



High-mind wandering correlates with high risk for problematic alcohol use in China and Germany

Shuyan Liu¹ · Ruihua Li² · Luisa Wegner^{1,3} · Chuanning Huang² · Matthias N. Haucke^{1,3} · Daniel J. Schadt⁴ · Min Zhao^{2,5,6} · Stephan Heinzl³

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Abstract

Everyone experiences the natural ebb and flow of task-unrelated thoughts. Given how common the fluctuations in these thoughts are, surprisingly, we know very little about how they shape individuals' responses to alcohol use. Here, we investigated if mind wandering is associated with a risk of developing problematic alcohol use. We undertook an online survey among the general population in China (N = 1123) and Germany (N = 1018) from December 2021 to February 2022 and examined the subjective experience of mind wandering and problematic alcohol use through the Mind Wandering Questionnaire (MWQ) and the Alcohol Use Disorders Identification Test (AUDIT). We compared mind wandering and problematic alcohol use between two countries and investigated the association between MWQ scores with AUDIT scores. We found higher scores on the MWQ and a high percentage of problematic alcohol use (i.e., AUDIT score ≥ 8) in Germany (22.5%) as compared to in China (14.5%). Higher self-reported mind wandering was associated with higher AUDIT scores. AUDIT scores were increased mostly in male, elder, and high-mind wandering people. Our findings highlight that mind wandering and problematic alcohol use enhanced in Germany as compared to in China. Our study sheds light on the relationship between mind wandering and problematic alcohol use that may help to further investigate causal effects of interventions.

Keywords Task-unrelated thoughts · Alcohol consumption · Mind wandering questionnaire · Alcohol use disorders identification test · Sino-German study

Shuyan Liu and Ruihua Li have equal contribution.

✉ Min Zhao
drminzhao@smhc.org.cn

- ¹ Department of Psychiatry and Psychotherapy, Charité – Universitätsmedizin Berlin (Campus Charité Mitte), Berlin, Germany
- ² Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, 600 South Wan Ping Road, Shanghai 200030, China
- ³ Clinical Psychology and Psychotherapy, Department of Education and Psychology, Freie Universität Berlin, Berlin, Germany
- ⁴ Psychology Department, Health and Medical University, Potsdam, Germany
- ⁵ Shanghai Key Laboratory of Psychotic Disorders, Shanghai, China
- ⁶ CAS Center for Excellence in Brain Science and Intelligence Technology (CEBSIT), Chinese Academy of Sciences, Shanghai, China

Introduction

Our minds wander approximately half of the time during a day [19]. Mind wandering refers to the occurrence of intrusive thoughts unrelated to the current task [43, 45]. It has been associated with craving [2, 27], inattention and impulsivity [1, 22], as well as with low executive control [30, 44, 45] and fluctuations in motivation [4]. Impairments in these emotional and cognitive domains are common in alcohol use disorder (AUD) [6, 13].

Indeed, aspects of mind wandering (namely intrusive thoughts) have been related to alcohol consumption before. Specifically, elaborated intrusion theory suggests the conscious experience of craving as a cycle of mental elaboration of an initial intrusive thought [16, 28]. Intrusive thoughts about alcohol occur when a person associates their drinking with certain internal (e.g., feeling stressed) or external cues (walking past a bar) [29]. These cues trigger intrusive thoughts about alcohol that can then be elaborated upon in a cognitive processing system through the sensory modalities

of vision, hearing, taste, and smell [29]. Increasing elaboration of such thoughts competes for the same limited cognitive resources, which correlates to a feeling of craving and to consumption of alcohol [17, 28, 29]. Other cognitive triggers, such as high alcohol expectancies were associated with increased appetitive response toward alcohol cues [7, 15] which might facilitate current and future alcohol consumption [23, 38, 42].

Mindfulness has been found to reduce mind wandering [37] and is known to moderate the relationship between impulsivity and the ability to disengage from alcohol-related thoughts [36]. Mindfulness might, thus, break what would otherwise create a positive feedback loop of automatic impulses to drink alcohol and alcohol-related thoughts [9]. The recent studies show that brief mindfulness-based training can help prevent and reduce alcohol cravings [48].

Theoretical reasoning moreover suggests additional paths of how mind wandering may relate to alcohol consumption. First, increased mind wandering was associated with impulsivity trait [1] and reduced ability to inhibit habitual response tendencies reduced ability to inhibit habitual response tendencies [12], both of which are known to facilitate problematic alcohol consumption [3, 6, 42]. Indeed, previous research showed that alcohol expectancies and habitual decision making predict relapse in alcohol dependence [42]. Second, acute alcohol ingestion in a lab lead to a greater incidence of mind wandering [10, 41], suggesting that alcohol consumption may elicit mind wandering. However, it is unclear whether real-life risky alcohol use is associated with chronically increased mind wandering rates, and whether such an association is valid across different cultural contexts.

Mind wandering has been studied across Eastern and Western cultures including in China [46] and in Germany [49], suggesting that it is a universal phenomenon [11, 26]. Yet, there are differences in mind-wandering rates across eastern and western cultures, suggesting that European participants do mind-wander more than Asian participants [47]. No recent study has been carried out on how mind wandering is associated with alcohol consumption across eastern and western cultures.

AUD is one of most common substance use disorders in both China and Germany with high prevalence [34] and low treatment rate [14, 50]. According to the World Health Organization (WHO), the 12-month prevalence of AUD in 2016 was 4.4% in China and 6.8% in Germany [34]. The treatment rate remains dramatically low, with only 2.4% in China [50] and 9% in Germany [14], which implies low treatment seeking rates, a lack of treatment availability, and an underuse of medical care [14, 50].

During the COVID-19 pandemic, on the one hand, a decline in alcohol availability and affordability and fewer chances to socialize [39] may lead to a reduction in alcohol

consumption [18]. On the other hand, COVID-related stress may increase excessive alcohol misuse that can escalate into AUD [5, 20].

In this study, we aim to investigate mind wandering, the rates of problematic alcohol use in China and Germany, and whether high-mind wandering rates are associated with problematic alcohol use. To this end, we assessed the association between trait levels of mind wandering, assessed via the mind wandering questionnaire (MWQ; [31]), and risky alcohol consumption, assessed via the Alcohol Use Disorders Identification Test (AUDIT; [40]). As has been shown previously, European participants tend to focus more on internal psychological states than Asian participants [47]. Consequently, we expected that participants in Germany would mind-wander more than participants in China. Consistent with a previous report [34], we expected that Germany would have a higher rate of problematic alcohol use compared with China. Importantly, we expected that higher trait mind wandering is associated with a higher risk for problematic alcohol use in both countries.

Methods

Participants and procedure

We conducted a cross-sectional Sino-German study on the general population. We created an anonymous online survey on the Wenjuanxing platform (<https://www.wjx.cn>) in China and the Unipark platform (<https://www.unipark.com/en/>) in Germany. Participants over 18 years of age were eligible to take part in this study. There were no other inclusion criteria. The online survey was conducted from December 2021 to February 2022. We recruited them through social media, advertisements, newsletters, and Prolific (<https://www.prolific.co>). Prolific is an online platform that helps researchers recruit participants. The participation in China was fully voluntary and there was no compensation. To make sure each participant only completed our survey once, the Wenjuanxing platform enabled control of metadata. Participants in Germany were voluntary and were compensated with payment to their Prolific accounts only once, which ensured that one individual could only participate once in our given study.

Our online survey consisted of a sociodemographic assessment (i.e., sex and age), the MWQ questionnaires, and the AUDIT. The study was approved by the Ethics Committees at Charité – Universitätsmedizin Berlin (registration number: EA2/143/20), at Freie Universität Berlin (registration number: 030/2022), and at Shanghai Mental Health Center (registration number: 2021ky-15).

Mind wandering and alcohol use disorders identification test

We used a short 5-item MWQ to capture mind wandering [31], which has been previously used in China and Germany [21, 25]. Each item was rated on a 6-point Likert scale from 1 (almost never) to 6 (almost always) and the total score of five items ranged from 5 to 30. We used a classical instrument developed by the WHO, the AUDIT, to capture problematic alcohol use among general populations [40]. It has been widely used in China and Germany [8, 24]. The AUDIT consists of ten items with scores ranging from 0 to 4, thus allowing results from 0 to 40. According to the WHO guidelines (<https://auditscreen.org/about/scoring-audit/>), a score of 8 or more indicates problematic alcohol use (scores from 8 to 14 suggest hazardous or harmful alcohol consumption and a score of 15 or more indicates the likelihood of moderate to severe AUD).

Data analysis

Statistical analysis was performed using R Statistical Software (version 4.1.0; R Foundation for Statistical Computing, Vienna, Austria, www.r-project.org). Differences were considered statistically significant at $p < 0.05$ and highly statistically significant at $p < 0.001$. To test effects of sex, age, country, and mind wandering on AUDIT scores, we used independent t tests for groups with pairwise comparisons in sex (males versus females), age (younger versus elder with median splits), country (China versus Germany), and mind wandering levels (lower vs. higher with median splits using the whole sample). Two-tailed hypothesis testing was used. To test if mind wandering scores had an influence on AUDIT scores, we ran a multiple linear regression model with significance testing implemented as a permutation test (ImPerm-package in R). In this model, we used “AUDIT score” as the outcome and included the main effects of “MWQ score”, “country” (China versus Germany; effect coding: -0.5 vs. +0.5) as well as their interaction effect of “MWQ score \times country” (to compare the relationship of mind wandering and problematic alcohol use between China and Germany), controlling for “sex” (males versus females; effect coding: -0.5 vs. +0.5) and “age” (continuous). The intercept of effects coding represented the mean of two conditions, not just the mean of one condition. All continuous predictors were mean-centred for analysis. To test the assumption of having no multicollinearity, we calculated the variance inflation factor (VIF) values for all independent variables of the model.

Results

Group description

1123 participants in China (700 females; age range: 18–78, Mean = 28.80, SD = 11.54) and 1018 participants in Germany (514 females; age range: 18–80, Mean = 28.71, SD = 9.07) completed our survey from December 2021 to February 2022. Regarding comparison of social-demographic variables between China and Germany, we did not find a significant difference of “age” ($t(2139) = 0.20$, $p = 0.84$), but significant differences in “sex” ($\chi^2 = 27.66$, $p < 0.001$) between China and Germany, as shown in Table 1. Moreover, we found that participants in Germany reported higher levels of mind wandering as compared to participants in China, $t(2139) = -14.06$, $p < 0.001$. Participants in Germany reported higher AUDIT score as compared to participants in China, $t(2139) = -9.43$, $p < 0.001$. In Germany, 22.5% of participants reported problematic alcohol use (i.e., AUDIT score ≥ 8), ratings substantially higher than in China, where 14.5% of participants reported problematic alcohol use ($\chi^2 = 22.21$, $p < 0.001$). The proportion of participants with hazardous or harmful alcohol use (i.e., AUDIT score 8–14) in Germany (17.2%) was higher than in China (8.4%, $\chi^2 = 37.01$, $p < 0.001$). However, as for the proportions of participants with the likelihood of moderate to severe AUD (i.e., AUDIT score ≥ 15), there were no significant difference between two countries (6.1% in China vs. 5.3% in Germany, $\chi^2 = 54.89$, $p = 0.459$). In general, there were sex and age differences in AUDIT scores. Male participants reported relatively higher AUDIT score as compared to females, $t(2130) = 12.32$, $p < 0.001$. Elder participants reported

Table 1 Participants’ sociodemographic variables and group comparisons

	China (N = 1123)	Germany (N = 1018)	<i>p</i>
Female (%)	700 (62.33%)	514 (50.94%)	$p < 0.001$
Mean Age (SEM)	28.80 (0.34)	28.71 (0.28)	$p = 0.84$
Mean MWQ (SEM)	15.70 (0.15)	18.69 (0.15)	$p < 0.001$
AUDIT			
Mean AUDIT (SEM)	3.08 (0.16)	5.17 (0.16)	$p < 0.001$
AUDIT score ≥ 8	163 (14.51%)	229 (22.50%)	$p < 0.001$
AUDIT score 8–14	94 (8.37%)	175 (17.19%)	$p < 0.001$
AUDIT score ≥ 15	69 (6.14%)	54 (5.31%)	$p = 0.46$

AUDIT: Alcohol Use Disorders Identification Test. MWQ: Mind Wandering Questionnaire. SEM: Standard Error of the Mean

relatively higher AUDIT score as compared to younger ones, $t(2030) = -5.94, p < 0.001$.

High-mind wandering respondents are at high risk to report problematic alcohol use

The risk for problematic alcohol use significantly differed between low versus high-mind wandering groups, $t(1956) = -3.75, p < 0.001$. As is shown in Fig. 1, individuals with higher mind wandering reported higher AUDIT scores (mean = 4.50, SD = 5.35) as compared to those with lower mind wandering (mean = 3.62, SD = 5.00). The high versus low-mind wandering groups differed in the proportions of participants reporting problematic alcohol use: In the high-mind wandering group, 20.8% of participants reported problematic alcohol use; in the low-mind wandering group, 15.8% of participants reported problematic alcohol use ($\chi^2 = 8.04, p = 0.005$).

Increased mind wandering correlated with high AUDIT scores

The multiple linear model ($F = 53.5, p < 0.001$) was shown in Table 2. There were no significant associations among the predictor variables (VIF values < 1.16). In general, we found that the main effects of “mind wandering” ($b = 0.12, p < 0.001$), “country” ($b = 1.42, p < 0.001$) and their interaction effect of “mind wandering \times country” ($b = 0.11, p < 0.001$) were significant predictors of high AUDIT scores after controlling for sociodemographic differences (i.e., sex and age, both p values < 0.001), shown in Fig. 2. An interaction effect of “mind wandering \times country” indicated that participants in Germany with the higher mind

Table 2 Multiple linear regression model

Variables	<i>b</i>	<i>p</i>
MWQ score	0.12	$< 0.001^*$
Country		$< 0.001^*$
China versus Germany	1.42	
MWQ score \times country	0.11	$< 0.001^*$
Sex		
Males versus Females	- 2.53	$< 0.001^*$
Age	0.04	$< 0.001^*$

MWQ: the mind wandering questionnaire * $p < 0.05$

wandering scores had higher AUDIT scores as compared to participants in China.

Discussion

We conducted a cross-culture study evaluating mind wandering, the rates of problematic alcohol use, and the impact of mind wandering on problematic alcohol use. In line with our hypothesis, we found Germany to have a higher mind wandering level and a higher rate of problematic alcohol use as compared to China. High-mind wandering was associated with high AUDIT scores. Male, old, and high-mind wandering people were particularly at risk for problematic alcohol use.

Our findings on a high-mind wandering level in Germany as compared to China are consistent with previous cross-cultural studies on mind wandering [47]. Such differences may contribute to the nature of eastern and western thought process [32] which requires further elucidation.

Fig. 1 The effect of mind wandering levels on the risk for problematic alcohol use. For the comparison between high ($N = 893$) versus low ($N = 1065$) mind wandering groups, each participant’s self-reported mind wandering score (MWQ) was ranked higher versus lower than the median (183 participants’ data at the median were removed). ***, $p < 0.001$

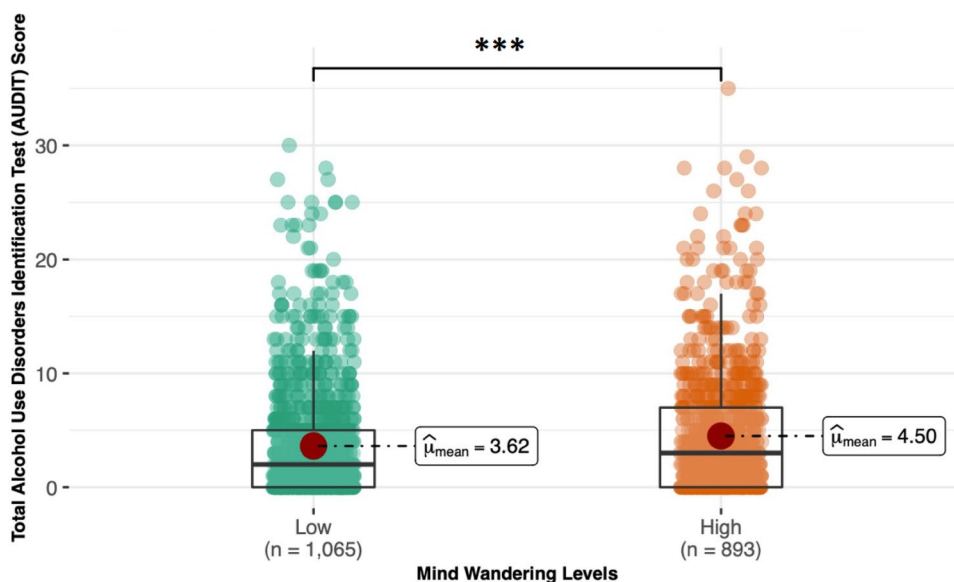
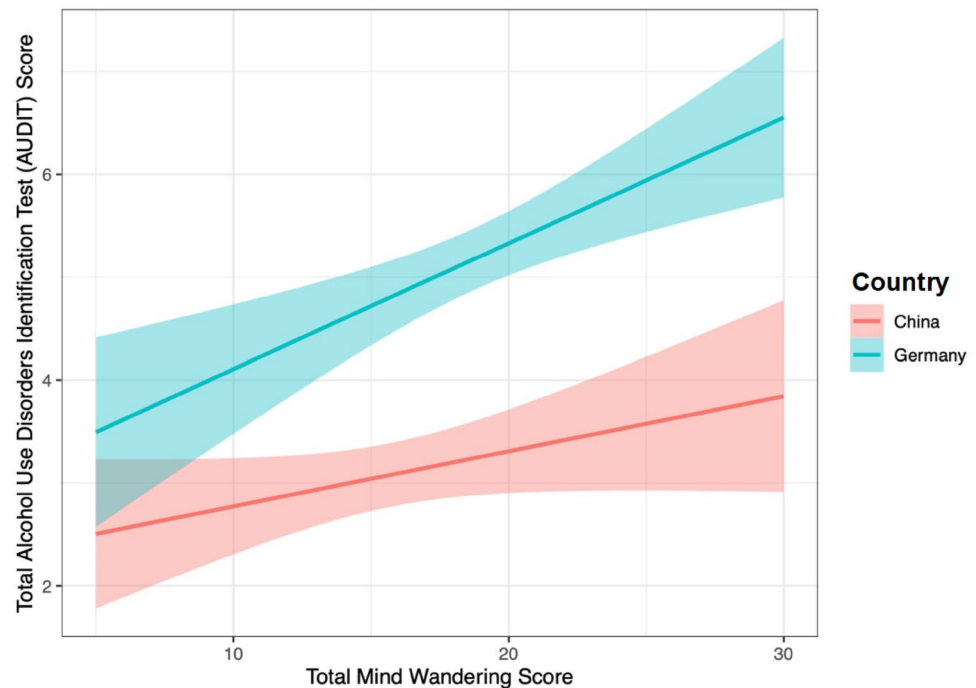


Fig. 2 The effect of mind wandering on problematic alcohol use in China and in Germany. The Alcohol Use Disorders Identification Test (AUDIT) score is displayed as a function of the mind wandering (MWQ) score, capturing problematic alcohol use among general populations, for China (N = 1123; red) versus Germany (N = 1018; blue)



Our findings on a higher rate of hazardous or harmful alcohol use in Germany (17.2%) as compared to in China (8.4%) reflect a generally higher alcohol consumption in Germany: In 2019, the annual alcohol per capita consumption in Germany (12.79 L of pure alcohol) was higher than in China (6.04 L) [33]. Moreover, in our data the rates of participants with likelihoods of moderate to severe AUD (based on the AUDIT) in China and in Germany were 6.1% and 5.3%, respectively. A previous WHO report showed that the 12-month prevalence of people with AUD in 2016 in China was 4.4% and in Germany was 6.8% [34]. Our findings are based on the AUDIT scores rather than a clinical diagnosis of AUD. AUDIT is a screening tool for unhealthy alcohol use, defined as risky or hazardous consumption or any AUD. Our results may lay the foundation for future studies on integrating a diagnostic tool.

Our findings provide new insights into the relevance of mind wandering in problematic alcohol use. We found that high-mind wandering was associated with high AUDIT scores in both countries. Respondents in Germany reported higher levels of mind wandering as compared to respondents in China. Moreover, we found high-mind wandering people were particularly at risk for problematic alcohol use. Our results suggest that individuals with high levels of mind wandering may be more prone to develop problematic alcohol use than those with low levels of mind wandering.

The causal direction of the found association between mind wandering and alcohol use remains open to further investigation: as one possibility, alcohol intake may increase mind wandering, possibly due to acute effects as alcohol

intake may enhance mind wandering [10, 41], or due to chronic effects, since long-term alcohol consumption may lead to brain damage of executive control functions [35], which may enhance mind wandering rates. As a second possibility, mind wandering may increase alcohol consumption: during craving, people may wander their minds for alcoholic drinks/drinking situations. Moreover, increased mind wandering was associated with impulsivity traits [1] and reduced ability to inhibit habitual response tendencies [12], which may increase alcohol use [3, 6, 42]. A longitudinal study with repeated measurements may be helpful to disentangle correlation from causation. Future work may also explore the content of mind wandering, i.e., whether minds wander for alcohol-related content (reflecting craving), and whether acute mind wandering increases impulsivity and habitual choice to facilitate drinking.

There were two main limitations in this study. Firstly, we relied on convenience sampling and the generalizability and representativeness are limited in our sample (e.g., population with a mean age of 28.76 years; standard deviation = 10.44). Therefore, we cannot exclude the observed effects apply to a particular subpopulation. To avoid convenience sampling bias, we took multiple diverse samples (i.e., samples across two countries in China and in Germany) as a larger sample size. Secondly, the association between mind wandering and alcohol use is of correlational nature and does not support conclusions about causation as mentioned above. Our study did not inquire about other factors that have also been associated with alcohol use/problems (e.g., motivation, impulsivity, executive control). Therefore, we cannot exclude that the

association of mind wandering with problematic alcohol use is mediated by other factors including attention, impulsivity traits or levels of executive control. Although with these limitations, we reported the rates of mind wandering and problematic alcohol use in China and Germany. In addition, the association between mind wandering and problematic alcohol use may inspire a new direction on alcohol use disorder and related interventions.

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Data Availability Derived data supporting the findings of this study are available from the first authors, S.L. and R.L., upon reasonable request.

Declarations

Ethical standards The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All participants gave their informed consent prior to their inclusion in the study.

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