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A wandering mind reflects a lonely mind: A cross-cultural study

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ABSTRACT

Our minds wander for half of our waking time, and evidence suggests that a wandering mind is often an unhappy one. However, the specific contents of unpleasant thoughts and feelings during mind wandering remain undiscovered. Here, we aim to investigate if mind wandering may closely relate to feelings of loneliness, such as experiencing a sense of being left out and isolated from others, within a cross-cultural context. Our study involved participants from the general populations of China (N= 1123) and Germany (N= 1018), surveyed between December 2021 and February 2022. Using an online survey tool, we assessed self-reported mind wandering (measured by the Mind Wandering Spontaneous and Deliberate Scale) and loneliness (measured by the UCLA Loneliness Scale), while controlling for self-esteem (measured by the Rosenberg Self-Esteem Scale), self-efficacy (measured by the General Self-efficacy Scale), and mental health status (measured by the General Health Questionnaire). Strikingly, we found that approximately half of the respondents in both China and Germany reported feelings of loneliness (49.8% in China versus 49.5% in Germany, p= 0.936). Regression analysis further revealed that higher levels of self-reported spontaneous (β = 0.04, p= 0.047) and deliberate mind wandering (β = 0.05, p= 0.009) were associated with higher levels of loneliness, even after controlling for sociodemographic variables, self-esteem, self-efficacy, and mental health status. These findings suggest that loneliness is a pervasive experience across cultures and may serve as a driving factor underlying unpleasant thoughts and feelings during episodes of mind wandering.

Introduction

The COVID-19 pandemic has been contended to have sparked an escalation in the prevalence of loneliness among individuals (Varga et al., 2021). Prior to the COVID-19 pandemic, the pooled prevalence of loneliness across 113 countries ranged from 2.7% to 21.3% (Surkalim et al., 2022), with notable prevalence rates observed in Europe, the USA, and China (5–43%) (Leigh-Hunt et al., 2017; Xia and Li, 2018). In Germany, the estimated prevalence of lonely people stood at 10% (Beutel et al., 2017). The situation has exacerbated due to COVID-19-related restrictions on daily life aimed at curbing the virus' spread (Brandt et al., 2022; Hwang et al., 2020; Liu et al., 2021a,b). On average, loneliness has increased by nearly 5% on average across countries since the onset of the pandemic (Ernst et al., 2022). During the COVID-19 pandemic, more than 1 in 3 people in the United States (Weissbourd et al., 2021) and in the United Kingdom (Li and Wang, 2020) have reported feeling lonely. Among people living in Germany and in China, 32% reported to be lonely in Germany (Berger et al., 2021) and 24 % of respondents in China felt lonely (Bao et al., 2021) under the first national lockdowns in 2020. Long-lasting loneliness has been found to raise health, social and economic risks (Hawkley and Cacioppo, 2010; Mihalopoulos et al., 2020) and mortality (Holt-Lunstad et al., 2015).

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Loneliness is subjectively experienced as a discrepancy between one's desired and actual social relationships (Perlman and Peplau, 1981). For example, oversea students who are longing to forge new friendships, but feel unable to connect with others, may experience loneliness. Risk factors for loneliness encompass gender, age, education, marital status, low levels of self-esteem, self-efficacy, and worsening mental health status (Barjaková et al., 2023; Buecker et al., 2023; Dahlberg et al., 2022; Hutten et al., 2022). Moreover, cultural differences can also shape experiences of loneliness (Barreto et al., 2021), given that culture can influence people's cognitive processes (Nisbett, 2003; Rokach et al., 2000). Nisbett (2003) analysed the differences between Asia and the West and identified distinct cognitive patterns across cultures (Nisbett, 2003): Asian cultures tend to perceive the world holistically, seeing the big picture and objects in relation to their environments and believing that control over events requires collaboration with others (Nisbett, 2003). Conversely, Western cultures perceive the world analytically and atomistically, focusing on individual objects while slighting the field, often feeling personally in control of events even in situations where control may be limited (Nisbett, 2003). Considering loneliness, individuals in Asian cultures often attribute their loneliness to "self-behaviour" and their desire for social acceptance, whereas those in Western cultures tend to attribute their loneliness to their expectations of "others' behaviour" (Yum, 2003). In other words, people in Asia who feel lonely tend to internalize blame, feeling responsible for their inability to achieve desired social relationships (Rokach, 2018). Conversely, people in the West are more likely to see "others" as responsible for their loneliness, such as their partners' lack of effort in maintaining the relationship (Rokach, 2018; Yum, 2003).

Why are some people more prone to loneliness, while others do not? A regulatory loop model of loneliness (Hawkley and Cacioppo, 2010) suggests that loneliness forms a negative loop of social interactions. Individuals who feel lonely crave security, yet their sense of insecurity heightens their sensitivity and vigilance towards social interactions (Hawkley and Cacioppo, 2010). This increased sensitivity to and surveillance for negative social interactions leads to cognitive biases: lonely individuals expect negative social interactions and tend to recall negative social information (Hawkley and Cacioppo, 2010). These negative social expectations foster negative feelings and attitudes toward others, which then confirm their initial expectations (Hawkley and Cacioppo, 2010). Consequently, people who feel lonely may harbour negative expectations about social interaction, leading to social withdrawal behaviours (Bellucci, 2020).

In addition to a regulatory loop model of loneliness, an evolutionary theory of loneliness (Cacioppo and Cacioppo, 2018) and homeostatic regulation (Damasio and Carvalho, 2013) highlighted that loneliness originates from intricate social and biological processes. These theories suggest that loneliness evolved as a survival mechanism, primarily to incentivize individuals to seek social connections with others, thereby maintaining homeostasis (Cacioppo and Cacioppo, 2018; Damasio and Carvalho, 2013; Holt-Lunstad et al., 2015). In this respect, the desire to alleviate loneliness can be seen as part of the general human desire to escape suffering (Rokach, 1990; Stein and Tuval-Mashiach, 2015). The Default Mode Network has been involved in loneliness, processing social information, simulating social interactions, self-referential thinking (Lam et al., 2021; Spreng et al., 2020; Wen et al., 2020), and in unintentional and intentional task-unrelated thoughts, commonly referred to as "mind wandering" (Seli et al., 2018; Smallwood and Schooler, 2006).

Our minds wander for half of our waking time (Killingsworth and Gilbert, 2010). The frequency of mind wandering varies across Eastern and Western countries. People in Western countries tend to mind-wander between 30% and 50% of their waking time (Kane et al., 2007; Killingsworth and Gilbert, 2010), while people in Eastern countries spend an estimated 24.4% of their waking time on mind wandering (Song and Wang, 2012). One important aspect of mind wandering is whether it occurs spontaneously or deliberately (Carriere et al., 2013; Seli, Risko, and Smilek, 2016). We may find our thoughts wandering spontaneously, known as "spontaneous mind wandering" (Seli et al., 2015), or we may allow our thoughts to wander on purpose, known as "deliberate mind wandering" (Robison and Unsworth, 2018; Seli et al., 2016). Both types of mind wandering were associated with an increased propensity to observe and/or attend to one's perceptions, thoughts, and feelings (Seli et al., 2015). However, spontaneous mind wandering is uniquely associated with being more reactive to one's inner experiences, while deliberate mind wandering is uniquely associated with being less reactive to one's inner experiences (i.e., non-reactivity to inner experience) (Seli et al., 2015). One enduring puzzle concerning this common phenomenon of everyday thought is how both types of mind wandering (spontaneous versus deliberate) relate to loneliness.

Killingsworth and Gilbert discovered that "a wandering mind is an unhappy mind" (Killingsworth and Gilbert, 2010), as they found that mind wandering was most prominently associated with negative thoughts and feelings. The ability to think about what is not occurring is a cognitive achievement that comes at an emotional cost (Killingsworth and Gilbert, 2010). While the association of mind wandering to aversive thoughts and feelings has been well-documented (Killingsworth and Gilbert, 2010), the negative content of mind wandering thought has remained less clear. Interestingly, 70% of our mind wandering episodes are about people (Mar et al., 2012; Song and Wang, 2012), reflecting our minds wandering to social thoughts by default (Meyer, 2019).

Two theoretical frameworks suggest potential associations between mind wandering and loneliness. According to Escape Theory, people may employ mind wandering as a coping strategy, seeking an escape from feelings of loneliness (Badcock et al., 2022). Mind wandering may provide a mental escape into imagined scenarios or pleasant thoughts (Badcock et al., 2022). However, mind wandering may also deepen feelings of loneliness. Excessive rumination or repetitive negative thoughts during mind wandering can exacerbate feelings of loneliness (Hager et al., 2022; Thamboo, 2016; Yun et al., 2023). The Social Monitoring Hypothesis suggests that people continuously monitor their social environment (Floyd et al., 2020; Pickett and Gardner, 2013). Loneliness may intensify this social monitoring, resulting in increased self-focus and mind wandering as individuals contemplate their social relationships in an attempt to cope with unmet social needs (Floyd et al., 2020; Pickett and Gardner, 2013). This negative cycle may further increase social monitoring and self-focus, perpetuating feelings of loneliness. Research is needed to empirically test these theoretical frameworks and elucidate the relationship between mind wandering and loneliness.

In light of these dynamics, we raise the question of whether loneliness is accompanied by the occurrence of mind wandering. Our study aims to estimate how many adults in China and Germany experience feelings of loneliness and explore its relationship with both spontaneous and deliberate mind wandering. Building on previous research from both countries in 2020 (Bao et al., 2021; Berger et al., 2021), we expect to find a higher percentage of adults reporting loneliness in Germany compared to China. Moreover, based on these prior findings (Mar et al., 2012; Meyer, 2019; Song and Wang, 2012), we hypothesize that negative thoughts and feelings during mind wandering about people may reflect or express feelings of loneliness. In other words, we may spend time feeling left out and isolated from others, dwelling on times that have made us unhappy being so withdrawn and comparing what we have now with or what we might desire to have. Specifically, we hypothesize that both spontaneous and deliberate mind wandering will be associated with feelings of loneliness, even after controlling for sociodemographic variables, self-esteem, self-efficacy, and mental health status. Prior studies have revealed that self-esteem, self-efficacy, and mental health status were associated with feelings of loneliness (Barjaková et al., 2023; Buecker et al., 2023; Dahlberg et al., 2022; Hutten et al., 2022). Therefore, we will account for these confounding variables in our analysis.

Methods

Respondents and procedure

We used a cross-sectional study design, employing a convenience sampling approach. The study involved conducting an anonymous online survey using the Wenjuanxing platform (https://www.wjx.cn) in China and the Unipark platform (https://www.unipark.com/en/) in Germany from December 2021 to February 2022. Respondents aged 18 years and older were voluntarily recruited through various advertising channels such as websites, social media platforms and Prolific (https://www.prolific.co). The study was approved by the Ethics Committees at Charité – Universitätsmedizin Berlin (ethics approval number: EA2/143/20), at Freie Universität Berlin (ethics approval number: 030/2022), and at Shanghai Mental Health Center (ethics approval number: 2021ky-15). The study was performed in accordance with the Declaration of Helsinki (World Medical Association, 2013). Prior to participating, all respondents were required to review and agree to an online informed consent by clicking "I agree".

Sample size considerations

As the population in China and Germany is large, we calculated sample size of 1067 per country which gives a margin of error of 3% (i.e., the amount of random sampling error in the results of a survey) at 95% confidence (Conroy, 2021). Considering a 10% dropout rate (Hoerger, 2010), 1174 participants per country were set as the target sample size.

Measurement

The survey consisted of a sociodemographic assessment (i.e., sex, age, years of education, and marital status) and validated items measuring spontaneous and deliberate mind wandering, self-esteem, self-efficacy, mental health status, and loneliness. Marital status has been divided into five categories (single, in a relationship, married/civil partnership, separated/divorced/dissolution, and widowed), which were coded from 1 to 5 respectively. Spontaneous and deliberate mind wandering were measured via the 4-item Mind Wandering Spontaneous (MW-S) and 4-item Mind Wandering Deliberate (MW-D) self-report scales (Cronbach's alpha: MW-*S*= 0.83; MW-*D*= 0.84) (Carriere et al., 2013) in validated Chinese (Cronbach's alpha: MW-*S*= 0.81; MW-*D*= 0.82) (Carciofo and Jiang, 2021) and German versions Cronbach's alpha: MW-*S*= 0.73; MW-*D*= 0.81) (Martarelli et al., 2021). The 4-item MW-S and 4-item MW-D were scored using a 7-point Likert scale. Each item was scored from 1 to 7 and the total scores ranged from 4 to 28. A respective higher score reflected a greater tendency to sontaneously or deliberately engage in mind wandering in everyday life.

Self-esteem was assessed by the 10-item Rosenberg Self-Esteem Scale (RSE) (Cronbach's alpha = 0.77) (Rosenberg, 1965) in the validated Chinese (Cronbach's alpha = 0.77) (Cheng and Hamid, 1995) and German versions (Cronbach's alpha = 0.81) (Ferring and Filipp, 1996). Each item was answered on a 4-point Likert scale with total scores ranged from 10 to 40. Higher scores indicated higher self-esteem.

Self-efficacy was measured by the 10-item General Self-efficacy Scale (GSES) (Cronbach's alpha = 0.90) (Schwarzer and Jerusalem, 1995) in the validated Chinese (Cronbach's alpha = 0.91) (Zhang and Schwarzer, 1995) and German versions (Cronbach's alpha = 0.85) (Schwarzer and Jerusalem, 1999). Each item was answered on a 4-point Likert scale with total scores ranged from 10 to 40. Higher scores indicated higher general self-efficacy.

Mental health status was measured by the 12-Item General Health Questionnaire (GHQ-12) (Cronbach's alpha = 0.82) (Banks et al., 1980; Goldberg et al., 1997) in the validated Chinese (Cronbach's alpha = 0.79) (Yang et al., 2003) and German versions (Cronbach's alpha = 0.91) (Schrnitz et al., 1999; Simone, 2002). Each item was answered on a 4-point Likert scale with total scores ranged from 0 to 36. Higher score indicated poorer mental health.

Loneliness was evaluated by the short 8-item UCLA Loneliness Scale (ULS-8) (Cronbach's alpha = 0.84) (Hays and DiMatteo, 1987) in the validated Chinese (Cronbach's alpha = 0.82) (Xu et al., 2018; Zhou et al., 2012) and German (Cronbach's alpha = 0.89) versions (Döring and Bortz, 1993; Liu et al., 2021a). Each item was answered on a 4-point Likert scale with total scores ranging from 8 to 32. Higher scores indicated higher levels of loneliness, and a cut-off score of 16 was used to measure some degree of loneliness (Liu et al., 2021a). A total score below 16 indicated "never" or "rarely" feeling lonely, between 16 and 23 indicated "sometimes" feeling lonely, and above 24 indicated "always" feeling lonely.

In the current study, all validated Chinese and German scales demonstrate strong reliability (Kline, 2013): The MW-S in both languages yielded high Cronbach's alpha values: 0.88 for Chinese and 0.87 for German. Similarly, the MW-D exhibited strong reliability in both languages, with Cronbach's alpha values of 0.82 for Chinese and 0.85 for German. Additionally, the RSE scale showed robust reliability in both Chinese (Cronbach's alpha = 0.89) and German (Cronbach's alpha = 0.93) versions. Similarly, the GSES scale displayed high reliability in both Chinese (Cronbach's alpha = 0.93) and German (Cronbach's alpha = 0.90) versions. Moreover, the GHQ scale demonstrated strong reliability in both languages, with Cronbach's alpha values of 0.87 for Chinese and 0.88 for German. Lastly, the ULS-8 scale showed good reliability in both Chinese (Cronbach's alpha = 0.79) and German (Cronbach's alpha = 0.86).

Data analysis

We performed data analysis in R version 4.1.0 using R Studio (http://www.rstudio.com/). The rate of loneliness among general populations in China and Germany was calculated by a total score on the ULS-8 with 16 or above. To test the effects of spontaneous and deliberate mind wandering on loneliness, we built up a multiple linear regression model. In this model, we included ULS-8 score as the outcome and used the predictor variables MW-S score, MW-D score, country (China versus Germany; effect coding: −0.5 vs. +0.5), as well as the interactions effects of MW-S score × country and MW-D score × country, additionally controlling for sociodemographic variables including sex (males versus females; effect coding: −0.5 vs. +0.5), age (continuous variable), years of education (continuous variable), and marital status (five categories, which were coded from 1 to 5), and the potential confounding variables including RSE score, GSES score, GHQ score, well as the interactions effects of RSE score × country, GSES score × country, and GHQ score × country. All 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. Statistical significance was defined as $p < 0.05$, and highly significant as $p < 0.001$.

Results

Group description

1123 respondents in China (700 females; age range: 18–78, Mean = 28.8, SD = 11.54) and 1018 respondents in Germany (514 females; age range: 18–80, Mean = 28.7, SD = 9.07) participated in our survey from December 2021 to February 2022. By comparing social-demographic variables, we found that there were no significant differences in age and years of education between samples in China and in Germany (all *p-values* > 0.19) except for a significant difference in "sex" (χ^2 =27.67, $p <$ 0.001), as shown in Table 1. Moreover, we found that respondents in Germany reported higher levels of both spontaneous ($t(2139) = -10.92$, $p < 0.001$) and deliberate ($t(2139) = -8.01$, $p < 0.001$) mind wandering as well as poorer mental health ($t(2139) = -12.66$, $p < 0.001$) as

Table 1
Respondents' sociodemographic variables and group comparisons.

	China (*N*= 1123)	Germany (*N*= 1018)	*p*
Female (%)	700 (62.3%)	514 (50.9%)	< 0.001
Mean Age (SD)	28.8 (11.54)	28.7 (9.07)	0.842
Education years (SD)	15.8 (3.03)	16.0 (3.36)	0.373
Marital status			
Single (%)	566 (50.4%)	539 (53.0%)	
In a relationship (%)	198 (17.6%)	322 (31.6%)	
Married/civil partnership (%)	335 (29.8%)	143 (14.0%)	
Separated/divorced/dissolution (%)	19 (1.7%)	14 (1.4%)	
Widowed (%)	5 (0.5%)	0 (0.0%)	
Mean MW-S (SD)	13.7 (5.21)	16.3 (5.48)	< 0.001
Mean MW-D (SD)	15.1 (4.85)	16.8 (4.94)	< 0.001
Mean RSE (SD)	30.2 (4.80)	28.7 (6.87)	< 0.001
Mean GSES (SD)	29.3 (4.99)	27.8 (5.27)	< 0.001
Mean GHQ (SD)	11.3 (4.81)	14.3 (6.22)	<0.001
ULS			
Mean ULS (SD)	15.7 (4.25)	16.1 (4.78)	0.051
ULS score≥16 (%)	559 (49.8%)	504 (49.5%)	0.936
ULS score 16–23 (%)	516 (46.0%)	428 (42.0%)	0.076
ULS score≥24 (%)	43 (3.8%)	76 (7.5%)	< 0.001

Note: MW-S: 4-item Mind Wandering Spontaneous. MW-D: 4-item Mind Wandering Deliberate. RSE: 10-item Rosenberg Self-Esteem Scale. GSES: 10-item General Self-efficacy Scale. GHQ: 12-item General Health Questionnaire. ULS-8: Short 8-item UCLA Loneliness Scale (ULS-8). SD: Standard Deviation.

compared to those in China. On the contrary, respondents in China reported higher self-esteem ($t(2139) = 5.80$, $p < 0.001$) and self-efficacy scores ($t(2139) = 6.72$, $p < 0.001$) as compared to those in Germany. Overall, there was no significant difference in self-reported loneliness score between respondents in China and in Germany, $t(2139) = -1.95$, $p = 0.051$. Interestingly, there were similar percentage of respondents who felt lonely in both countries: 49.8% of respondents in China and 49.5% in Germany reported feeling lonely varying from "sometimes" (46% in China vs. 42 % in Germany, $\chi^2 = 3.15$, $p = 0.076$) to "always" (3.8% in China vs. 7.5% in Germany, $\chi^2 = 12.78$, $p < 0.001$).

Regression results

We found that loneliness was significantly explained by a range of predictor variables in our regression model. Loneliness was associated with lower self-esteem ($\beta = -0.31$, $p < 0.001$), with lower self-efficacy ($\beta = -0.05$, $p = 0.023$), and with poorer mental health ($\beta = 0.18$, $p < 0.001$), as shown in Table 2. The influences of self-esteem, self-efficacy, and mental health status on loneliness differed between countries: we found that the effect of self-esteem on loneliness was stronger in China than in Germany ($\beta = 0.11$, $p = 0.009$), the effect of self-efficacy on loneliness was stronger in Germany than in China ($\beta = -0.13$, $p = 0.002$), and the effect of mental health status on loneliness was stronger in China than in Germany ($\beta = -0.12$, $p = 0.001$), as shown in Fig. 1.

Crucially, after controlling for influences of self-esteem, self-efficacy, and mental health status, we found that high spontaneous mind wandering ($\beta = 0.04$, $p = 0.005$) and high deliberate mind wandering ($\beta = 0.05$, $p = 0.009$) both were associated with higher loneliness scores. These effects were stable and of similar magnitude in both countries (no significant differences in interaction effects of country × spontaneous mind wandering, $\beta = -0.002$, $p = 0.967$, and country × deliberate mind wandering, $\beta = -0.05$, $p = 0.165$). Importantly, these effects were present after controlling for sociodemographic differences (i.e., sex, age, years of education, and marital status, all *p-values* < 0.021, except for years of education, $p = 0.529$). There were no significant associations among the predictor variables (all variance inflation factor (VIF) values < 2.42).

Table 2
Multiple linear regression model explaining loneliness scores.

Variables	*β*	*Standard Error*	*t value*	*p*
Intercept	16.05	0.08	197.17	< 0.001***
MW-S score	0.04	0.02	1.99	0.047*
MW-D score	0.05	0.02	2.62	0.009**
RSE score	−0.31	0.02	−15.19	< 0.001***
GSES score	−0.05	0.02	−2.28	0.023*
GHQ score	0.18	0.02	9.79	< 0.001***
Country (China vs. Germany)	−1.04	0.17	−6.32	< 0.001***
MW-S score × country	−0.002	0.04	−0.04	0.966
MW-D score × country	−0.05	0.04	−1.39	0.165
RSE score × country	0.11	0.04	2.63	0.009**
GSES score × country	−0.13	0.04	−3.04	0.002**
GHQ score × country	−0.12	0.04	−3.40	< 0.001***
Sex (Males vs. Females)	−0.49	0.16	−3.08	0.002**
Age	0.06	0.01	6.04	< 0.001***
Education years	0.02	0.03	0.63	0.53
Marital status	−0.69	0.12	−5.84	< 0.001***

RSE: 10-item Rosenberg Self-Esteem Scale. GSES: 10-item General Self-efficacy Scale.
MW-S: 4-item Mind Wandering Spontaneous. MW-D: 4-item Mind Wandering Deliberate.
β: unstandardized regression coefficients.
***, $p < 0.001$; **, $p < 0.01$; *, $p < 0.05$.

Discussion

Does a wandering mind reflect a lonely mind? To uncover myths about loneliness across cultures, we conducted a cross-sectional study in China and in Germany. We investigated the proportion of adults who felt lonely and explored if mind wandering correlated with feelings of loneliness. Contrary to our expectations, we found that similar proportions of respondents in both countries (49.8% in China and 49.5% in Germany) experienced feelings of loneliness. In line with our expectations, both high spontaneous and deliberate mind wandering was associated with high loneliness scores in both countries after controlling for sociodemographic variables, self-esteem, self-efficacy, and mental health status.

Our findings indicate that approximately half of the respondents in both China and Germany have reported feeling lonely sometimes or always. Furthermore, no significant differences in loneliness rates between China and Germany in 2022 were observed, suggesting that loneliness is a common experience across both eastern and western cultures (Jeste et al., 2020).

We provided the first evidence that high spontaneous and high deliberate mind wandering were associated with high levels of loneliness in both countries, even after controlling for factors such as low self-esteem, low self-efficacy, and poor mental health, which are well-established contributors to loneliness. Previous studies have shown that low self-esteem, self-efficacy, and worsening mental health status are associated with high levels of loneliness (Barjaková et al., 2023; Hutten et al., 2022). In addition, we identified between-country differences, with the effect of self-esteem and mental health status on loneliness being stronger in China than in Germany, while the effect of self-efficacy on loneliness was stronger in Germany than in China. Such differences may arise from the influence of cultural variations in self-concept on loneliness (Rokach, 2018). Self-esteem involves personal judgments of self-worth, while self-efficacy focuses on judgments of personal capability, often within a particular domain (Bandura, 1997; Klassen, 2004; Rosenberg, 1965). In Asian cultures, people attribute

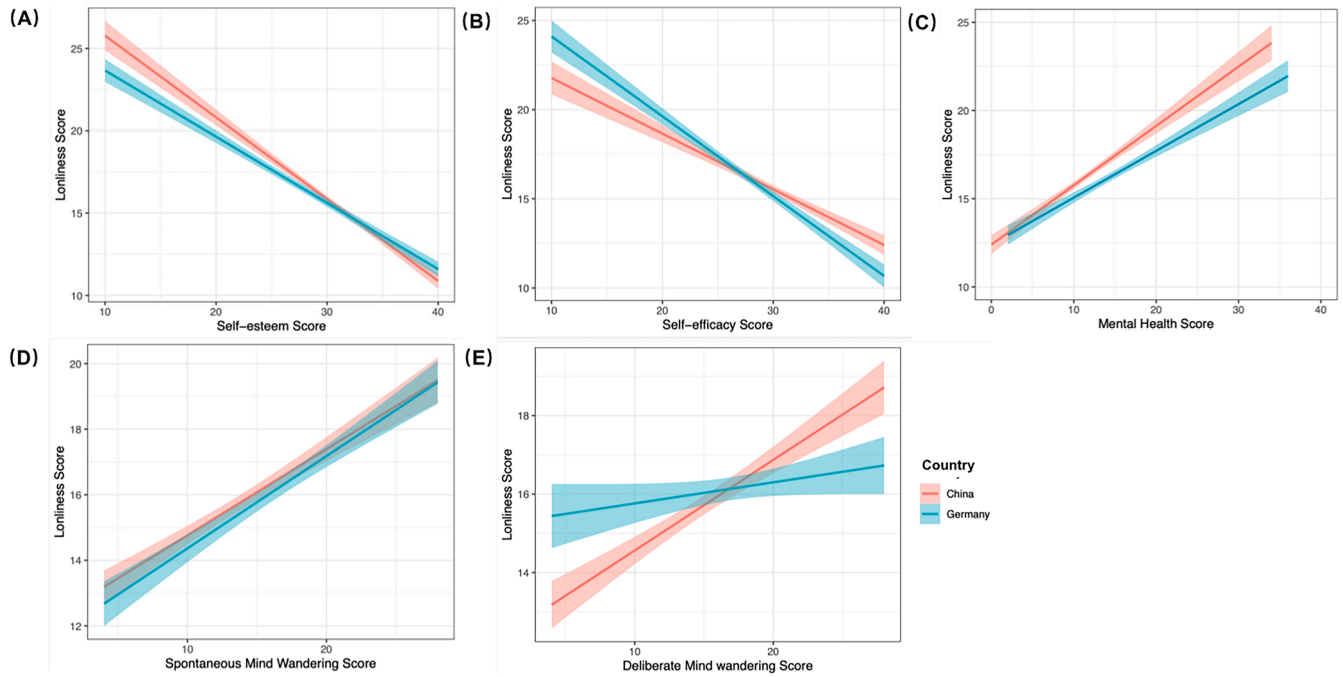

Fig. 1. The effect of self-esteem, self-efficacy, spontaneous and deliberate mind wandering on loneliness in China and in Germany. The loneliness (ULS-8) score is displayed as a function of the (A) self-esteem, (B) self-efficacy, (C) mental health status, (D) spontaneous and (E) deliberate mind wandering score, capturing loneliness among adults, in China (N= 1123; red) versus in Germany (N= 1018; blue).

their loneliness to themselves and their perceived incapability to establish desired social connections (Rokach, 2018). In Western cultures, people often hold strong beliefs in their capabilities and attribute their loneliness to others in their pursuit of desired relationships (Rokach, 2018; Yum, 2003). Prior research has indicated lower self-esteem and self-efficacy scores among Asians in comparison to Western populations (Klassen, 2004). This difference was attributed to a "modesty bias" among Asians, characterized by a negative perception of self-enhancement, as well as a preference for collective functioning rather than an emphasis on "self-focusing" (Kağıtçıbaşı, 1997). However, our study showed that respondents in China reported higher self-esteem and self-efficacy scores compared to those in Germany, suggesting the universal and culture-specific features of global self-concept (Marsh et al., 2020; Schmitt and Allik, 2005). Overall, our findings, along with previous studies, highlight the cross-cultural consistency of the association between low self-esteem, self-efficacy, and high levels of loneliness, while also acknowledging the cultural variations in these constructs. Future studies may investigate how cultural context may change self-concept and loneliness over time (Haas and vanDellen, 2020).

Beyond these well-known risk factors for loneliness, our study added value by discovering that a wandering mind reflects a lonely mind in both China and Germany. In line with Escape Theory (Badcock et al., 2022) and the Social Monitoring Hypothesis (Floyd et al., 2020; Pickett and Gardner, 2013), people may engage in mind wandering as a means of diverting attention from feelings of loneliness and managing unfulfilled social desires. It also reflects that we often desire to have social contacts with other people when our minds wander (Mar et al., 2012; Song and Wang, 2012). Further research could delve into whether lonely individuals engage in more frequent instances of mind wandering because they are contemplating ways to increase their social contacts.

As loneliness is recognized as a mental health concern, exploring mind-wandering, a member of the family of spontaneous-thought phenomena, can provide insights into negative mood and mental disorders characterized by changes in spontaneous thought, such as depression, anxiety, and attention deficit hyperactivity disorder (Christoff et al., 2016; Smallwood et al., 2009).

Implications

Understanding the association between mind wandering and loneliness could hold profound implications for potential interventions designed to alleviate loneliness (Veronese et al., 2021). For example, employing relaxation techniques, such as deep breathing, meditation, mindfulness, and yoga, may foster individuals' awareness of their moment-to-moment thought patterns and feelings (Teoh et al., 2021). This heightened awareness can reduce the tendency to wander off into negative or lonely thoughts or redirecting their attention away from such negativity (Besse et al., 2022; Teoh et al., 2021). Moreover, if mind wandering indeed reflects (partially unsuccessful) attempts to alleviate loneliness, it raises the possibility that training programs designed to enhance social skills could be valuable in improving individuals' social strategies. Digital platforms can be powerful instruments to deliver relaxation techniques, cognitive reappraisal exercises, and social programs to individuals struggling with loneliness triggered by mind wandering (Harley, 2022; Shah et al., 2021). Understanding how sociodemographic variables intersect with mind wandering and loneliness can help identify vulnerable populations and tailor interventions to meet the diverse needs of individuals and communities in the contemporary global context (Yang, 2023). Insight into sociodemographic disparities and their interaction with mind wandering can guide the development of gender-sensitive, age-sensitive, and culturally sensitive interventions to tackle loneliness across diverse populations.

Limitations

The observed results need to be interpreted with caution. We collected our data conveniently by recruiting adults who had access to the Internet. Thereby, the representativeness is limited in our study populations (e.g., people of 28.8 $\pm$ 10.4 years old). To reduce sampling bias, we took two independent samples: one in China and another in Germany. Respondents were from China's 34 provincial divisions and Germany's 16 federal states. Making an accurate estimate of the prevalence of loneliness is changeling due to variations across all stages of the life course, sex and age differences, and the use of different scales of

measurement (Leigh-Hunt et al., 2017). However, we expect our sample to be diverse and heterogenous that may add additional value to a sample of university students (Narita et al., 2022). In our sample, except for students, participants worked in various fields, such as office administration, healthcare, education, civil service, sales, agriculture, arts, sports and media. Moreover, our findings regarding the association between mind wandering and loneliness remained consistent across two culturally distinct countries, China and Germany. This suggests that our results may generalize well across countries. However, it is important to note that the observed results may be influenced by other potential confounding variables. Taking social media use as an example, studies have indicated a relationship between use of popular social media platforms and feelings of loneliness (O'Day and Heimberg, 2021; Pittman and Reich, 2016). Future studies may delve deeper into exploring other potential confounding variables.

Conclusion

Our correlational findings may be of interest to longitudinal studies examining the causal nature of associations between mind wandering and loneliness in diverse social and cultural contexts. Such studies are vital, given the well-documented long-term detrimental impacts of loneliness on health (Haucke et al., 2022; Hawkley and Cacioppo, 2010). Moreover, our study illuminates a pathway for further research into why and how mind wandering might contribute to feelings of loneliness — or vice versa, why and how feelings of loneliness might lead to increased mind wandering. Future studies should also delve deep into understanding loneliness across cultures.

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Consent for publication

Not applicable.

CRediT authorship contribution statement

Shuyan Liu: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Supervision, Funding acquisition. **Min Zhao:** Methodology, Investigation, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Ruihua Li:** Methodology, Investigation, Data curation, Writing – review & editing. **Chuanning Huang:** Methodology, Investigation, Data curation, Writing – review & editing. **Jiang Du:** Methodology, Investigation, Writing – review & editing. **Daniel J. Schad:** Methodology, Investigation, Writing – review & editing, Supervision. **Stephan Heinzel:** Methodology, Formal analysis, Investigation, Data curation, Writing – review & editing, Supervision, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data and study materials are available from the corresponding authors on reasonable request.

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