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## Investigating biases of attention and memory for alcohol-related and negative words in alcohol-dependents with and without major depression after day-clinic treatment

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### ABSTRACT

This study aimed to investigate attentional and memory biases in alcohol-dependents with and without major depression compared to healthy controls. We assumed that both groups of alcohol-dependents would show attentional and memory biases for alcohol-related words. For the alcohol-dependents with depression, we additionally expected both types of biases for negative words. Alcohol-dependents without co-morbidity (Alc) and alcohol-dependents with major depression (D-Alc) as well as control participants with a moderate consumption of alcohol (Con) completed an alcohol Stroop task and a directed forgetting paradigm using word stimuli from three categories: neutral, negative, and alcohol-related. Stroop effects showed that not only alcohol-dependents but also control participants were more distracted by alcohol-related than by negative words. In the directed forgetting procedure, all participants showed a significant effect for each word-category, including alcohol-related and negative words. The D-Alc-group memorized more alcohol-related than negative to-be-remembered words. The results do not corroborate the hypothesis of more pronounced attentional and memory biases in alcohol-dependents. However, in alcohol-dependents with depression a memory bias for alcohol-related material was found, suggesting that this group may be more pre-occupied with alcohol than patients without such co-morbidity.

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### 1. Introduction

Alcohol use disorders are essentially characterized by compulsive uncontrolled alcohol use despite adverse physical, psychological, or social consequences due to a “strong desire to use alcohol” and/or “unsuccessful efforts to cut down alcohol use” (Development of Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition, DSM-V; American Psychiatric Association). For instance, Lubman et al. (2004, p. 1491) postulate that in chronic alcohol-dependents, maladaptive, uncontrolled behaviors and high relapse rates might be “compulsive in nature as result of dysfunction within inhibitory brain circuitry”. To take a closer look at cognitive control processes, Friedman and Miyake (2004) propose to distinguish between the inhibition of prepotent response and the resistance to proactive interference. The ability

to inhibit prepotent responses or appetitive tendencies (such as impulsive alcohol use) is often measured via the attentional bias with attentional bias referring to the observation that motivationally relevant cues can grab or hold attention, and this is related to individual differences in appetitive and aversive motivation. By contrast, proactive interference as assessed via the memory bias is defined as the ability to resist memory intrusions from information that was previously relevant to the task but has become irrelevant. Thus, the memory bias refers to an enhanced recall of motivationally relevant (but task irrelevant) cues.

In alcohol use disorders, both types of cognitive processing biases are of great importance. To date, most studies in alcohol-dependents focused on problems caused by attentional bias toward alcohol-related information i.e., in the alcohol Stroop test (for review see Cox et al., 2006; Field and Cox, 2008). Less is known regarding the extent to which alcohol-dependents have problems caused by memory biases such as difficulty suppressing repetitive thoughts about drinking and drinking expectations as measured for instance in the directed forgetting paradigm (Todor, 2007). Growing evidence shows that both types of impaired cognitive control may

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lead to stronger craving and preoccupation with alcohol, intensifying the urge to drink, and thereby causing a vicious circle of withdrawal and relapse in alcohol-dependents (Cox et al., 2002; Wiers et al., 2002; May et al., 2004). Moreover, the experience of recurring relapses weakens the alcohol-dependents' confidence in their ability to control their addictive behavior (Cox et al., 2006; Wiers et al., 2006; Fadardi and Ziaee, 2010).

In order to assess alcohol-related attentional bias, Stetter et al. (1995) applied both, the classical Stroop task, as well as the "alcohol Stroop test" to alcohol-dependents and healthy controls. They found an alcohol-specific interference effect for alcohol-dependent patients, which was independent of neuropsychological deficits. Various authors confirmed the alcohol-specific attentional bias in alcohol-dependents (Johnson et al., 1994; Stormark et al., 2000; Sharma et al., 2001; Lusher et al., 2004; Fadardi and Cox, 2009; Field et al., 2013), although some studies – including our own previous investigation (Fridrici et al., 2013) – failed to replicate these findings (Cox et al., 1999; Duka et al., 2002; Ryan, 2002; Cox et al., 2003).

Up to now, only two studies investigated directed forgetting in alcohol-dependents in order to assess memory biases (Todor, 2007; Noel et al., 2009). Directed forgetting experiments demonstrate that, in general, the explicit instruction to forget some and to memorize other stimuli is reflected by a better recall of the to-be-remembered-items (R-items) compared to the to-be-forgotten-items (F-items). According to recent investigations by Hauswald et al. (2011) and Zwissler et al. (2011), the successful performance of directed forgetting is based on two cognitive processes: 1. selective rehearsal of the R-items and, 2. controlled inhibition of the F-items. Consequently, a low performance in directed forgetting (i.e., equivalent recall of R- and F-items) would reflect impaired ability to inhibit the F-items or reduced selective rehearsal of the R-items. Noel et al. (2009) found that alcohol-dependents performed worse in a letter trigram-based directed forgetting procedure than controls. They had more difficulties in forgetting the, presumably motivationally neutral, trigram stimuli than controls (no comparison to alcohol-related stimuli included) and this impairment was correlated with the duration of alcohol addiction. Todor (2007) applied alcohol-related and neutral words and found that healthy controls demonstrated a directed forgetting effect for both word categories. By contrast, alcohol-dependents did neither show directed forgetting effects for alcohol-related or neutral words. Taking a closer look at the results, the alcohol-dependents showed selective rehearsal by remembering more alcohol-related R-words and reduced controlled inhibition by remembering more alcohol-related F-words. However, for neutral words, they performed well in forgetting the F-items, but, comparatively, not in remembering the R-items – with both ways leading to the disappearance of the directed forgetting effect. Thus, for alcohol-dependents it seems to be difficult to attenuate the influence of alcohol-related memories by intentionally forgetting such memories and rendering them inaccessible to their immediate focus of attention.

To our knowledge, only one recently published study (Noel et al., 2013) examined the ability to suppress automatic or prepotent responses compared to the ability to control interference from memory among alcohol-dependents. The ability to suppress automatic responses was assessed by the anti-saccade task, the Stroop task and the Hayling task, whereas the ability to control interference from memory was measured by the Peterson Brown task and the cued recall. Their findings suggest that alcohol-dependence is mainly associated with an impaired ability to suppress automatic responses (seen in a higher attentional bias), whereas the ability to control interference from memory was preserved (no memory bias).

Alcohol-related cognitive biases seem to be malleable. Franken et al. (2003) found a positive correlation between memory bias

and craving in alcohol dependents. With respect to the alcohol-related attentional bias, recent studies found this bias to be positively correlated with craving (Field et al., 2013), quantity and frequency of substance use (Field et al., 2004), relapse risk (Cox et al., 2002) as well as alcohol priming by smelling alcoholic beverages (Cox et al., 2003), expectancy of substance availability (Field and Cox, 2008) and experienced stress level (Field and Powell, 2007; Garland et al., 2012). In addition, efficient treatment appears to reduce alcohol-related attentional bias (Flaudias et al., 2013). However, as most studies focused on untreated alcohol-dependents or patients at an early stage of treatment, little is known about the presence of alcohol-related cognitive biases in successfully treated alcohol-dependents who – nevertheless – show a high risk of relapse (Boothby and Doering, 2005). To our knowledge, the alcohol-related attentional bias and the alcohol-related memory bias have never been comparatively investigated in alcohol-dependents after completing a day-clinic rehabilitation program.

Depression is the most frequent co-morbid disorder in alcohol-addiction (Driessen et al., 1998). Various investigations found impaired performance in the Stroop task (Schatzberg et al., 2000; Harvey et al., 2005) as well as in the directed forgetting procedure (Power et al., 2000; Cottencin et al., 2008) in patients with major depression. However, some studies did not find an attentional bias in depressed patients (Murphy et al., 1999; Markela-Lerenc et al., 2006; Wong and Moulds, 2008). According to Lau et al. (2007) inhibitory dysfunction in patients with major depression is most likely valence-specific – most pronounced for negatively valenced stimuli. This attentional bias toward negatively valenced information may lead to an enhanced memory for negatively valenced emotional material in patients with major depression (Leppanen, 2006) and decreased memory performance if negatively valenced distractors are present (Beblo et al., 2010). All in all, as Sinclair et al. (2010) pointed out, despite high prevalence of co-morbid depression among alcohol-dependents and its acknowledged impact on etiology, presentation and outcome, still little is known about its impact on cognitive biases in alcohol use disorders.

In the present investigation, alcohol-dependents without depressive symptoms (Alc) were compared with alcohol-dependents suffering from co-morbid depression (D-Alc) and healthy controls (Con) by means of the alcohol Stroop task and the directed forgetting paradigm. First, it was assumed that both groups of alcohol-dependents are more distracted by alcohol-related words than by negative words shown by a higher Stroop interference effect as well as a smaller directed forgetting effect for alcohol-related words. Second, we expected alcohol-dependents with co-morbid major depression to be more distracted by negative words than the other two study samples.

## 2. Methods

### 2.1. Subjects

Three groups of subjects participated in the investigation. Alcohol-dependent patients without co-morbid diagnoses (Alc,  $n=28$ ), alcohol-dependent patients with co-morbid major depression (D-Alc,  $n=28$ ) and healthy control participants (Con,  $n=28$ ). The three groups were matched for age, gender and educational level (see Table 1).

The alcohol-dependent patients were recruited during a rehabilitation program at a day-clinic of the Clinic of Psychiatry and Psychotherapy Bethel, Ev. Hospital Bielefeld, Germany. They were tested between 15 and 45 days after drinking cessation at the end of their treatment – the D-Alc-group after 26 days on average which differed significantly from the Alc-group without depression (20 days on average, see Table 1). All patients were free of any withdrawal symptoms and detoxification medication for at least 10 days. All alcohol-dependents were routinely checked for substance abuse during their treatment. We can be reasonably sure that there was no use of substances during the entire period of

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