



## Discussion

## Is there room for attentional impairments in binge drinking? A commentary on Carbia et al. (2018)

Séverine Lannoy<sup>a</sup>, Alexandre Heeren<sup>a,b</sup>, Valérie Dormal<sup>a</sup>, Joël Billieux<sup>c</sup>, Pierre Maurage<sup>a,\*</sup><sup>a</sup> Laboratory for Experimental Psychopathology (LEP), Psychological Science Research Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium<sup>b</sup> Clinical Neuroscience Division (Neur), Institute of Neuroscience, Université catholique de Louvain, Brussels, Belgium<sup>c</sup> Addictive and Compulsive Behaviour Lab (ACB-Lab), Institute for Health and Behaviour, University of Luxembourg, Esch-sur-Alzette, Luxembourg

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## ABSTRACT

Binge drinking is an excessive pattern of alcohol use, highly prevalent in adolescents and young adults. Several studies have explored the cognitive impairments associated with binge drinking, and Carbia et al. (2018) recently proposed a systematic review of these impairments. Although this review offers an insightful and up-to-date synthesis of this research field, the authors concluded that binge drinking is not associated with attentional impairments. We argue that such conclusion is premature. We identified published studies not mentioned by Carbia et al. (2018), which documented attentional impairments in binge drinking. In particular, a differential exploration of attentional networks has suggested that binge drinkers not only exhibit impairments for the executive control of attention, but also for its alerting network. We thus recommend a better consideration of attention in future experimental and translational research agendas.

Binge drinking (BD) is a pattern of excessive alcohol consumption, characterized by repeated alternations between large alcohol intakes and withdrawal periods, which is now considered as an important public health concern in youth (Hingson et al., 2017). BD has gained a prominent place in public health and addiction research during the last decade. In this way, many studies have attempted to determine its upstream risk factors and related impairments, notably to predict long-term consequences. While prior narrative reviews already synthesized knowledge about BD, most of them have focused on brain correlates, and no work has summarized behavioral research. Taking stock on this issue, Carbia et al. (2018) recently filled this gap by providing a much-needed comprehensive review of the neuropsychological studies in young binge drinkers. They concluded that BD is associated with established difficulties in verbal memory and executive functions (i.e. prepotent response inhibition, cognitive flexibility, and information monitoring in working memory) whereas planning abilities, short-term memory, attention, processing speed, and visuospatial construction remain preserved. Considering published studies, we argue that these conclusions are premature and we discuss experimental data at odds with the proposal that BD is unrelated to attentional impairments.

At the conceptual level, the studies identified by Carbia et al. (2018) led to a quite restricted definition of attentional processes, exclusively focusing on sustained and selective attention. However, this approach is

inconsistent with the prominent theoretical models of attention. According to the attentional networks approach (Petersen and Posner, 2012; Posner and Rothbart, 2007) — one of the most influential contemporary models of attention — attentional system can be subdivided into three functionally and anatomically independent networks, namely alerting (allowing to achieve and maintain a state of alertness), orienting (allowing to select sensory information by engaging, disengaging, or shifting attention from one stimulus to another), and executive control (involving the top-down control of attention to resolve response conflicts) networks. Of note, the validity of this model has been confirmed by behavioral and neuroimaging studies (e.g., Fan et al., 2005, 2009), and it has been used to explore attentional networks in general and psychopathological populations (Heeren et al., 2015; Maurage et al., 2014; Pacheco-Unguetti et al., 2011; Woicik et al., 2009). This theoretical and experimental framework has also led to significant insights to understand how attentional processes, particularly the executive control, predict emotion regulation (Morillas-Romero et al., 2015; Tortella-Feliu et al., 2014), a phenomenon of critical importance in psychopathology (Moriya and Sugiura, 2012) constituting a central perspective for future BD studies. Therefore, we believe that the lack of consideration of this theoretical perspective and of its related experimental outcomes leads to an erroneous conclusion concerning attentional impairments in BD, and offers a somehow biased view of the

\* Corresponding author at: Université catholique de Louvain, Institut de Psychologie, LEP. Place du Cardinal Mercier, 10, B-1348, Louvain-la-Neuve, Belgium.

E-mail addresses: [severine.lannoy@uclouvain.be](mailto:severine.lannoy@uclouvain.be) (S. Lannoy), [alexandre.heeren@uclouvain.be](mailto:alexandre.heeren@uclouvain.be) (A. Heeren), [valerie.dormal@uclouvain.be](mailto:valerie.dormal@uclouvain.be) (V. Dormal), [joel.billieux@uni.lu](mailto:joel.billieux@uni.lu) (J. Billieux), [pierre.maurage@uclouvain.be](mailto:pierre.maurage@uclouvain.be) (P. Maurage).<https://doi.org/10.1016/j.neubiorev.2019.01.006>

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cognitive alterations presented by this population.

Indeed, among the nine attention-related studies identified by Carbia et al. (2018), only two showed significantly reduced sustained (Hartley et al., 2004) or slower selective (Salas-Gomez et al., 2016) attention in BD. Nevertheless, beyond the motor impulsivity related to BD, which has been approached by Carbia et al. (2018), the cited study of Townshend and Duka (2005) showed attentional impairments among female binge drinkers in a vigilance task. Moreover, we identified via an additional comprehensive literature search (conducted on PubMed on September 20, 2018; using “binge drinking” and “attention” as keywords and completed by the examination of reference lists; see Fig. 1), three studies corroborating this observation (Lannoy et al., 2017<sup>1</sup>; Sanchez-Roige et al., 2014; Scaife and Duka, 2009), which were not referenced to in the review of Carbia et al. (2018). Two of these studies (Sanchez-Roige et al., 2014; Scaife and Duka, 2009) explored attention using tasks whereby various degrees of executive abilities were recruited. In the first study, female binge drinkers were particularly impaired in discrimination trials based on attentional processes in a task also evaluating shifting abilities (Scaife and Duka, 2009), while in the second one, binge drinkers presented difficulties in trials requiring higher attentional load in a task also involving inhibitory control (Sanchez-Roige et al., 2014). It is worth noting that these studies (Sanchez-Roige et al., 2014; Scaife and Duka, 2009; Townshend and Duka, 2005) neither relied on the attentional networks framework nor specifically assessed attentional abilities (as they were more focused on executive functions). Nevertheless, and although these studies used multi-determined paradigms, they underlined that the difficulties presented by binge drinkers are particularly present during the experimental conditions requesting high attentional resources. Besides, the last study (Lannoy et al., 2017) determined the relative contribution of each attentional process in BD using the Attention Network Task (assessing alerting, orienting, and executive control). In this study, the three attentional networks were considered and the authors confirmed that, beyond executive control difficulties, impairments were observed in BD for the alerting network. Dovetailing with the works mentioned above (Hartley et al., 2004; Townshend and Duka, 2005), these results reinforce the importance of the previously called “vigilance” or “sustained attention” deficits found in BD. A key argument proposed by Carbia et al. (2018) is that the impairments associated with BD are mostly recognized using cognitive tasks that are relatively demanding in terms of cognitive load, and thus mostly related to executive processes. However, this conclusion does not seem supported by recent results: attentional impairments in BD encompass alerting abilities, beyond executive control. Although these results constitute the only experimental exploration specifically focusing on attentional networks in BD, they call for future research proposing replications and extensions of these findings. Especially, we encourage upcoming studies to test attentional abilities in binge drinkers by referring to the attentional networks approach. As most BD studies measure processes tapping on the executive network of attention, we also propose to develop an in-depth investigation of the possible impairments related to alerting, but also to orienting, as these processes remain little explored. These explorations should be conducted both with the Attention Network Task (i.e. replicating previous findings) and with specific tasks assessing each attentional network.

Eventually, although it is not the main target of this commentary, which aims to systematically focus on behavioral results as initially proposed by Carbia et al. (2018), it should be mentioned that the presence of attentional impairments in BD is strongly supported by recent neuroimaging data, as notably suggested by two recent studies. First, Herman et al. (2018) showed that the BD score (Townshend and Duka, 2002) is associated with reduced activation in the functional

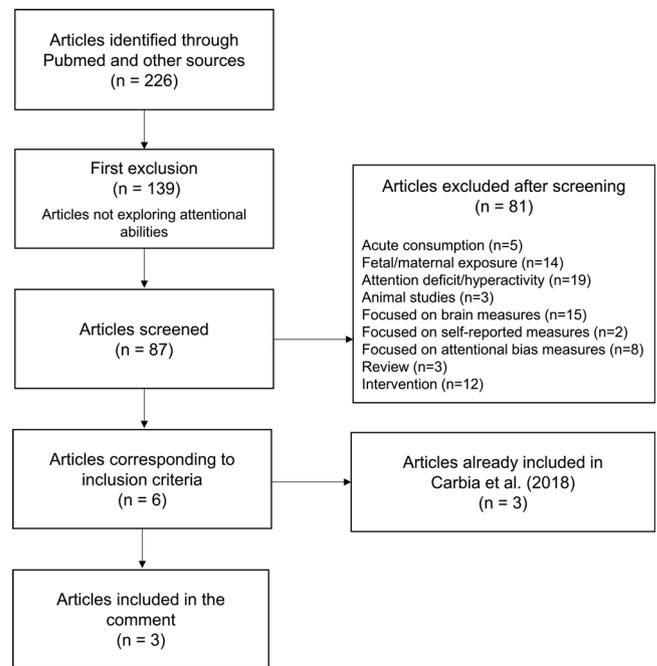


Fig. 1. PRISMA flowchart presenting articles selection.

areas of the ventral attention network (responsible for the attention towards behaviorally relevant stimuli, particularly salient and unexpected ones). These results therefore suggest that BD is related to attentional impairments, correlated to the intensity of alcohol consumption. Second, another research focusing on the neural dynamics of attentional circuitry in BD combined magnetoencephalography and neuroimaging data (Correas et al., 2018) to show that: (1) Event-related theta power (particularly sensitive to cognitive effort) correlates with selective attention performance and is negatively related to alcohol consumption in binge drinkers; (2) theta band oscillations between the right anterior and posterior inferior frontal cortices indicate a decreased connectivity of the prefrontal network during attentional engagement in binge drinkers. Such results thus reinforce the need to further consider attentional processes in BD with both behavioral and neuroscientific measures. Interestingly, the study of Herman et al. (2018) also highlighted that the lower activation in the ventral attention network was more pronounced in fearful contexts, which further supports the relevance to consider the relationship between attentional networks and emotional regulation in BD, as mentioned above.

Altogether, the presence of attentional impairments in BD, as suggested by the additional results presented in this comment, yields strong implications for future research. On the one hand, provided that most of the experimental procedures assessing cognitive functions impaired in BD depend upon attentional resources (e.g., Sanchez-Roige et al., 2014), one may wonder whether previously identified impairments, interpreted as purely relying on memory or executive functions, could at least partly result from impaired attentional processes. In this way, to ensure that the impairments observed are specifically related to the processes measured, it calls for an exhaustive control of the efficiency of attentional networks when assessing cognitive functions in BD. On the other hand, the presence of attentional impairments has clinical implications for BD. Therapeutic programs focusing on attentional training might constitute a requisite step before proposing to rehabilitate other cognitive functions. Indeed, efficient attentional functioning is critical for executive processes, emotion regulation, and therefore for the implementation of adaptive behaviors (Morillas-Romero et al., 2015). The rehabilitation of attentional networks should thus constitute a key component of a unified revalidation approach in youth (e.g., Rueda et al., 2012).

<sup>1</sup> This study has been published just after the temporal framework considered in the systematic review of Carbia et al., (2018).

## Declarations of interest

None.

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