable dependency and major consequences as a result of the alcohol use. In the present study participants were categorized as low, moderate, or high risk alcohol users, based on their AUDIT score. There have been varying suggestions regarding the interpretation of AUDIT score and the level of risk the score indicates (Babor & Robaina, 2016; Johnson, Lee, Vinson & Seale, 2013; Spada & Wells, 2010). Spada & Wells (2010) categorized participants as "non-problem drinkers" if they scored 6 or lower. The same scoring was applied for the group labelled *low risk* in the present study. Because of the small number of high-scoring participants, it was deemed appropriate to set a cut-off score of 15 for the *high risk* group for two reasons: (1) prior research has identified this as an optimal cut-off point for identifying alcohol dependence, with a specificity of 100% while retaining acceptable level of sensitivity (Johnson et al., 2013), and (2) because it made the high risk group big enough to identify meaningful and significant data. The intermediate respondents who scored 7-15 were categorized as *moderate risk*. The original English language instrument has shown good internal consistency ( $\alpha = .80$ ; Meneses-Gaya et al., 2009). In this study, it was administered as part of an internet based self-report questionnaire, and the Norwegian version of AUDIT was used (Aasland, Amundsen, Bovim, Fauske, & Mørland, 1990). Existing evaluation of the Norwegian AUDIT has reported good validity and reliability (Gundersen, Mordal, Berman & Bramness, 2013). This study found internal consistency to be acceptable ( $\alpha = .78$ )

*The Positive Alcohol Metacognitions Scale* (PAMS; Spada & Wells, 2008) is a clinical assessment tool constructed for identifying positive metacognitive beliefs about alcohol use. The measure consists of 12 items making up 2 factors: (1) positive metacognitive beliefs about emotional self-regulation and (2) positive metacognitive beliefs about cognitive self-regulation. Each item is a statement about the subjective experience of alcohol consumption, and the respondent is asked to score their response based on how much he/she agrees to the



statement. Responses are scored on a 4-point Likert scale, where 1 = “do not agree”, 2 = “agree slightly”, 3 = “agree moderately” and 4 = “agree very much”. Thus, high scores indicate a high level of positive metacognitive beliefs about alcohol consumption. Example of an item included in beliefs about emotional self-regulation is “Drinking makes me more confident”, while “Drinking makes me think more clearly” is an example of an item included in beliefs about cognitive self-regulation. The instrument has shown good internal consistency ( $\alpha = .84-.88$ ; Spada & Wells, 2008). For this study, the PAMS was administered in a Norwegian translation. This study found internal consistency to be good ( $\alpha = .86$ ).

*The Negative Alcohol Metacognitions Scale* (NAMS; Spada & Wells, 2008) was constructed alongside PAMS, but differ in that it assesses negative metacognitive beliefs about alcohol use. The measure consists of 6 items, and like PAMS the respondent is asked to score their response according to how much they agree with the statement. A 4-point Likert scale identical to the one in PAMS is used in NAMS. NAMS is also made up of two factors: (1) negative metacognitive beliefs about uncontrollability and (2) negative metacognitive beliefs about cognitive harm. An example of an item included in beliefs about uncontrollability is “I have no control over my drinking”, while an example of an item included in beliefs about cognitive harm is “Drinking will make me lose control”. The instrument has shown good internal consistency ( $\alpha = .74-.87$ ; Spada & Wells., 2008). A Norwegian translation of the NAMS was used, and in this study internal consistency was found to be questionable ( $\alpha = .66$ ).

*The Desire Thinking Questionnaire* (DTQ; Caselli & Spada, 2011) is an instrument constructed to assess desire thinking. It is made up of a total of 10 items which are classified in two factors, consisting of five items each: (1) *verbal perseveration* (VP) and (2) *imaginal prefiguration* (IP). Each item is a statement describing elaborating thoughts about desired alcohol consumption. An example of a statement about verbal perseveration factor is “I repeat mentally to myself that I need to drink [alcohol]”, while an example of imaginal prefiguration is the statement “I imagine how I would feel like when drinking [alcohol]”. The respondent is asked to rate how often they engage in such thinking patterns themselves. This is reported on a 4-point Likert-scale, where 1 = “Almost never”, 2 = “Sometimes”, 3 = “Often” and 4 = “Almost always”. Hence a higher score indicates that the respondent frequently engages in desire thinking related to alcohol consumption. The instrument has shown acceptable test-retest reliability and acceptable to good internal consistency (verbal perseveration:  $\alpha = .78$ , imaginal prefiguration:  $\alpha = .80$ ; Caselli & Spada, 2011). In the original questionnaire by Caselli & Spada (2011) statements do not specify what activity is desired, instead referring to

a “desired activity”. In this study, each statement specified alcohol consumption. The DTQ was administered in Norwegian translation. This study found internal consistency to be acceptable to good (verbal perseveration:  $\alpha = .82$ ; imaginal prefiguration:  $\alpha = .79$ ).

*The Patient Health Questionnaire* (PHQ-4; Kroenke et al., 2009) is a 4-item self-report questionnaire constructed as an ultra-brief instrument for detecting depression and anxiety. PHQ-4 is a shortened version of the PHQ-9 (Kroenke et al., 2001), which consists of 9 items. The instrument begins by asking “Over the last 2 weeks, how often have you been bothered by the following problems?”, followed by the 4 items. 2 items relate to depression (e.g. “Little interest or pleasure in doing things), while the other 2 relate to anxiety (e.g. “Feeling nervous, anxious or on edge”). Items are scored on a 4-point Likert scale with scores from 0-4, where 0 = “Not at All”, 1 = “Several Days”, 2 = “More Than Half the Days” and 3 = “Nearly Every Day”. Total scores can therefore range from 0 to 12, with higher scores indicating greater presence and consequences from depression and anxiety. Scores ranging 0-2 are considered normal, 3-5 mildly elevated, 6-8 moderately elevated and 9-12 severely elevated. The instrument has shown good internal consistency ( $\alpha = .85$ ; Kroenke et al., 2009). The questionnaire was administered in Norwegian translation, and this study found internal consistency to be good ( $\alpha = .87$ ).

### **Data Analyses**

All analyses were carried out using IBM SPSS Statistics version 25, with the exception of the path analysis, in which SPSS Amos was applied as this software allows for structural equation modelling.

Respondents were designated to a low, moderate or high risk group corresponding to their AUDIT-score. In order to gain an overview of group characteristics, a comparison of means was carried out using one-way ANOVA analysis. The analysis included descriptive variables (gender, relationship status, work status, age) as well as relevant measures regarding metacognitions (PAMS, NAMS), desire thinking (DTQ), alcohol use (AUDIT) and mental health (PHQ-4). Some of the variables showed significant skewness and kurtosis. Therefore, for the subsequent analyses, square root transformation was used on AUDIT, NAMS, and PHQ-4. IP and VP were also transformed to correct for positive skewness ( $1/x$ ). Correlations between the study variables were explored using Pearson's bivariate correlations analysis. In order to examine the contribution of each variable in the proposed model, a hierarchical regression analysis was conducted. Variables were added through a blockwise entry, ordered in accordance with the original model. AUDIT was the dependent variable, while gender, age

and relationship status were included as control variables in the first step of the regression. Then followed, in turn, PHQ-4, PAMS, IP, VP and lastly NAMS. A path analysis was done in order to examine the effect of variables on outcome and the relationships between the variables simultaneously. The structure and directions of relationships was based on the original model. Adjustments to the model were made according to modification indices.

## **Results**

### **Overview of participants and comparing means between risk groups**

Based on scores on the AUDIT, respondents were categorized into three groups according to their reported alcohol use: low risk (a), moderate risk (b) and high risk (c). As shown in Table 2 the share of male respondents increased as the risk increases. The same held true for respondents who were not in a relationship. Mean age was lowest in the moderate and high-risk groups. Differences in work status were negligible and non-significant. Levels of positive and negative alcohol metacognitions, as well as verbal and imaginal desire thinking, were all found to increase parallel to the alcohol use risk, and these findings were significant ( $p < 0.01$ ). Thus, we found metacognitive beliefs and desire thinking related to alcohol use to be more prominent in groups where alcohol use was riskier. The PHQ-4 measure of anxiety and depression presented higher scores in the moderate- and high-risk group compared to the low-risk group. Findings were significant ( $p < 0.01$ ). Results are presented in Table 2.

**Table 2***Mean scores on descriptive data and survey responses among respondents*

	Low <sup>a</sup>	Moderate <sup>b</sup>	High <sup>c</sup>	Total	$\chi^2$	<i>p</i>	Post Hoc
	% (n)	% (n)	% (n)	% (N)			
Female	69.3% (226)	54.7% (129)	38.5% (10)	62.1% (365)	19.0	< .001	
Single	23.3% (76)	45.3% (107)	50.0% (13)	33.3% (196)	33.3	<.001	
Work	94.8% (309)	98.3% (232)	92.3% (24)	96.1% (565)	5.6	.062	
	M (SD)	M (SD)	M (SD)	M (SD)	<i>F</i>		
Age	39.5 (15.8)	29.4 (12.3)	31.4 (14.1)	35.1 (15.2)	34.3	< .001	a > b, c
AUDIT	4.0 (1.6)	10.0 (2.3)	18.9 (2.7)	7.0 (4.3)	1095.7	<.001	c > b > a
PAMS	20.5 (5.2)	25.3 (5.5)	30.3 (6.8)	22.8 (6.1)	80.7	< .001	c > b > a
NAMS	6.6 (1.5)	7.2 (1.8)	9.3 (3.4)	7.0 (1.8)	31.3	<.001	c > b > a
VP	5.1 (0.3)	5.6 (1.5)	6.5 (2.3)	8.7 (3.6)	46.0	<.001	c > b > a
IP	5.7 (1.3)	6.8 (1.9)	8.7 (3.6)	6.4 (1.9)	62.3	<.001	c > b > a
PHQ-4	1.7 (2.2)	2.4 (2.3)	2.8 (2.2)	2.0 (2.3)	12.9	<.001	c, b > a

*Note.* N= 588. Low (n = 326), Moderate (n = 236), High (n = 26); Post Hoc test using Tukey HSD; AUDIT = Alcohol Use Disorder Identification Test, PHQ-4 = The Patient Health Questionnaire, PAMS = Positive Alcohol Metacognitions Scale, NAMS = Negative Alcohol Metacognitions Scale, IP = Imaginal Prefiguration, VP = Verbal Perseveration.

### Associations between alcohol use, metacognitive beliefs and desire thinking

AUDIT correlations with the PAMS and IP were moderate. Meanwhile, there were positive and weak correlations between AUDIT and both the NAMS and VP. This shows that higher levels of alcohol metacognitions and desire thinking were associated with higher level of alcohol use risk, and more specifically that associations with positive metacognitive beliefs and imaginal prefiguration were particularly strong.

There was a moderate, positive correlation between PAMS and IP as well. Positive alcohol metacognitions were associated with imaginal prefiguration. The two subscales of DTQ, IP and VP, were moderately and positively correlated. The PAMS and NAMS, however, demonstrated a very weak correlation. The PHQ-4 variable had a very weak positive correlation with the AUDIT and VP, while correlations with PAMS and IP were weak. Furthermore, no correlation was found between PHQ-4 and NAMS. This demonstrates that symptoms of anxiety and depression had only a weak association to alcohol use and alcohol-related metacognitions. Bivariate correlations between all variables are shown in Table 3. With the exception of the non-significant correlation between AUDIT and PHQ-4, all correlational values were significant.

**Table 3**

*Correlational analyses between measures of alcohol use, metacognitive beliefs, desire thinking and mental health*

	AUDIT	PHQ-4	PAMS	NAMS	IP
AUDIT					
PHQ-4	.16*				
PAMS	.51*	.35*			
NAMS	.28*	.08	.21*		
IP	.43*	.31*	.47*	.31*	
VP	.38*	.18*	.31*	.36*	.50*

*Notes. \*p < 0.01; AUDIT = Alcohol Use Disorder Identification Test, PHQ-4 = The Patient Health Questionnaire, PAMS = Positive Alcohol Metacognitions Scale, NAMS = Negative Alcohol Metacognitions Scale, IP = Imaginal Prefiguration, VP = Verbal Perseveration*

### **Relative contributions of metacognitive beliefs and desire thinking in explaining level of alcohol use**

The predictors in the regression analysis were added through a blockwise entry based on the model presented by Caselli & Spada (2015). When collinearity was examined, VIF and tolerance statistics both demonstrated acceptable values in all variables. All VIF values were below 1.8 (cut-off above 10), and tolerance statistics ranged from 0.58 to 0.93 (cutoff below 0.2). The first step of the analysis consisted of control variables (gender, age and relationship status). This step predicted 12% of variance in AUDIT score. In the second step PHQ-4 was added to the model, increasing explained variance by 1%. In the third step PAMS was added, contributing the greatest  $R^2$  change of 18%. In the following steps, IP, VP and NAMS was added in turn, each variable respectively adding 4%, 3% and 1% of predicted variance ( $R^2$ ). The model predicted 38% of variance in AUDIT score. All steps in the regression analysis were significant. In the final model, PAMS was the greatest predictor of AUDIT score ( $\beta = .36$ ), followed by VP ( $\beta = .17$ ) and IP ( $\beta = .13$ ) and NAMS ( $\beta = .11$ ). The PHQ-4 however, did not significantly predict any variance in AUDIT score. Significant predictions were demonstrated in gender ( $\beta = -.19$ ) and age ( $\beta = -.13$ ) as well, while relationship status did not significantly predict AUDIT score. Statistics for all steps in the regression analysis as well as the variables in the final step are presented in Table 4.

**Table 4***Hierarchical regression with AUDIT as the dependent variable*

Step	<i>F</i> Change	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> Change
1. Female	26.79	.12	
Age			.12**
Single			
2. PHQ-4	5.50	.12	.01*
3. PAMS	155.48	.31	.18**
4. IP	36.98	.35	.04**
5. VP	23.52	.37	.03**
6. NAMS	6.36	.38	.01**
Final step	$\beta$	<i>t</i>	
Female	-.19	-5.51**	
Age	-.13	-3.18**	
Single	-.02	-0.50	
PHQ-4	-.07	-1.82	
PAMS	.36	9.11**	
IP	.13	3.07**	
VP	.17	4.24**	
NAMS	.09	2.52**	

*Note.* \*\* $p < 0.01$ ; \* $p < 0.05$ ; AUDIT = Alcohol Use Disorder Identification Test, PHQ-4 = The Patient Health Questionnaire, PAMS = Positive Alcohol Metacognitions Scale, NAMS = Negative Alcohol Metacognitions Scale, IP = Imaginal Prefiguration, VP = Verbal Perseveration

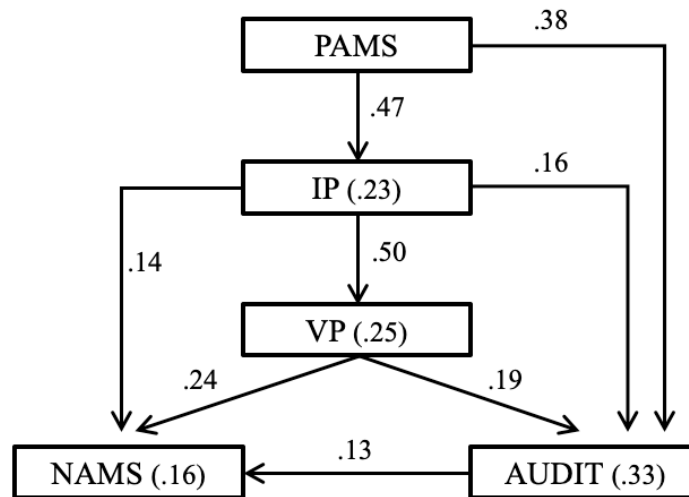
### Testing the original model and suggestions for new paths

Path analysis was conducted in order to test the model of metacognitive beliefs, desire thinking, and alcohol use. Initial analysis tested a path with the relationships established in the original model. The analysis indicates a good model fit if chi-square is non-significant ( $p > .05$ ), it has close to zero Root Mean Square Error of Approximation (RMSEA; cut-off  $< .06$ ) as well as Standardized Root Mean Square Residual (SRMR; cut-off  $< .08$ ), Comparative Fit Index (CFI) close to 1 (cut-off  $\geq .90$ ) and Tucker Lewis Index (TLI) close to 1 (cut-off  $\geq .90$ ; Hu & Bentler, 1999).

The analysis of the hypothesized model found that PAMS had weak, non-significant effect on both VP and NAMS. Furthermore, the model had significant chi-square ( $X^2 = 98.31$ ,  $df = 2$ ,  $p < .05$ ), and unacceptable model fit (RMSEA = .29, SRMR = .08, CFI = .85, TLI = .27).

Following the preliminary analysis, the modification index indicated that the model would improve if associations from PAMS to VP and NAMS were left out, and by adding associations from PAMS to AUDIT directly as well as from IP to NAMS and AUDIT. The modified model resulted in a good model fit, chi-square ( $X^2 = 5.18$ ,  $df = 2$ ,  $p > .05$ , RMSEA = .05, SRMR = .02, CFI = 1.00, TLI = .98). PAMS had a moderate, significant effect on AUDIT score ( $\beta = .38$ ,  $p < .01$ ), while a weak and significant effect was found for both IP ( $\beta = .16$ ,  $p < .01$ ) and VP ( $\beta = .19$ ,  $p < .01$ ). When accounting for effect of PAMS and IP on AUDIT score, 33% of AUDIT variance was explained. The current model is presented in Figure 5.





$\chi^2 = 5.18$ , RMSEA = .05, SRMR = .02,  
 CFI = 1.00, TLI = .98  
 Errors not allowed to correlate

*Figure 5.* Path analysis of alcohol metacognitions, desire thinking and alcohol use Note. All values are significant ( $p < .01$ ); PAMS = positive alcohol metacognitions, IP = imaginal prefiguration, VP = verbal perseveration, NAMS = negative alcohol metacognitions, AUDIT = alcohol use disorders identification test, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, CFI = Comparative Fit Index, TLI = Tucker Lewis Index

## Discussion

### Summary of main findings

The aim of this study was to investigate the role of metacognitions and desire thinking in alcohol use. When comparing characteristics of the low, moderate and high risk AUDIT groups, we found that levels of alcohol metacognitions and desire thinking increased parallel to risk. Correlational analysis demonstrated that positive and negative alcohol metacognitions as well as verbal and imaginal desire thinking were all positively correlated to AUDIT score. All metacognitive measures were significant, independent predictors of AUDIT score variance in the regression model, and so the regression model is in accordance with the final path model. Summarized, findings were consistent with the hypothesis that the included metacognitive measures would be positively associated with level of alcohol use. The hypothesized model required modifications in order to achieve good statistical fit, and so the final model suggested in the present study deviates from the hypothesized model. Still, the fundamental structure was the same in both models.

The present study found that positive alcohol metacognitions correlated and predicted alcohol use more strongly than negative alcohol metacognitions. With regard to this, findings from prior research has varied, with some studies (Spada, Moneta & Wells, 2007; Spada & Wells, 2008; 2009) finding the two variables to be quite uniform, while one (Dragan, 2015) have findings similar to the ones in the present study, where correlations were markedly stronger for positive alcohol metacognitions than negatives. This is in contrast to research on metacognitions in other disorders, as negative metacognitive beliefs have demonstrated stronger predictive power in anxiety disorders (Wells, 1999; Wells & Carter, 2001) and depression (Papageorgiou & Wells, 2003).

### The current model explained

Positive alcohol metacognitions demonstrated a direct effect on alcohol use. The direct line from PAMS to alcohol use could represent the tendency of people to comply to the motivating effect of positive beliefs, resulting in alcohol use. The other path from positive metacognitive beliefs lead to imaginal prefiguration, the initial phase of desire thinking. The current model presented a path from imaginal prefiguration directly to alcohol use. According to Martino et al. (2019), imaginal prefiguration can predict craving independently of verbal perseveration. Thus, the direct path to alcohol use may represent instances where people who engage in imaginal prefiguration end up consuming alcohol as a result of craving, even

without verbal perseveration occurring. Brain imaging has documented that alcohol-related stimuli induce stronger craving responses in heavy drinkers and people with AUD when compared to light drinkers and healthy controls (Braus et al., 2001; Ihssen, Cox, Wiggett, Fadardi & Linden, 2010; Tapert et al., 2003). These neural responses predict relapse in abstinent alcohol addicts (Braus et al., 2001). Imaginal prefiguration, a mental form of stimuli, seems to have a similar effect.

Two more paths were directed from imaginal prefiguration in the current model: one leading to negative alcohol metacognitions, and one to verbal perseveration. Verbal perseveration too had a path leading to negative alcohol metacognitions. The paths to negative alcohol metacognitions from the two desire thinking subscales could represent instances in which people experience imaginal and verbal desire thinking as a sign of lack of control over alcohol related cognitions and craving, independent of whether alcohol consumption actually takes place. The other path from verbal perseveration lead to alcohol use, and may represent instances where self-talk about engaging in alcohol use is acted upon. Lastly, the path from alcohol use leading to negative alcohol metacognitions could illustrate how engaging in alcohol use can lead to the individual experiencing this as a lack of control over their alcohol use and alcohol-related behaviour. Surprisingly, both kinds of desire thinking demonstrate stronger associations with negative alcohol metacognitions than actual alcohol use. This may be a reason why relapse rates are so high despite long periods of abstinence: persistence of desire thinking may linger, and could continue to stimulate dysfunctional metacognitive beliefs that trigger future alcohol use.

### **Comparing the models**

The original model and the model from the current study have a common structure, but also important differences, as demonstrated in Figure 6.

There are two main differences between the models: First, the use of different measures for outcomes as well as different targets for the positive and negative metacognitive beliefs (alcohol and desire thinking). Second, the original model had two paths that originated in positive metacognitions, one associated with verbal perseveration and the other with negative metacognitions. Neither path was represented in the current alcohol model, which instead included three new paths: one from positive metacognitions to the desired target and two from imaginal prefiguration, one of which lead to negative metacognitions and the other to outcome variable (i.e. alcohol use). The role of positive alcohol metacognitions seems to be of particular importance, as this is the greatest predictor of alcohol use in the current model.

This highlights the advantage of including both alcohol metacognitions and desire thinking when attempting to formulate a metacognitive conceptualization of AUD, as these are interactive processes. Furthermore, our model supports earlier findings on metacognition in addictive behaviour: according to Hamonniere & Varescon (2018), research indicates that metacognitive beliefs are important in the initiation and maintenance of addictive behaviours. Positive metacognitive beliefs are believed to motivate engagement in behaviour, thus being central in the initiation of addictive behaviours, while negative metacognitions are assumed to contribute to the persistence of the addictive behaviour. The current model seems to fit well with this explanation, and can be said to elaborate upon it as it includes desire thinking in the conceptualization. In conclusion, the current model seems to complement and elaborate upon the original model.

The use of different measures in the current model makes it challenging to ascertain what underlies the differences and how the two models relate to one another. A broader study including the PAMS/NAMS, PMDT/NMDT, and AUDIT/craving measures could demonstrate this interaction and provide a more detailed description of metacognitions in AUD. Furthermore, differences could occur as a result of differences between the samples studied. The original model was based on an Italian sample (Caselli & Spada, 2015), while the sample for the current model was Norwegian. Italy and Norway have different cultures related to alcohol and drinking, which could manifest as differences in alcohol metacognitions and desire thinking as well. WHO (2018) report that the per capita consumption of alcohol is the same in Italian and Norwegian populations. However, there are significant differences in how alcohol is consumed, one example being that Norwegians report higher levels of binge drinking. Differences are particularly striking when comparing problem drinking (WHO, 2018): prevalence of AUD and alcohol dependence in Norway is reported at 7,2% and 4% respectively. In contrast, Italian prevalence of AUD is 1,3%, while prevalence of alcohol dependence is 0,6%. These findings indicate that there may be significant differences in the samples used in the compared path models.

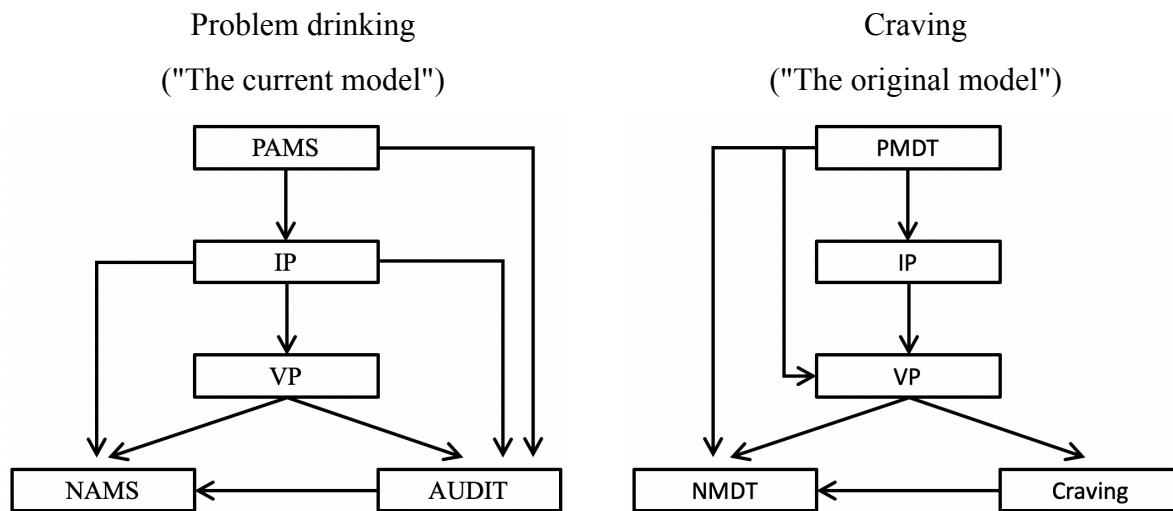


Figure 6. The current metacognitive model of problem drinking (left) and the original model of craving. PAMS = Positive metacognitive alcohol metacognitions, IP = imaginal prefiguration, VP = verbal perseveration, AUDIT = Alcohol use disorder identification test, NAMS = negative alcohol metacognitions scale, PMDT = Positive metacognitions about desire thinking, NMDT = negative metacognitions about desire thinking

### Limitations and further research

There are important limitations to the present study that must be recognized. The cross-sectional design of the study prevents inference of causality. Longitudinal or experimental research would allow for confirmation of causal relationships, and should be the aim of future research. It would be of particular interest to observe changes in alcohol metacognitions, desire thinking and alcohol use in the context of a course of metacognitive therapy. Caselli et al. (2018) have completed one such course of treatment, but this included only five participants and desire thinking was not measured as a part of the study.

The use of self-report measures carries the risk of measurement errors and self-report biases, such as social desirability bias, recall bias, context effects, and misunderstandings. Our measure of alcohol use is particularly prone to error, because it is often underestimated in self-report measures (Stockwell et al., 2004).

Although the overall sample size for the study was satisfactory, the group of high-risk alcohol users was small ( $n = 26$ ). Of them, only ten respondents received AUDIT score of 20 or above, the level considered by the AUDIT manual to signal need for treatment (Babor et al., 2001). Furthermore, only one participant attested to having received treatment for alcohol use before. As the proposed model aims to explain problem alcohol use, it would be preferable to have a larger group of high-risk or alcohol dependent participants. This would allow for more valid analyses and more nuanced data on the high-risk alcohol users.

As this is the first attempt to measure alcohol metacognitions and desire thinking about alcohol use simultaneously, results from the present study are preliminary. The study should be replicated in order to test the reliability of the current model. It follows that the model should be studied with regards to other addictive behaviours as well, in order to examine the structure of a general metacognitive conceptualization for addictive behaviours.

The neurophysiological effect of metacognitive therapy in general, and metacognitive beliefs and desire thinking in AUD specifically, should be elaborated on. Addiction is a phenomenon with a basis in neural reward pathways and long-term associative memory (Hyman, Malenka & Nestler, 2006). Including neurophysiological measurements, e.g. brain imaging and EEG, in future metacognitive research on addictive behaviours could provide insights into the interaction between brain activity and metacognitions.

Our analyses demonstrated that alcohol use risk was elevated in male and single respondents. Furthermore, the negative correlation between age and alcohol use risk illustrates that risk decreases as age increases in our sample. This is in line with existing research on the association between alcohol use and gender (FHI, 2018; WHO, 2018), relationship status (Braithwaite, Delevi & Fincham, 2010), and age (Statistisk Sentralbyrå, 2018). The effect of gender, age, and relationship status on alcohol metacognitions were not within the scope of this study, but could be an interesting topic of further research.

Alcohol use disorder is highly comorbid with other mental disorders (Grant et al., 2004; Regier et al., 1990). A core assumption in the metacognitive theory for alcohol use is that metacognitive beliefs and desire thinking are processes applied to cope with negative thoughts and emotions, symptoms that are prevalent in a range of mental illnesses. Thus, the role of mental illness on alcohol metacognitions, desire thinking and alcohol use should be elaborated on further.

Only moderate amounts of variance of alcohol use was explained in our regression model (38%) and the current path model (33%). Thus, a great deal of variance is not explained. Improving the prediction of alcohol use should be an aim in further research.

The PAMS, NAMS and DTQ have not previously been distributed in Norwegian translation. As such, there was no pre-existing data on the validity and reliability for these questionnaires. While the PAMS and DTQ demonstrated acceptable internal consistency, the value for the NAMS was questionable.

### **Clinical implications**

The findings from the present study give rise to some clinical implications. If we assume that metacognitions and desire thinking contribute to the initiation and maintenance of problem alcohol use, it follows that they will be important topics when handling and treating such problems.

Clinicians should be aware of the potential role of metacognitive beliefs about alcohol use and desire thinking in patients with AUD. Metacognitions could be assessed prior to treatment, with potential relevance for anamnesis and case description. Psychoeducation and socialization based on metacognitive theory could help the patient recognise dysfunctional metacognitive beliefs and desire thinking that contribute to their AUD.

The metacognitive therapeutic approach aims to modify and reduce metacognitive beliefs about alcohol use and desire thinking. Existing data on metacognitive therapeutic techniques applied to AUD is scarce, but results are promising (Caselli, Gemelli & Spada, 2016; Caselli et al., 2018). The present study adds to the growing body of research that supports the assumption that metacognitive theory and treatment are applicable in addictive behaviours, including alcohol use disorder. A metacognitive approach to AUD should be adapted to the characteristic traits found in this disorder. An example would be to take the prominent role of positive metacognitions into consideration. Another example would be to take into account the effect desire thinking may have even after long periods of abstinence.

### **Conclusion**

The aim of this study was to investigate the role of metacognitive beliefs and desire thinking in alcohol use, and to test a path model of alcohol use and desire thinking. The present study found positive correlations between alcohol use and both alcohol metacognitions and desire thinking, in accordance with prior research. Furthermore, the present study also demonstrated the interaction between alcohol metacognitions and desire thinking in explaining alcohol use. These interactions were presented in the metacognitive model of alcohol use. The findings from this study supports the relevance of a metacognitive perspective in understanding and intervening in addictive behaviours. In turn, this may help improve treatment of addictive behaviours such as alcohol use disorder.

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