**Desire thinking as an underlying mechanism in Alcohol Use Disorder and nicotine dependence**

**Running head:**

**Desire thinking in Alcohol Use Disorder and nicotine dependence**

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**Contributors**

The first and second authors (methodology, supervision, data curation, formal analysis, writing - original draft, review, and editing). The Third author (supervision, clinical diagnosis, writing - review and editing). The forth author (data curation, formal analysis, clinical diagnosis).

**Conflict of interest**

None declared.

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**Abstract**

Desire thinking is an emerging construct in the addictive behaviors literature. No research, to date, has investigated its contribution to problematic alcohol use and nicotine dependence in patient samples when accounting for established predictors of addictive behaviors. The present study sought to clarify, in patient samples, the relative contribution of desire thinking in the associations between negative affect, impulsivity, and thought suppression on the one hand and craving, problematic alcohol use, and nicotine dependence on the other. To achieve this goal, two groups of individuals with Alcohol Use Disorder (AUD) (n=370; age range=15-67 years) and nicotine dependence (n=365; age range=17-75 years) were selected, and measures of negative affect, impulsivity, thought suppression, craving, desire thinking, problematic alcohol use, and nicotine dependence were completed by both groups. Results showed that in both groups, negative affect and thought suppression indirectly affected alcohol and nicotine craving, problematic alcohol use, and nicotine dependence through the mediating role of desire thinking. The present study shows the independent role of desire thinking in predicting problematic alcohol use and nicotine dependence in patient samples, indicating its potential relevance for treatment.

**Keywords:** Alcohol Use Disorder; craving; desire thinking; impulsivity; negative affect; nicotine dependence; thought suppression.

**Key Practitioner Message**

* Negative affect and thought suppression indirectly affected nicotine-related problems through desire thinking.
* Desire thinking mediated the path from negative affect and thought suppression to alcohol-related problems
* Desire thinking should be targeted in treatment programs for individuals with alcohol and nicotine use.

**Desire thinking as an underlying mechanism in Alcohol Use Disorder and nicotine dependence**

**1. Introduction**

# Craving, as a new criterion of Alcohol Use Disorder (AUD) in DSM-5 (American Psychiatric Association, 2013; Hartwell and Ray, 2018), plays an important role in addictive behaviors. Craving increases the likelihood of alcohol use and alcohol dependence (Khosravani et al., 2019; Hochster et al., 2018; Remmerswaal et al., 2019; Thorberg et al., 2019). Furthermore, higher levels of craving are associated with nicotine use (Gunter et al., 2020) and reduced resistance to cigarette use (Stevenson et al., 2017) resulting in nicotine lapse (Motschman et al., 2018). In addition, cognitive-affective factors such as negative affect, impulsivity, and thought suppression are well-known to contribute to alcohol and nicotine use. Thus, the present study investigated the role of desire thinking in the associations of negative affect, impulsivity, and thought suppression with craving, problematic alcohol use, and nicotine dependence in clinical samples.

# Negative affect is a well-established precipitant of addictive behaviors (Khosravani et al., 2017). Research has shown that individuals who drink alcohol to cope with their psychological distress are more likely to exhibit failures in regulating their negative emotions (Paulus et al., 2021). Evidence has also shown that inducing negative affect increases alcohol craving (Bresin et al., 2018). Impulsivity, which is defined as a behavior engaged in without thinking and planning, is also a core component of AUD and nicotine dependence (Kale et al., 2018; Szczypiński et al., 2021) and is strongly associated with both alcohol and nicotine craving (Coates et al., 2020; Billieux et al., 2007) so that it impairs cognitive control (Zaso et al., 2021), and leads to relapse (Pettiford et al., 20007; Sliedrecht et al., 2021). Importantly, individuals with increased impulsivity tend to use alcohol and nicotine to cope with negative affect (Herman and Duka, 2019; Spillane et al., 2013). In addition, a wide array of research has reported that thought suppression is an important factor in alcohol and nicotine use (Bernard et al., 2021; Khosravani et al., 2022) so that using this maladaptive cognitive strategy to suppress smoking and alcohol-related thoughts increases these thoughts (Klein, 2007) resulting in further alcohol and nicotine use (Erskine et al., 2010; Garland et al., 2012).

# Various studies have confirmed the associations between negative affect, impulsivity, and thought suppression on the one hand and alcohol and nicotine use on the other hand, although possible underlying mechanisms linking these constructs have not been clearly delineated. Recently, the construct of ‘desire thinking’ has emerged in the literature focusing on addictive behaviors. This construct has been found to be strongly associated to a wide array of addictive behaviors (for a recent review see: Mansueto et al., 2019). Desire thinking is a voluntary thinking style, which involves the perseverative focusing on memories, images and information related to a desired target (Caselli and Spada, 2011). Desire thinking operates on a verbal and imaginal level. The verbal level (termed ‘verbal perseveration’) is characterized by repetitive self-talk regarding the need to achieve a desired target. The imaginal level (termed ‘imaginal prefiguration’) is characterized by the construction of mental images of a desired target or its context for consumption (Caselli and Spada, 2011).

# In individuals with AUD, desire thinking has been found to strengthen permissive beliefs about alcohol use (Caselli et al., 2021) and increase craving and alcohol-related behaviors (Caselli et al., 2016; Solem et al., 2020; Caselli et al., 2017; Martino et al., 2017; 2019; Kavanagh et al., 2009). Individuals with nicotine dependence experience high levels of desire thinking beyond negative affect and nicotine craving (Caselli et al., 2012; Solem et al., 2020). In addition, desire thinking is associated with negative affect, impulsivity, and thought suppression (Allen et al., 2017; Khosravani et al., 2022; Sharifi Bastan et al., 2022). It has been purported that the cumulative relationship between negative affect, impulsivity, and thought suppression may play a role in predicting addictive behaviors through perseverative thinking strategies such as desire thinking (Efrati et al., 2021).

# Some studies have evaluated the mediating role of desire thinking concerning different variables. For example, [Chakroun-Baggioni](https://www.sciencedirect.com/science/article/pii/S0165178116318649%22%20%5Cl%20%22%21) et al. (2017) found that desire thinking affects the relationship between mindfulness and craving in university students, inhibiting the former. Allen and colleagues (2017) have shown that desire thinking may have an underlying role in relation to negative affect and craving in problematic internet pornography use. In a non-clinical sample, Caselli and colleagues (2015a) reported that the indirect effect of novelty seeking on craving was mediated by desire thinking. In another study, these authors showed the mediating role of desire thinking in the relationship between emotional intolerance and drinking problems (Caselli et al., 2015b). Brandtner and colleagues (2020) have shown that desire thinking mediates the association between initial urge for gaming and the decision to engage in gaming. More recently, a study has confirmed the significant indirect paths of negative affect, impulsivity, and thought suppression to social media-related addictive patterns affected by the important role of desire thinking (Sharifi Bastan et al., 2022). Finally, Brandtner and Brand (2021) showed that negative emotional reactivity has an indirect effect on craving for online gaming as activated through the mediating role of desire thinking. Although these studies explored the role of desire thinking in addictive behaviors, no research, to date, has investigated whether desire thinking may be an underlying mechanism linking negative affect, impulsivity, and thought suppression on the one hand to problematic alcohol use, nicotine dependence and craving on the other.

# As previous studies have reported that desire thinking is activated to regulate internal states and is an important factor in addictive behaviors (Caselli and Spada, 2010, 2015), including both use and craving, it would be of value to determine whether it remains such when accounting for negative affect, impulsivity and thought suppression in AUD and nicotine dependence, so the mediation model using structural equation modeling (SEM) was used to determine whether desire thinking had a mediating role in the paths of negative affect, impulsivity, and thought suppression to alcohol and nicotine craving and problematic alcohol use and nicotine dependence in individuals with AUD and nicotine dependence. The hypothesized models for evaluating the aims of the present study are presented in Figures 1 and 2. We broadly hypothesized that negative affect, impulsivity, and thought suppression would be positively correlated with measures of use, craving, and desire thinking. We also hypothesized that desire thinking would be positively correlated with measures of use and craving and that it would predict scores on these measures independently of negative affect, impulsivity, and thought suppression.

*Figure 1: A hypothesized theoretical model for individuals with Alcohol Use Disorder.*

**Negative affect**

Age of onset use

**Problematic alcohol use**

**Impulsivity**

Duration of use

**Thought suppression**

**Alcohol craving**

Comorbidity

*Figure 2: A hypothesized theoretical model for individuals with nicotine dependence.*

**Negative affect**

Age of onset use

**Nicotine dependence**

**Impulsivity**

Duration of use

**Thought suppression**

**Nicotine craving**

Comorbidity

**2. Methods**

*2.1. Participants*

A total of 370 individuals with a primary diagnosis of AUD (male=62.2%, age range=15-67 years) and 360 with nicotine dependence (male=62.7%, age range=14-75 years) who were seeking treatment for their addictive behavior participated in this study.

Individuals with AUD were selected on the basis of psychiatric data that indicated a recent primary diagnosis of AUD using the structured clinical interview based on the DSM-5 (SCID-5; American Psychiatric Association, 2013; First et al., 2014). Those selected also had to have a score equal to or higher than 15 (Johnson et al., 2013) on the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001) in order to gain further confirmation of the presence of AUD. Participants were also required to not have used alcohol in the previous 12 hours. Individuals with nicotine dependence were selected on the basis of a score ≥ *3* on the Fagerstrom Test of Nicotine Dependence (FTND; Heatherton et al., 1991). Furthermore, all those selected on the basis of displaying nicotine dependence on the FTND were also required to be smoking 10 or more cigarettes daily. Physical and neurological diseases, personality disorders, and psychotic spectrum disorders were exclusion criteria in both groups of individuals with AUD and nicotine dependence.

Some individuals with AUD and nicotine dependence were presented with secondary comorbid psychiatric disorders, including Bipolar Disorder, Generalized Anxiety Disorder, Major Depressive Disorder, Polysubstance Use, and Obsessive-Compulsive Disorder (see Table 1) that are diagnosed according to the SCID-5 or the availability of such information in patients' psychiatric records. Among participants, some with AUD (n=100, 27.3%) and nicotine dependence (n=165, 45.2%) had poly-substance use. Some patients with AUD were hospitalized (n=35; 9.5%), and some with AUD (n=155, 41.9%) and nicotine dependence (n=96, 26.3%) had a history of successfully quitting the substance used. Furthermore, 129 (34.9%) individuals with AUD had a history of psychotherapy. This study was approved by our Institutional Review Board of XXX, and was performed by observing the criteria of the Helsinki Declaration. In addition, all participants were willing to participate in this study and provided informed consent.

*2.2. Measures*

*2.2.1. Completed measured in both groups with AUD and nicotine dependence*

*2.2.1.1. The Depression Anxiety and Stress Scale-21 (DASS-21; Lovibond and Lovibond, 1995).* Negative affect (anxiety, depression, and stress) was assessed using the DASS-21, which is a self-report measure containing 21 items assessing anxiety (7 items: e.g., "I felt scared without any good reason"), depression (7 items: e.g., "I couldn’t seem to experience any positive feeling at all"), and stress (7 items: e.g., "I found it difficult to relax") rated on a four-point Likert scale (ranging from 'never'=0 to 'always'=3). Higher scores indicate higher levels of negative affect. Evidence has shown that the DASS-21 had good validity and reliability cross-culturally (Zanon et al., 2021). In the current study, the Cronbach's alpha was 0.92 for both groups, indicating excellent reliability.

*2.2.1.2. The Barratt Impulsiveness Scale-15 (BIS-15 Spinella, 2007*). Impulsivity was assessed using the BIS, which is a self-report measure containing 15 items (e.g., "I act on the spur of the moment"). In the BIS-15, each item is rated on a four-point Likert scale (ranging from ‘never’=1 to ‘completely’=4). The BIS-15 has been shown to possess good psychometric properties (e.g., Juneja et al., 2019). Higher scores indicate higher levels of impulsivity. In the current study, the Cronbach alphas were 0.70 for the AUD group and 0.74 for the nicotine dependence group, indicating acceptable reliability.

*2.2.1.3. The White Bear Suppression Inventory (WBSI; Wegner and Zanakos, 1994*[*)*](https://onlinelibrary.wiley.com/doi/abs/10.1002/per.478)*.* Thought suppression was assessed using the WBSI, which is a self-report measure containing 15 items (e.g., "There are thoughts that keep jumping into my head"). In the WSBI, each item is scored on a five-point Likert scale (ranging from ‘strongly disagree’=1 to ‘strongly agree’=5). Higher scores indicate higher levels of thought suppression. The WSBI has good validity and reliability (Vincken et al., 2012). In the current study, the Cronbach alphas were 0.83 for the AUD group and 0.87 for the nicotine dependence group, indicating good reliability.

*2.2.1.4. The Desire Thinking Questionnaire (DTQ; Caselli and Spada, 2011).* Desire thinking was assessed using the DTQ*,* which is a self-report measure containing 10 items. The DTQ includes two subscales of verbal perseveration (e.g., "When I begin to think about the desired activity I find it difficult to stop") and imaginal prefiguration (e.g., "I imagine myself doing the desired activity"). Each item is scored on a four-point Likert scale (ranging from ‘never’=1 to ‘always’=4). Higher scores indicate higher levels of desire thinking. The DTQ has been found to possess good psychometric properties in individuals with AUD and nicotine dependence (Khosravani et al., 2022). In the current study, the Cronbach alphas were 0.84 for the AUD group and 084 for the nicotine dependence group, indicating good reliability.

*2.2.2. Measures completed by individuals with AUD*

*2.2.2.1. The Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001).* Problem alcohol use was assessed using the AUDIT, which is a self-report measure containing 10 items (e.g., "How many drinks containing alcohol do you have on a typical day when you are drinking?"). AUD is determined by scoring equal to or higher than 15 (Johnson et al., 2013). In the present study, the mean score of participants with AUD was 18.57. Higher scores indicate more severe levels of harmful alcohol use. The AUDIT has good internal reliability in individuals with problematic alcohol use (Khosravani et al., 2021). In the current study, the Cronbach alpha was 0.90, indicating excellent reliability.

*2.2.2.2. The Penn Alcohol Craving Scale (PACS*; Flannery et al., 1999). Alcohol craving was assessed using the PACS, which is a self-report measure containing 5 items (e.g., "How often have you thought about drinking or about how good a drink would make you feel?"). Items on this scale are scored on a 6-point Likert scale (ranging from ‘never’=0 to almost always’=6). Higher scores indicate higher levels of carving. The excellent psychometric properties of this measure have been confirmed in numerous studies (Kim et al., 2008). In the current study, the Cronbach alpha was 0.92, indicating excellent reliability.

*2.2.3. Completed measures in individuals with nicotine dependence*

*2.2.3.1. The FTND (Heatherton et al., 1991).* Nicotine dependence was assessed using the FTND, which is a self-report measure containing 6 items (e.g., "How soon after you wake up do you smoke your first cigarette?"). Scores of 3 or above indicate the presence of nicotine dependence. Items on this scale are scored on different Likert scales so that some items are scored as 1 (‘yes’) 0 (‘no’) and others as multiple-choice items scored from 0 to 3. Higher scores indicate higher levels of nicotine dependence. The FTND has been found to have good reliability in previous studies (e.g., Poormahdy et al., 2022). In the current study, all individuals in the nicotine dependence group had a score equal to or higher than 3 on the measure. In the current study, the Cronbach alpha was 0.75, indicating good reliability.

*2.2.3.2. The PACS (Flannery et al., 1999) adapted for individuals with nicotine dependence*. In the present study, the 5-item PACS was adapted for the group with nicotine dependence by changing the phrase "the use of alcohol" in the scale into "the use of cigarettes" (e.g., "At its most severe point, how strong was your craving to use social media during the past week?") in all 5 items used in the group. In the current study, the Cronbach alpha was 0.90, indicating excellent reliability.

*2.3. Statistical analysis*

The data were checked for normality by estimating skewness and kurtosis statistics. The relationships among variables in the two groups with AUD and nicotine dependence were analyzed using Pearson's Product Moment correlation. To test the two hypothesized models, structural equation modeling (SEM) was conducted for the two groups of individuals with AUD and nicotine dependence. Also, indirect effects were further checked by conducting bootstrapping with 5000 resamples in AMOS 21.0, and if the 95% confidence interval (CI) does not cover zero, indirect paths are significant. In these two models, negative affect, impulsivity, and thought suppression were the predictor variables, and desire thinking was the mediator variable in the two groups. In the AUD group, alcohol craving and problematic alcohol use were the outcome variables. In the nicotine dependence group, nicotine craving and the degree of nicotine dependence were the outcome variables. In addition, in the two models, comorbidity, age of onset, and duration of use were controlled.

To check the acceptability of the model fit of both models, Tucker-Lewis Index (TLI), the comparative fit index (CFI), the goodness-of-fit index (GFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMSR) were calculated. If the values of the first three indicators (TLI, CFA, and GFA) are ≥0.92, and other indexes (i.e., RMSEA and SRMSR) are lower than < 0.08, the model fit is acceptable (MacCallum et al., 1996; Hu and Bentler, 1999; Kline, 2015; Schermelleh-Engel et al., 2003). The SEM models were estimated with maximum likelihood (ML) in AMOS software.

**3. Results**

*3.1. Demographic and correlational analyses*

The demographic and clinical characteristics of the two groups are presented in Table 1. The values of skewness and kurtosis were within acceptable ranges (Table 1), i.e., between 1/+1 and + 1/-1 (Byrne, 2010; Kline, 2015). There were no missing values. The data were normally distributed.

Table 1: Demographic and clinical characteristics of participants.

|  |  |  |
| --- | --- | --- |
| Clinical and demographic characteristics | AUD group (n=370),Mean ±S.D or n (%) | Nicotine dependence group (n=365),Mean ±S.D or n (%) |
| Age, years | 34.89 ±11.13 | 33.64±11.61 |
| Gender |  |  |
| Male | 230(62.2%) | 229 (62.7%) |
| Female | 140 (37.8%) | 136 (37.3%) |
| Education, years  | 12.34±3.11 | 12.93±3.14 |
| Marital status  |  |  |
| Single | 204 (55.2%) | 198 (54.2%) |
| Married | 120 (32.4%) | 141 (38.6%) |
| Divorced | 46 (12.4%) | 26 (7.2%) |
| Age of onset use | 22.96±6.47 | 20.76±6.24 |
| Duration of use | 11.93±8.54 | 12.81±10.13 |
| Daily smoking | - | 20.18±9.22 |
| Comorbidity | 123 (33.3) | 73 (20%) |
| Bipolar Disorder | 27 (7.3%) | 9 (2.5%) |
| Generalized Anxiety Disorder | 11 (3%) | 16 (4.4%) |
| Major Depressive Disorder | 50 (13.5%) | 42 (11.5) |
| Polysubstance use | 34 (9.2%)  | - |
| Obsessive-Compulsive Disorder | 1 (0.3) | 6 (1.6%) |
| Clinical and psychological variables | (Mean ±S.D)(Skewness, Kurtosis)  | (Mean ±S.D)(Skewness, Kurtosis)  |
| Negative affect | (34.02±12.66) (-0.25,-0.57) | (31.03±12.76) (-0.23, -0.38) |
| Impulsivity | (34.35±6.97) (-0.40,0.51) | (34.71±6.80) (-0.41,0.61) |
| Thought suppression | (51.08±9.18) (-0.19,0.50) | (48.81±10.13) (0.34,0.09) |
| Craving | (20.48±6.0) (-0.49,-0.06) | (19.56±6.30) (-0.57,0.16) |
| Desire thinking | (25.05±5.88) (-0.10,-0.13) | (25.09±5.95) (0.13,-0.32) |
| Problematic alcohol use | (18.57±8.56) (0.23,-0.34) | - |
| Nicotine dependence | - | (6.08±2.36) (-0.54,-0.55) |

The results of correlations among variables are shown in Table 2. The results revealed that negative affect, impulsivity, and thought suppression were significantly and positively correlated with desire thinking, alcohol craving, and problematic alcohol use in the AUD group, as well as with desire thinking, nicotine craving, and nicotine dependence in the nicotine dependence group (see Table 2).

Table 2: Correlations among all variables in both groups with alcohol use disorder and nicotine dependence.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Individuals with AUD (n=370) | 1 | 2 | 3 | 4 | 5 | 6 |
| 1- Negative affect | - |  |  |  |  |  |
| 2- Impulsivity  | 0.51\*\* | - |  |  |  |  |
| 3- Thought suppression | 0.44\*\* | 0.18\*\* | - |  |  |  |
| 4- Alcohol craving  | 0.46\*\* | 0.19\*\* | 0.30\*\* | - |  |  |
| 5- Desire thinking | 0.30\*\* | 0.12\* | 0.44\*\* | 0.24\*\* | - |  |
| 6- Problematic alcohol use | 0.35\*\* | 0.30\*\* | 0.20\*\* | 0.52\*\* | 0.25\*\* | - |
| Individuals with nicotine dependence (n=365) | 1 | 2 | 3 | 4 | 5 | 6 |
| 1- Negative affect | - |  |  |  |  |  |
| 2- Impulsivity  | 0.53\*\* | - |  |  |  |  |
| 3- Thought suppression | 0.33\*\* | 0.28\*\* | - |  |  |  |
| 4- Nicotine craving  | 0.43\*\* | 0.36\*\* | 0.25\*\* | - |  |  |
| 5- Desire thinking | 0.22\*\* | 0.10\* | 0.24\*\* | 0.20\*\* | - |  |
| 6- Nicotine dependence | 0.40\*\* | 0.27\*\* | 0.19\*\* | 0.60\*\* | 0.29\*\* |  |

Note. \* *p* < 0.05. \*\* *p* < 0.01.

*3.2. Testing the hypothesized model in individuals with AUD*

Figure 3 shows the results of evaluating the hypothesized model of the effects of negative affect, impulsivity, and thought suppression on AUD and alcohol craving. Results indicated an acceptable model fit of the data (χ2(22) =57.50, *p*<0.001, CFI=0.95; GFI=0.98, TLI=0.96, SRMSR=0.041, RMSEA=0.049). In the model, among the covariate variables, duration of alcohol use (*p*<0.001) and comorbidity (*p*<0.05) had positive effects on both alcohol craving and problematic alcohol use, but not the age of onset use (*p*>0.05). Negative affect and impulsivity, but not thought suppression (*p*>0.05), had positive effects on alcohol craving and problematic alcohol use, respectively (*p*<0.001). Negative affect and thought suppression, but not impulsivity (*p*>0.05), had positive effects on desire thinking (*p*<0.001). Desire thinking, in turn, had a positive effect on alcohol craving and problematic alcohol use (*p*<0.001). Alcohol craving and problematic alcohol use were associated (*p*<0.001). The model explained 26% and 34% of the variances of alcohol craving and problematic alcohol use, respectively.

*Figure 3: The standardized coefficients of the model tested for individuals with AUD.*

**0.33**

**0.79**

Verbal perseveration

**0.55**

Imaginal prefiguration

**0.24\*\***

**0.45\*\***

**0.20\*\***

0.07

Age of onset use

**0.34**

**Negative affect**

0.06

**0.44**

0.03

**Problematic alcohol use**

**0.19\*\***

**0.16\*\***

Duration of use

**0.51**

0.08

**Impulsivity**

**0.42\*\***

**0.23\*\***

**0.10\***

-0.03

Comorbidity

**0.20\*\***

**0.36\*\***

**0.26**

**0.18**

0.04

**Alcohol craving**

**0.11\***

**Thought suppression**

0.10

*Note:* Short arrows indicate the explained variances. Dotted arrows show insignificant paths. \* *p* < 0.05. \*\* *p* < 0.001.

The results of 95% CI to test indirect effects on problematic alcohol use and alcohol craving showed that negative affect, via the mediating role of desire thinking, had positive indirect effects on both alcohol craving (*β*=0.03, *p*<0.05) and problematic alcohol use (*β*=0.09, *p*<0.001). Also, an indirect effect of thought suppression on alcohol craving (*β*=0.06, *p*<0.001) and problematic alcohol use (*β*=0.15, *p*<0.001) through desire thinking was observed. Finally, the indirect effect of impulsivity on both alcohol craving (*β*=0.01, *p*>0.05) and problematic alcohol use (*β*=0.01, *p*>0.05) was not confirmed (Table 3).

*3.3. Testing the hypothesized model in individuals with nicotine dependence*

Figure 4 shows the results of evaluating the hypothesized model of the effects of negative affect, impulsivity, and thought suppression on nicotine dependence and nicotine craving. Results indicated an acceptable model fit of the data (χ2(22) =57.64, *p*<0.001, CFI=0.94; GFI=0.97, TLI=0.95, SRMSR=0.045, RMSEA=0.056). Regarding covariates, duration of use had a positive effect on nicotine craving and nicotine dependence (*p*<0.001), and age of onset of use had a negative effect on nicotine craving, but comorbidity had no significant relation to nicotine craving and dependence (*p*>0.05). Except for thought suppression, negative affect and impulsivity had positive effects on nicotine craving and nicotine dependence (*p*<0.001). Desire thinking had positive effects on both nicotine craving and dependence (*p*<0.001). Nicotine craving and nicotine dependence were associated (*p*<0.001).

*Figure 4: The standardized coefficients of the model tested in the nicotine dependence group.*

**0.11**

**0.77**

Verbal perseveration

**0.61**

**0.22\*\***

Imaginal prefiguration

**0.23\*\*\***

**0.28\*\*\***

0.06

**0.44**

Age of onset use

**Negative affect**

0.01

**0.33**

**0.23\*\*\***

**Nicotine dependence**

**0.15\*\*\***

0.01

Duration of use

**0.53**

0.05

**Impulsivity**

**0.49\*\*\***

**0.19\*\*\***

0.04

**-0.11\***

Comorbidity

**0.17\*\*\***

**0.28\*\*\***

**0.23**

**0.28**

**0.17\*\***

**Nicotine craving**

0.05

**Thought suppression**

0.07

*Note:* Short arrows indicate the explained variances. Dotted arrows show insignificant paths.

\* *p* < 0.05. \*\* *p* < 0.01. \*\*\* *p* < 0.001.

The evaluation of 95% CI to check indirect effects is shown in Table 3. The significant indirect effects of negative affect on nicotine craving (*β*=0.05, *p*<0.01) and nicotine dependence (*β*=0.06, *p*<0.01) through the mediating effects of desire thinking were confirmed. Desire thinking significantly mediated the effects of thought suppression on nicotine craving (*β*=0.05, *p*<0.01) and nicotine dependence (*β*=0.06, *p*<0.01). Desire thinking did not have a significant mediating role in the relationship between impulsivity with nicotine craving (*β*=0.01, *p*>0.05) and dependence (*β*=0.02, *p*>0.05).

Table 3: Standardized indirect effects using bootstrapping with 5000 resamples.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Paths | Effect  | SE boot | P | 95% Bias corrected CI |  |
|  |  |  |  | Lower bound | Upper bound |
| Negative affect → Desire thinking → Alcohol craving | 0.03 a | 0.02 | 0.04\* | 0.05 | 0.09 |
| Negative affect → Desire thinking → Problematic alcohol use | 0.09 a  | 0.02 | 0.001\*\*\* | 0.03 | 0.12 |
| Impulsivity → Desire thinking → Alcohol craving | 0.01 | 0.01 | 0.19 | -0.05 | 0.01 |
| Impulsivity → Desire thinking → Problematic alcohol use | 0.01  | 0.01 | 0.44 | -0.01 | 0.04 |
| Thought suppression → Desire thinking → Alcohol craving | 0.06 a | 0.04 | 0.001\*\*\* | 0.02 | 0.14 |
| Thought suppression→ Desire thinking → Problematic alcohol use | 0.15 a | 0.04 | 0.001\*\*\* | 0.06 | 0.22 |
| Negative affect → Desire thinking → Nicotine craving | 0.05 a | 0.02 | 0.007\*\* | 0.02 | 0.08 |
| Negative affect → Desire thinking → Nicotine dependence | 0.06 a | 0.03 | 0.001\*\*\* | 0.02 | 0.15 |
| Impulsivity → Desire thinking → Nicotine craving | 0.01 | 0.01 | 0.46 | -0.01 | 0.03 |
| Impulsivity → Desire thinking → Nicotine dependence | 0.02 | 0.02 | 0.35 | -0.02 | 0.07 |
| Thought suppression → Desire thinking → Nicotine craving | 0.05 a | 0.02 | 0.006\*\* | 0.02 | 0.09 |
| Thought suppression → Desire thinking → Nicotine dependence | 0.06 a | 0.03 | 0.001\*\*\* | 0.02 | 0.16 |

Note.

a. Confidence intervals not including zero.

\* *p*<0.05. \*\* *p*<0.01. \*\*\* *p*<0.001.

**4. Discussion**

The present study sought to clarify, in patient samples presenting with AUD and nicotine dependence, the relative contribution of desire thinking in the associations between negative affect, impulsivity, and thought suppression on the one hand and craving, problematic alcohol use, and nicotine dependence on the other. Our findings suggested that, in both groups of AUD and nicotine dependence, negative affect and thought suppression indirectly affected alcohol and nicotine craving, problematic alcohol use, and nicotine dependence through the mediating role of desire thinking. These findings are broadly in line with what has been observed in the literature (Allen et al., 2017; Brandtner and Brand, 2021; Brandtner et al., 2020; Caselli et al., 2015a,b; [Chakroun-Baggioni](https://www.sciencedirect.com/science/article/pii/S0165178116318649#!) et al., 2017), which confirms the role of desire thinking as an underlying mechanism that affects addictive behaviors, beyond negative affect, impulsivity, and thought suppression (Caselli et al., 2013; 2012; Efrati et al., 2020).

So why should desire thinking play a prominent role in the relationship between established behavioral, emotional, and cognitive psychological factors (negative affect, impulsivity, and thought suppression) and both problematic alcohol use and levels of nicotine dependence, as well as alcohol and nicotine craving in clinical samples of AUD and nicotine dependence? A possible explanation is that desire thinking can be considered a sustained maladaptive form of coping. The function of desire thinking may thus be that of helping to regulate, in the short-term, discrepancies between actual and ideal states brought about by negative affect and the rebound effects of thought suppression with resultant anticipation of pleasant states and relief from emotional distress (Caselli and Spada, 2010, 2016; Kavanagh et al., 2004; 2005). In the medium to longer term, however, the activation of desire thinking is recognized to lead to an escalation and perseveration of emotional distress, as well as craving, as the desired target (in this case alcohol and nicotine use) is perseveringly elaborated upon but not achieved. This, in turn, will lead to the desired activity being perceived as the only, and increasingly urgent, route to regulate both emotional distress and craving.

The present study showed that although impulsivity had a significant association with desire thinking as well a direct relation to alcohol and nicotine-related craving and use in the groups of AUD and nicotine dependence, its effects on the outcome variables were not mediated by desire thinking in the same groups. This finding may suggest that desire thinking, which is an active cognitive self-regulation strategy, in contrast to impulsivity, which is more automatic, operates through a different cognitive route. Impulsivity may lead to addictive behavior without any self-controlling, thinking, and premeditation bypassing higher-order thinking (Ostafin et al., 2008) which would include desire thinking. On similar lines, a study has found that metacognitions, known as the activating beliefs in desire thinking (Caselli and Spada, 2015), had no mediating role in the relationship between impulsivity and problematic smartphone use (Casale et al., 2021). In addition, it is possible that impulsivity may be more closely associated with behavioral constructs rather than cognitive processes (e.g., desire thinking) so that a study also has shown that desire thinking is more correlated with behavioral aspects of impulsivity (i.e., motor impulsivity) than its cognitive facets (i.e., intentional impulsivity and non-planning) (Aydın et al., 2022). However, studies have not ever been conducted on the indirect effect of impulsivity on the use of alcohol and nicotine via the mediating role of desire thinking, so further studies are warranted to clarify this issue.

To sum up, the present study shows that in both AUD and nicotine dependence groups, negative affect and thought suppression indirectly affected alcohol and nicotine craving, problematic alcohol use, and nicotine dependence through the mediating role of desire thinking. In other words, both verbal perseveration and imaginal prefiguration appear to increase the impact of both negative affect and thought suppression on the severity of clinical presentations.

*4.1. Clinical implications*

 Clinically, the present study suggests that desired thinking should be carefully evaluated and targeted in the therapeutic programs for individuals with AUD and nicotine dependence. Thus, the evaluation of desire to use or avoid using alcohol may be important in clinical settings targeting the treatment of AUD (Schlauch et al., 2019). For example, individuals with AUD who display higher desire thinking may be more likely to be at risk of increased craving and use, and consequently relapse. The targeted reduction of desire thinking may therefore be of crucial importance in reducing the chances of relapse (Martino et al., 2019). Recent research has shown that Metacognitive Therapy (MCT; Wells, 2008), which targets desire thinking, may be effective in reducing addictive behaviors (Caselli et al., 2018; Caselli and Spada, 2016) by using techniques such as detached mindfulness and attention training, as well as restructuring beliefs about the advantages and disadvantages of engaging in desire thinking (Caselli et al., 2016). In addition, training individuals to use mindfulness and acceptance-based strategies rather than less effective strategies, such as suppressing intrusive thoughts may help them establish greater tolerance to both negative affect and craving, reducing the possibility of engaging in alcohol and nicotine use as forms of cognitive-affective self-regulation (Bowen et al., 2006, 2007; Garland and Roberts-Lewis, 2013; Rogojanski et al., 2011).

*4.2. Limitations*

The present study suffers from some classical limitations. For instance, the use of self-report measures (especially scales evaluating craving and dependency), which are vulnerable to response bias, should be noted. Future studies may focus on employing visual analog scales to deal with this limitation. The cross-sectional design of the study is another limitation that makes it impossible to argue for any causal conclusions; as a result, a longitudinal design is needed to further determine the validity of the patterns observed. Finally, the results have been obtained on clinical samples seeking treatment, so they may not be generalizable to non-clinical samples and also individuals with AUD and nicotine dependence not enrolled in treatment.

**5. Conclusions**

The present study clarifies the role of desire thinking as a mediator in linking negative affect and thought suppression to craving and use in individuals with AUD and nicotine dependence beyond the effects of comorbidity, age of alcohol and nicotine onset, and usage duration. These findings support the possibility of targeting desire thinking in individuals with AUD and nicotine dependence, especially those who are struggling with their psychological distress and have more tendencies to suppress their intrusive thoughts.

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