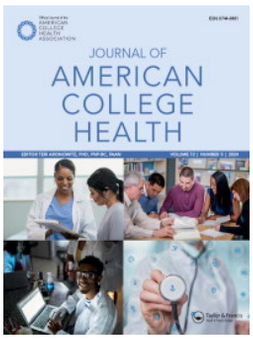

Journal of American College Health

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/vach20

College students' daily mind wandering is related to lower social well-being

Polina Beloborodova, Janine M. Dutcher, Daniella K. Villalba, Michael J. Tumminia, Afsaneh Doryab, Kasey Creswell, Sheldon Cohen, Yasaman Sefidgar, Woosuk Seo, Jennifer Mankoff, Anind K. Dey, J. David Creswell & Kirk Warren Brown

To cite this article: Polina Beloborodova, Janine M. Dutcher, Daniella K. Villalba, Michael J. Tumminia, Afsaneh Doryab, Kasey Creswell, Sheldon Cohen, Yasaman Sefidgar, Woosuk Seo, Jennifer Mankoff, Anind K. Dey, J. David Creswell & Kirk Warren Brown (29 May 2024): College students' daily mind wandering is related to lower social well-being, Journal of American College Health, DOI: 10.1080/07448481.2024.2351417

To link to this article: https://doi.org/10.1080/07448481.2024.2351417

JOURNAL OF AMERICAN COLLEGE HEALTH
https://doi.org/10.1080/07448481.2024.2351417

Routledge
Taylor & Francis Group

RESEARCH ARTICLE

College students' daily mind wandering is related to lower social well-being

Polina Beloborodova, PhD[a], Janine M. Dutcher, PhD[b], Daniella K. Villalba, PhD[b], Michael J. Tumminia, PhD[c], Afsaneh Doryab, PhD[d], Kasey Creswell, PhD[b], Sheldon Cohen, PhD[b], Yasaman Sefidgar, PhD[e], Woosuk Seo, PhD[f], Jennifer Mankoff, PhD[g], Anind K. Dey, PhD[h], J. David Creswell, PhD[b] and Kirk Warren Brown, PhD[a,b]

[a]Psychology Department, Virginia Commonwealth University, Richmond, Virginia, USA; [b]Psychology Department, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA; [c]Psychology in Education Department, University of Pittsburgh, Pittsburgh, Pennsylvania, USA; [d]School of Engineering and Applied Science, University of Virginia, Charlottesville, Virginia, USA; [e]Department of Electrical & Computer Engineering, University of Washington, Seattle, Washington, USA; [f]School of Information, University of Michigan, Ann Arbor, Michigan, USA; [g]Paul G. Allen School of Computer Science and Engineering, University of Washington, Seattle, Washington, USA; [h]Information School, University of Washington, Seattle, Washington, USA

ABSTRACT

Objective: This study sought to examine how daily mind wandering is related to loneliness, felt connection to others, and school belonging among college students. **Participants:** Three samples ($n=209$, $n=173$, and $n=266$) from two US campuses were recruited. **Methods:** Data were collected *via* ecological momentary assessment over the course of two academic quarters in one sample and an academic semester in two samples. **Results:** Social well-being declined throughout the academic term in all samples. Lower day-to-day mind wandering predicted lower loneliness at the next time point and was concurrently related to a higher felt connection to others and higher school belonging. Thoughts about the past and future were associated with lower social well-being than present-focused thoughts. **Conclusions:** This study supports the proposition that promoting present-centered attention can benefit college students' social well-being and alleviate their feelings of loneliness and isolation that they often experience.

ARTICLE HISTORY
Received 6 January 2023
Revised 18 January 2024
Accepted 28 April 2024

KEYWORDS
Ecological momentary assessment; loneliness; mind wandering; social connection; social well-being

Social connection, reflected in subjective perceptions of belonging and closeness to others, is key for both psychological and physical health.[1] It is considered a fundamental psychological need,[1,2] the absence of which contributes to ill-being and pathology.[3] College students are a group particularly vulnerable to social isolation and loneliness.[4] Moreover, college students' rates of social disconnection appear to be increasing: In 1987, 38% of freshmen students reported socializing with friends more than 16 h a week,[5] whereas in 2019 this figure dropped to 18.6%.[6]

Social disconnection and loneliness are often observed in the first days and weeks of college as first-year students transition from home and high school to college life.[7] For many, this feeling may be transient. However, research has also suggested that social well-being declines over the course of academic terms. In a sample of first year students, loneliness at the end of the term was significantly higher than at the beginning.[8] A straightforward explanation for the decline in social well-being is the increase in study load, leading to a reduction in available time for socializing. Indeed, Wang et al's[9] analysis of passive smartphone sensing data collected continuously over several months found that students started the term with a high frequency and duration of conversations, both of which decreased until the end of the final examination period. However, the decrease in social well-being may become self-perpetuating as feelings of disconnection lead to further social isolation, in turn leading to more disconnection, and so forth in a downward spiral.[10]

The nature of social connection and its consequences have been studied through its presence, as well as its absence, as loneliness. Like social connection, loneliness is not synonymous with objective social isolation, or quantity of social relationships but rather is more strongly influenced by the perceived relationship quality.[1,11] Particularly when chronic, it has been associated with a range of negative outcomes, including compromised cognition and motivation, depression, and weakened immune functioning,[12] and it can be as detrimental to physical health as obesity or smoking.[13] A lack of the sense of belonging, another aspect of social well-being distinct from loneliness and felt connection,[14] also has implications for both psychological and physical health across the life span[15] and has predicted higher depressive symptoms among college students.[16]

Theory and emerging research suggest that mind wandering and its purported opposite, presence of mind,[17] may be as important to social well-being as they are to mental and physical health. Mind wandering is a normal aspect of the human condition related to default mode network activation in the brain.[18] It is a ubiquitous state that research indicates is present

CONTACT Polina Beloborodova beloborodp@vcu.edu Psychology Department, Virginia Commonwealth University, 806 West Franklin Street, Box 842018, Richmond, VA 23284-2018, USA
Supplemental data for this article is available online at https://doi.org/10.1080/07448481.2024.2351417

in 25–50% of our waking hours.[19,20] However, a growing body of laboratory and field research has demonstrated that excessive mind wandering is associated with markers of psychological and physical ill-being, including poorer emotional well-being,[20] lower life satisfaction,[21] and molecular changes indicative of cellular aging.[22] Mind wandering is a common response to stress and negative mood[18] that can be prevalent among college students, especially during high pressure examination periods. Characterized as a state of decoupled attention, mind wandering interferes with the encoding of information and impairs academic performance.[23] Recent research indicates that mind wandering is a heterogeneous phenomenon,[18] and thoughts of the past are more strongly related to poorer psychological well-being than thoughts about the future.[24] Past-focused thinking often takes the form of rumination, a maladaptive form of coping that involves repetitively and passively focusing on self-related negative feelings and thoughts[25] that exacerbates and perpetuates negative affect.[26]

The opposite of mind wandering could be called the presence of mind,[17,22] wherein attention and thought are engaged with here-and-now activities and experiences. This has been most commonly studied *via* the larger, multidimensional construct of mindfulness, defined clinically as a state of receptive or non-judgmental, sustained attention to present-moment events and experiences.[27] Long theorized to be important to human flourishing,[28] considerable empirical research supports the role of mindfulness in mental and physical health and well-being.[29] There is, however, little research on the connection between attention to present-moment experience and social well-being.

Buddhists and other scholars have long proposed that present-centered attention helps support positive social interactions and relationships.[30,31] Several studies have found that mindfulness, assessed through self-report questionnaires as a stable disposition of attentiveness to present-moment experience, facilitates effective communication. Specifically, those with greater mindfulness better understand others' verbal content, vocal inflections, and non-verbal behavior;[32,33] attune to others' emotions and motivations;[34] and take interest in an interaction or relationship partner's thoughts, emotions, and welfare.[35] When directed to another in a social exchange, present-centered attention is thought to increase the likelihood of observing or discerning the other's wants and needs, permitting greater responsivity to them.[36] Oppositely, mind wandering may foster ineffective communication and result in decreased subjective social well-being.

Several experimental studies have examined the efficacy of mindfulness training for enhancing social functioning. Jones and Hansen[37] found that a mindfulness intervention fostered more supportive communication among college students. Brief mindfulness training has been shown to decrease loneliness and increase social contact relative to both active and passive control conditions.[38,39] A greater frequency of informal mindfulness meditation practice in daily life has been linked to increased perceived social integration and positive emotions.[40] Those results show that present-centered attention and the lack thereof (mind wandering) are related to social well-being. However, previous research is limited to correlational survey studies, laboratory experiments, and intervention studies that do not permit investigation of this connection as it may occur in daily life.

Present research

The first aim of this two-study series was to offer a more comprehensive outlook on college students' social well-being than in previous research. This was achieved by measuring three distinct aspects of social well-being: loneliness, connection to others, and school belonging. Unlike previous studies that collected data at one or two time points throughout an academic term, we used ecological momentary assessment (EMA), which allowed us to examine the lived, day-to-day experiences of students, without concerns about memory decay, which can bias self-report measures requiring significant retrospection. Our second aim was to extend the scope of prior studies on (in)attention to present-moment experiences and social well-being. Previous research has measured present-centered attention as a stable disposition that affects the outcomes of controlled laboratory experiments or as meditation practice in intervention studies. We sought to examine the connection between momentary lapses of attention to the present (mind wandering) and downstream changes in social well-being as they naturally occur in college students' daily lives. After receiving the necessary IRB approvals from the University of Washington Institutional Review Board (STUDY00003244, Study 1, Sample 1) and Carnegie Mellon University Institutional Review Board (STUDY2016_00000421, Study 1, Sample 2 and STUDY2017_00000380, Study 2), we recruited 1st and 2nd year college students in 2017 and 2018. In both studies, participants provided written informed consent during the initial laboratory visit.

We first anticipated that social well-being, measured as felt social connection, school belonging, and (the lack of) loneliness would decline over the course of an academic term. Second, we hypothesized that increased rates of mind wandering would exacerbate anticipated declines in social well-being over a term. That is, we expected that higher mind wandering would be concurrently related to, and predict higher levels of loneliness, lower felt connection to others, and a lower sense of school belonging. Finally, we examined whether the mind wandering into the past *vs.* the future would be associated with lower social well-being as measured by our three outcomes. We acknowledge that the relationship under study may be bi-directional, with greater social well-being predicting lower mind wandering later on, as shown by Croswell et al.[41] We made our analytic choice because improving social well-being may not always be feasible, especially during high stress periods, whereas reducing mind wandering by directing attention to the present moment is trainable and accessible, and thus has greater intervention potential.

Two studies were conducted based on previously collected datasets. The majority of the variables featured in the present study series were not included in previous studies based on these datasets and are presented for the first time. Study 1 was designed to examine the temporal, semester-long, or

quarter-long patterns of the three social well-being outcomes to determine whether anticipated declines were observable. To test the generalizability of the temporal patterns, two independent samples were collected, one on the West Coast of the USA during the Winter and Spring quarters of 2018 (sample 1) and the other on an East Coast college campus during the spring semester of 2017 (sample 2). The primary purpose of Study 2 was to test our hypotheses regarding mind wandering and social well-being using a third sample (Sample 3) collected from the same east coast university as Sample 2. In both studies, we controlled for baseline levels of loneliness, social support, and social/academic fit when examining both the temporal trends in day-to-day loneliness, connection, and school belonging and the incremental role of day-to-day mind wandering in predicting these outcomes. We also conducted sensitivity analyses to test the hypothesized relationships using a different measure of lapses in present-centered attention, controlling for the quantity and diversity of social interactions (see Supplemental Materials).

Transparency and openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. The data, analysis scripts, and materials are publicly available at Open Science Framework: https://osf.io/hq72x/. The study and analysis plan were not pre-registered.

Study 1

This study aimed to examine temporal patterns of social well-being, measured as lower loneliness and higher felt connection and school belonging during an academic term (one semester or two quarters). We controlled for weekly and daily changes in loneliness and connection in these analyses, as we expected that students would feel less lonely and more connected during less academically demanding periods (weekends and evenings) when they had more time to socialize.

Table 1. Demographic characteristics of research participants.

	Study 1, sample 1	Study 1, sample 2	Study 2
Sample size	209	173	266
Age (years)			
Min–max	18–23	18–20	18–23
M (*SD*)	18.41 (0.69)	18.15 (0.39)	18.62 (0.66)
Gender, % (*n*)			
Female	63.6 (133)	53.2 (100)	59.3 (156)
Male	35.4 (74)	38.3 (72)	40 (108)
Transgender female	0.5 (1)	–	–
Nonbinary	–	0.5 (1)	0.7 (2)
Not disclosed	0.5 (1)	–	–
Ethnicity, % (*n*)*			
East Asian	41.63 (87)	43.35 (75)	42.11 (112)
White	41.63 (87)	33.53 (58)	31.58 (84)
South Asian	15.31 (32)	16.76 (29)	17.29 (46)
Latinx	7.66 (16)	6.94 (12)	5.64 (15)
Black	4.31 (9)	4.62 (8)	7.52 (20)
Pacific Islander	2.87 (6)	1.73 (3)	0.38 (1)
Native American	1.91 (4)	0.58 (1)	0.38 (1)
Other	4.31 (9)	4.62 (8)	2.63 (7)

Note. *Selecting more than one ethnicity was possible.

Method

Participants

Samples. Sample 1 participants were students at a large public West Coast university operating on a quarter system ($n = 209$; demographic characteristics are shown in Table 1). Sample 2 was composed of students at a large private East Coast university operating on a semester system ($n = 173$). Participants in both samples were eligible if they were English-speaking first-year undergraduate students aged 18–25 years who owned a smartphone no older than iPhone 5 or Android 5. They were recruited through each Psychology Department's participant pools, posted flyers around campus, email blasts, and advertisements on students' social media groups.

Sample size justification. The sample sizes in the current study exceeded the Maas and Hox[42] recommendations of 100 level 2 units (participants) needed for unbiased estimates of the regression coefficients and standard errors at both levels of analysis in multilevel models. Additionally, we conducted simulation-based sensitivity power analyses using the *simr* R package[43] (version 1.0.5) to determine the smallest unstandardized effect sizes that the current design could detect. The results indicated that it permitted detection of the effect of day of study (the main predictor of interest) on loneliness as small as 0.008 scale points (93%, 95% CI = [86.11, 97.14]) in Sample 1 and 0.013 scale points (90%, 95% CI = [82.38, 95.10]) in Sample 2. Detectable effects on connection were −0.010 scale points (89%, 95% CI = [81.17, 94.38]) in sample 1 and −0.017 scale points (89%, 95% CI = [81.17, 94.38]) in Sample 2. The detectable effect on school belonging in Sample 2 was −0.040 scale points (92%, 95% CI = [84.84, 96.48]). Accumulated throughout the study period (from the beginning to the end of the academic term), those unstandardized effects translated to a relatively small change of <0.5 (out of 5) loneliness and connection scale points and <1 (out of 7) school belonging scale points. Thus, the proposed design can detect small effects.

Procedure

Sample 1. Data were collected *via* ecological momentary assessment (EMA) over the course of seven days at four time points over two quarters (a total of 24 weeks—12 per quarter): weeks 3, 7, 14, and 18. Each period of data collection started on Wednesdays and ended on Tuesdays. During each week, loneliness and connection to others were assessed four times per day (once in the morning, twice in the afternoon, and once in the evening), on a quasi-random schedule. The data were collected using

Qualtrics survey software (Provo, UT, USA). The links to the surveys were sent *via* text message. The participants had up to an hour to complete the surveys after receiving the link. Once this timeframe elapsed, the link expired, and any data not submitted during that period was marked as missing. Compliance with the EMA protocol was acceptable: the percentage of participants who replied to a given EMA survey prompt ranged from 53.11 to 89.47% ($M = 74.68\%$, $SD = 7.62\%$). Participants could earn up to $245, which was pro-rated according to the number of surveys they responded to. As additional compensation, they could keep the FitBit Flex 2 device that was given to them for other study purposes not reported here.

Sample 2. Except where noted, data were collected as in Sample 1. One exception was that data were collected at three time points during a single semester: weeks 1, 6, and 15. Loneliness and felt connection were assessed three times per day with the same items as in sample 1. School belonging was assessed once every evening. Compliance with the EMA protocol was good; the share of participants who replied to a given EMA survey prompt ranged from 71.68 to 89.60% ($M = 80.62\%$, $SD = 4.36\%$), except for one time point on the first day of the study when the completion rate was 13.87%. The participants were compensated up to $200 (pro-rated). As in Sample 1, they also received and were permitted to keep the FitBit Flex 2 device used for other study purposes not reported here.

Measures, baseline. Baseline loneliness, social support, and social/academic fit (Sample 2 only) were measured at the initial laboratory visit. Loneliness was evaluated with the *UCLA Loneliness Scale*,[44] a measure containing 20 items (example: "How often do you feel that you are no longer close to anyone?"; from 1 = *never* to 4 = *always*; sample Cronbach's alpha = .92). Social support was measured using the *Two-Way Social Support Scale*,[45] a 21-item measure (e.g., "There is someone I can talk to about the pressures in my life"; scale from 1 = *not at all* to 6 = *always*; alpha = .94). Social/academic fit was evaluated using the *Sense of Social and Academic Fit Scale*,[46] a measure containing 17 items (e.g., "I fit in well at [university name]"; scale from 1 = *strongly disagree* to 7 = *strongly agree*; alpha = .91).

Measures, EMA. At each EMA prompt, participants reported their mood states, including how *lonely* and *connected* they felt at that moment, using a 5-point scale (from 1 = *not at all* to 5 = *extremely*). *School belonging* (Sample 2 only) was assessed at the end of each day with a single item ("Today, I feel like I belong at [university name]"; scale from 1 = *strongly disagree* to 7 = *strongly agree*). For purposes not reported here, the EMA surveys also included questions on students' current activities, stress, coping strategies, health behaviors, and, in Sample 2 only, social experiences. The completion of each EMA survey took ~3–5 min.

Statistical analyses. Analyses were performed with restricted maximum likelihood (REML) multilevel models.[47] The *nlme* R package[48] (version 3.1-155) was used to estimate the two-level random coefficients models nesting EMA reports (level 1) within participants (level 2). Loneliness, felt connection, and school belonging (Sample 2 only) were separately regressed on weekly cyclicity, day of the study, and time of day in the loneliness and connection models (four time points in Sample 1 and three in Sample 2). Baseline levels of loneliness, social support, and social/academic fit were included in the Sample 2 models for loneliness, connection, and school belonging, respectively. Gender and ethnicity were included in all models. Further statistical analysis details are presented in the Supplemental Materials.

Results

Descriptive statistics

Sample-wide grand means and other descriptive statistics of loneliness, connection, and school belonging were calculated (see Table 2). To visually inspect the changes in EMA-measured loneliness, connection, and school belonging over time, we averaged these across all participants at each time point (EMA prompt). We then calculated the moving averages of each variable. A window of three EMA records was used to calculate moving averages, meaning that each observation was replaced with a mean of the previous, current, and next observations. This transformation reduced fluctuations in the data and "smoothed" each series to observe the temporal trends more clearly.

Figure 1 shows that in Sample 1, loneliness scores steadily increased from the beginning to the end of the two quarters. Additionally, loneliness scores appeared to decrease on the weekends (middle of each data collection week on the plot, since data were collected from Wednesday to the following Tuesday). The connection scores showed an opposite pattern. Figure 1 suggests a curvilinear trend in perceived social connection, with a general decline toward the end of the first quarter (just before the spring break after week 7) and recovery at the start of the second quarter. Figure 2 shows that in Sample 2, the connection showed a general downward trend over the semester, while loneliness scores demonstrated a general upward trend. The connection scores increased on weekends (middle of each data collection period on the plot) and decreased on weekdays. Loneliness showed no discernible weekly cyclicity. School belonging demonstrated the same patterns as social connection (see Supplemental Figure 1).

Table 2. Descriptive statistics and bivariate correlations of study 1 variables (sample 1 $n = 209$; sample 2 $n = 173$).

Variable	1	2	3	4	5	6	*M* (*SD*)	Min	Max
Baseline									
1. Loneliness	1	−.60***	−.58***	.36***	−.59***	−.50***	2.19 (0.48)	1.20	3.60
2. Social support	–	1	.46***	−.18*	.42***	.33***	4.76 (0.80)	2.11	6.00
3. Social/academic fit	–	–	1	−.21**	.39***	.61***	4.99 (0.82)	2.26	6.71
EMA-level									
4. Loneliness	–	–	–	1	−.24**	−.46***	1.67 (0.56)	1.00	3.89
5. Connection	–	–	–	−.41***	1	.48***	2.86 (0.69)	1.00	4.70
6. School belonging	–	–	–	–	–	1	5.01 (1.14)	1.11	7.00
M (*SD*)	–	–	–	1.65 (0.61)	2.87 (0.75)	–			
Min	–	–	–	1.00	1.20	–			
Max	–	–	–	3.96	4.86	–			

Note. M: mean; *SD*: standard deviation; sample 1 correlation coefficients are indicated in the lower triangle (only EMA-level loneliness and connection were measured), with descriptive statistics at the bottom; sample 2 correlation coefficients are indicated in the upper triangle, with descriptive statistics on the right; baseline loneliness was on a 1–4 scale, baseline social support was scored on a 1–6 scale, baseline social/academic fit was on a 1–7 scale; EMA-level loneliness and connection were scored on a 1–5 scale, EMA-level school belonging was on a 1–7 scale.

*$p < .001$.

**$p < .01$.

***$p < .05$.

Figure 1. Moving averages of loneliness and felt connection across two quarters, sample 1; gray areas indicate measurement periods; the plot is based on four measurements per day, seven days per week, four weeks in total.

Hypotheses testing

The results of the REML multilevel analyses are presented in Tables 3–5 for loneliness, connection, and school belonging, respectively. Table 3 shows that in both samples, loneliness increased linearly, as indicated by significant estimates for the day of the study variable. A significant negative day × day quadratic term indicated that the increase became less steep with time. Weekly cyclicity was also observed, with loneliness rising on weekdays and dropping on weekends in Sample 1.

The demographic variables did not significantly predict loneliness. Table 4 shows that in both samples, felt connection linearly decreased over the study period, as indicated by significant estimates for the day of the study variable. A significant day × day quadratic term was also present, supporting the earlier observation of a curvilinear trend in connection (c.f., Figures 1 and 2). Weekly cyclicity was observed, with connection rising on weekends relative to weekdays. Finally, felt connection increased from morning to evening, as indicated by a significant positive estimate for the time of day. In Sample 1, White participants tended to feel more connected compared to other ethnicities, whereas East Asian participants did not. Additionally, in Sample 2, female participants felt less connected than male participants. Table 5 shows that school belonging (Sample 2) followed the same pattern as the connection: an overall decrease over the study period, a quadratic day × day effect, and weekly cyclicity with increases on the weekends and decreases on weekdays. The demographic variables did not significantly predict school belonging. Baseline social well-being variables—loneliness, social support, and social/academic fit—significantly predicted state social well-being in their respective models.

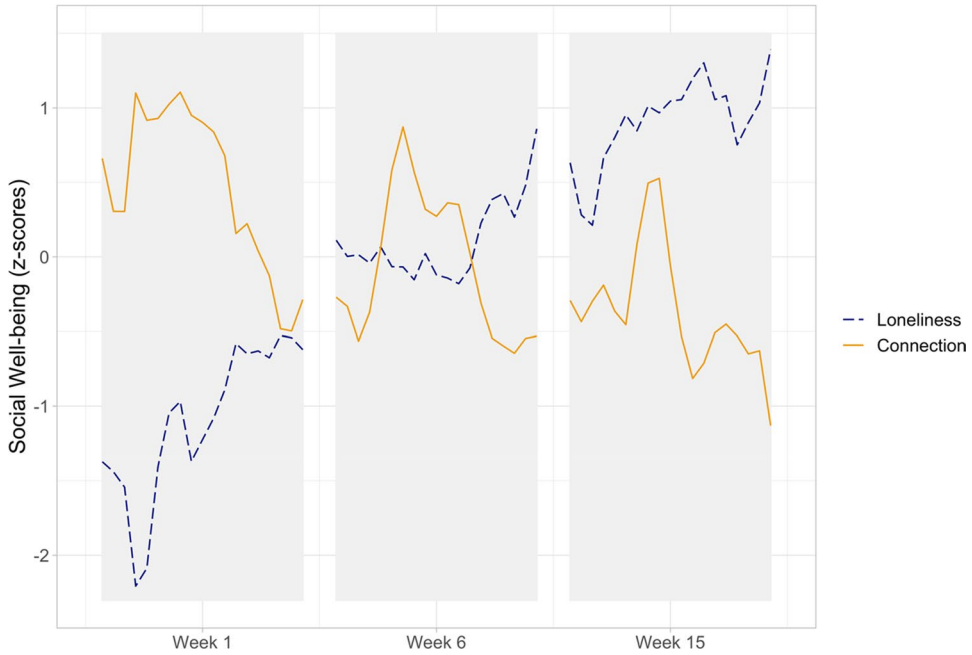

Figure 2. Moving averages of loneliness and felt connection across a semester, sample 2; gray areas indicate measurement periods; the plot is based on three measurements per day, seven days per week, three weeks in total.

Table 3. Multilevel model analyses of temporal patterns of loneliness (sample 1 and sample 2).

	Sample 1			Sample 2		
Predictors	Estimates (unstandardized)	95% CI	*p*	Estimates (unstandardized)	95% CI	*p*
(Intercept)	1.516	1.330, 1.702	<.001	1.437	1.262, 1.612	<.001
Day of study	0.016	0.009, 0.023	<.001	0.037	0.025, 0.049	<.001
Weekly cyclicity (cosine)	0.023	0.004, 0.042	.015	0.012	−0.014, 0.038	.370
Time of day	0.005	−0.002, 0.013	.126	0.006	−0.010, 0.021	.473
Day × day interaction	−0.0002	−0.0005, −0.00001	.043	−0.001	−0.0013, −0.0001	.017
Baseline loneliness	–	–	–	0.440	0.268, 0.612	<.001
Gender (female)	−0.080	−0.260, 0.101	.385	−0.054	−0.221, 0.114	.528
Ethnicity (White)	−0.061	−0.278, 0.156	.578	0.040	−0.175, 0.254	.715
Ethnicity (East Asian)	0.098	−0.116, 0.311	.369	−0.028	−0.242, 0.166	.710
Random effects						
σ^2	0.464			0.501		
$\tau_{00\ ID}$	0.356			0.263		
ICC	.434			.344		
N_{ID}	203			172		
Observations	17295			8613		
Marginal R^2/conditional R^2	.016/.443			.076/.394		

σ^2: level-1 variance after adjusting for predictors; $\tau_{00\ ID}$: variance in individual intercepts; ICC: intraclass correlation coefficient; N_{ID}: number of participants; marginal R^2: proportion of variance in the outcome explained by fixed effects only; conditional R^2: proportion of variance explained by fixed and random effects together.

Brief discussion

This study examined college students' patterns of social well-being using two independent samples, measured as loneliness, felt connection to others, and school belonging, each during one or two academic terms. We hypothesized that loneliness would increase, and connection would decrease over the study period. The results of the multilevel models showed support in both samples. Additionally, the temporal trends in school belonging were similar to those found in connection. Curvilinear trends were also present in all social well-being outcomes in both samples: the increase in loneliness and decrease in connection and school belonging became less steep over time. These results provide evidence for declines in first-year college students' social well-being and serve as a foundation upon which the influence of mind wandering and presence of mind can be examined.

Study 2

Having uncovered term-long trends in college students' social well-being in Study 1, the present study tested the hypothesis that higher levels of mind wandering over an academic term are related to lower social well-being. Specifically, we presupposed that mind wandering would be related to loneliness, connection, and belonging measured at the same (time t), and at the following assessment point ($t+1$). Additionally, we hypothesized that past-related

Table 4. Multilevel model analyses of temporal patterns of connection (sample 1 and sample 2).

	Sample 1			Sample 2		
Predictors	Estimates (unstandardized)	95% CI	*p*	Estimates (unstandardized)	95% CI	*p*
(Intercept)	2.582	2.361, 2.803	<.001	2.989	2.783, 3.194	<.001
Day of study	−0.024	−0.032, −0.016	<.001	−0.031	−0.045, −0.017	<.001
Weekly cyclicity (cosine)	−0.092	−0.115, −0.070	<.001	−0.069	−0.099, −0.040	<.001
Time of day	0.087	0.077, 0.097	<.001	0.150	0.130, 0.170	<.001
Day × day interaction	0.001	0.0006, 0.0011	<.001	0.001	0.0002, 0.0015	.016
Baseline social support	–	–	–	0.378	0.259, 0.497	<.001
Gender (female)	0.108	−0.106, 0.323	.321	−0.262	−0.460, −0.065	.010
Ethnicity (White)	0.530	0.272, 0.788	<.001	0.148	−0.099, 0.396	.238
Ethnicity (East Asian)	0.127	−0.128, 0.381	.327	0.066	−0.173, 0.305	.586
Random effects						
σ^2	0.730			0.741		
$\tau_{00\ ID}$	0.505			0.363		
ICC	.409			.329		
N_{ID}	203			172		
Observations	17320			8613		
Marginal R^2/conditional R^2	.050/.439			.107/.401		

σ^2: level-1 variance after adjusting for predictors; $\tau_{00\ ID}$: variance in individual intercepts; ICC: intraclass correlation coefficient; N_{ID}: number of participants; marginal R^2: proportion of variance in the outcome explained by fixed effects only; conditional R^2: proportion of variance explained by fixed and random effects together.

Table 5. Multilevel model analyses of temporal patterns of school belonging (sample 2).

Predictors	Estimates (unstandardized)	95% CI	*p*
(Intercept)	5.373	5.055, 5.690	<.001
Day of study	−0.056	−0.087, −0.026	<.001
Weekly cyclicity (cosine)	−0.077	−0.131, −0.024	.004
Day × day interaction	0.002	0.0002, 0.0030	.029
Baseline social/ academic fit	0.848	0.670, 1.026	<.001
Gender (female)	−0.088	−0.378, 0.202	.550
Ethnicity (White)	0.023	−0.355, 0.401	.905
Ethnicity (East Asian)	0.074	−0.280, 0.428	.680
Random effects			
σ^2	0.854		
$\tau_{00\ ID}$	0.727		
ICC	.460		
N_{ID}	170		
Observations	2760		
Marginal R^2/ conditional R^2	.242/.591		

σ^2: level-1 variance after adjusting for predictors; $\tau_{00\ ID}$: variance in individual intercepts; ICC: intraclass correlation coefficient; N_{ID}: number of participants; marginal R^2: proportion of variance in the outcome explained by fixed effects only; conditional R^2: proportion of variance explained by fixed and random effects together.

thoughts would be associated with lower social well-being than present and future-focused thoughts, as past research has suggested.[24] To examine whether the trends in social well-being, and their hypothesized relations with mind wandering were specific to first-year students, we enrolled both first- and second-year students in the study and covaried year in college in the analyses along with gender, ethnicity, and baseline levels of social well-being. We also conducted sensitivity analyses by (1) testing the relationship between mind wandering and social well-being using a different scale for measuring lapses in present-moment attention[49] and (2) testing our hypothesized relations while controlling for the quantity and diversity of interactions on each day of assessment. The results of the sensitivity analyses are shown in the Supplemental Materials.

Method

Participants

Participants were returning Study 1, Sample 2 undergraduate students who were in their second year at the time of data collection (32%, $n = 85$), with an additional independent group of 134 first-year (50.4%) and 47 second-year (17.7%) undergraduate students from the same east coast university (total $n = 266$). The inclusion criteria and participant recruitment methods were the same as in Study 1, Sample 2. The demographic characteristics of the participants are presented in Table 1.

Sample size justification

As in Study 1, the sample size in this study exceeded the recommended 100 participants.[42] Sensitivity power analysis, conducted in the same manner as in Study 1, showed that the current design provided sufficient power to detect relatively small unstandardized effects of concurrent and lagged mind wandering on loneliness ($b_{\text{mind wandering}} = -0.035$, $b_{\text{lagged mind wandering}} = -0.028$, power = 90%, 95% CI = [82.38, 95.10]), connection ($b_{\text{mind wandering}} = 0.036$, $b_{\text{lagged mind wandering}} = 0.031$, power = 91%, 95% CI = [83.60, 95.80]), and school belonging ($b_{\text{mind wandering}} = 0.050$, $b_{\text{lagged mind wandering}} = 0.031$, power = 91%, 95% CI = [83.60, 95.80]).

Procedure and measures

Data were collected in a manner similar to Study 1 during a single semester at three time points: weeks 2, 7, and 14. Each period of data collection continued for seven days, from Monday to Sunday. Mind wandering, loneliness, and felt connection to others were assessed four times per day (once in the morning, twice in the afternoon, and once in the evening). School belonging was assessed once every

evening. Participant compensation was the same as that in Study 1 (Sample 2). Compliance with the EMA protocol was acceptable: the proportion of participants who replied to a given EMA survey prompt ranged from 68.42 to 94.74% ($M = 84.22\%$, $SD = 4.74\%$), except for three time points on the second and third days of the study when over 40% of the participants missed the EMA prompts.

Loneliness, felt connection, and school belonging were measured in Study 1 (Sample 2). We evaluated mind wandering using a one-item measure from the Killingsworth and Gilbert[20] study, "I was thinking about something other than what I was currently doing" (*yes* = 1, *no* = 0). Temporal focus of participants' thoughts was evaluated with an item "Which of the following would best characterize these thoughts?" with three answer choices: *past-*, *present-*, and *future-focused* (dummy-coded, with the present focus as the reference group). Baseline loneliness, social support, and social and academic fit were measured in Study 1, Sample 2, with Cronbach's alphas of .93 for both the UCLA Loneliness Scale and the Two-Way Social Support Scale, and .92 for the Sense of Social and Academic Fit Scale.

Finally, at each EMA prompt participants indicated whether they had interacted with someone since the last survey and with whom (family member, romantic partner, friend, roommate, classmate, instructor/supervisor, acquaintance, other). For other purposes (not reported here), questions also included in the survey concerned students' current activities, traumatic experiences, mood, coping strategies, and health behaviors. The time taken to complete the EMA surveys was ~3–5 min.

Statistical analyses

Analyses were performed with restricted maximum likelihood (REML) multilevel models using the same software as in Study 1. We examined the links between concurrent and lagged ($t - 1$) mind wandering and each of loneliness, connection, and school belonging. We used two-level, random-coefficient models nesting level 1 experience-sampled measures within participants (level 2). The day of the study, weekly cyclicity, and for loneliness and connection, time of the day were covaried. Lagged relations were tested using within-day data, as previous research has found within-day relations to be more robust than cross-day relations.[49] Gender, ethnicity, and year in college (first or second) were covaried. Further statistical analysis details are shown in the Supplemental Materials.

Results

Descriptive statistics

Descriptive statistics and correlations were calculated for the baseline measures of loneliness, social support, social and academic fit, within-participants means of continuous EMA-level variables (loneliness, connection, and school belonging), and average daily counts of one-item mind wandering[1] (see Table 6). The analysis of the responses to the mind wandering measure showed that the percentage of times when individual participants reported mind wandering, out of the total number of completed EMA surveys, ranged from zero (the participant did not report any mind wandering throughout the study) to 100% (the participant reported mind wandering in each EMA survey), with a mean of 42.24% of surveys ($SD = 29.65\%$). There was considerable variability in the timeframe to which the participants attributed their thoughts. As shown in Figure 3, the percentage of thoughts concerning the present varied from zero (the participant did not report any present-related thoughts throughout the study) to 100% (the participant reported present-related thoughts in each EMA survey), with a mean of 65.2% ($SD = 26.69\%$). Past time thoughts ranged from zero to 85.25% ($M = 5.35\%$, $SD = 9.66\%$), and future time thoughts ranged from zero to 100% ($M = 29.44\%$, $SD = 24.87\%$).

Hypotheses testing

The results of the analyses are presented in Table 7. The significant temporal patterns of loneliness and connection were similar to those found in Study 1. Notably, we observed an overall decrease in social well-being across all the outcomes. Year of academic enrollment and ethnicity were not significant predictors of any of the outcomes. Gender, however, significantly predicted connection, with female participants feeling less connected than male participants, as in Study 1, Sample 2. Most importantly, concurrent mind wandering was

Table 6. Descriptive statistics and bivariate correlations of study 2 variables ($n = 266$).

Variable	1	2	3	4	5	6	7
Baseline							
1. Loneliness	1						
2. Social support	−.57***	1					
3. Social/academic fit	−.59***	.45***	1				
EMA-level							
4. Loneliness	.35***	−.22***	−.33***	1			
5. Connection	−.54***	.43***	.39***	−.15*	1		
6. School belonging	−.54***	.47***	.66***	−.44***	.51***	1	
7. Mind wandering	.13*	.06	−.19**	.28***	−.10	−.17**	1
M (*SD*)	2.14 (0.49)	4.90 (0.68)	5.03 (0.85)	1.68 (0.68)	2.75 (0.69)	4.99 (1.12)	1.68 (1.21)
Min	1.15	2.63	2.21	1.00	1.08	1.11	0.00
Max	3.40	6.00	6.88	4.34	4.42	7.00	4.00

Note. M: mean; *SD*: standard deviation; baseline loneliness was on a 1–4 scale, baseline social support was on a 1–6 scale, baseline social/academic fit was on a 1–7 scale; EMA-level loneliness and connection were on a 1–5 scale, EMA-level school belonging were on a 1–7 scale, mind wandering was on a 0–4 scale.
*$p < .001$.
**$p < .01$.
***$p < .05$.

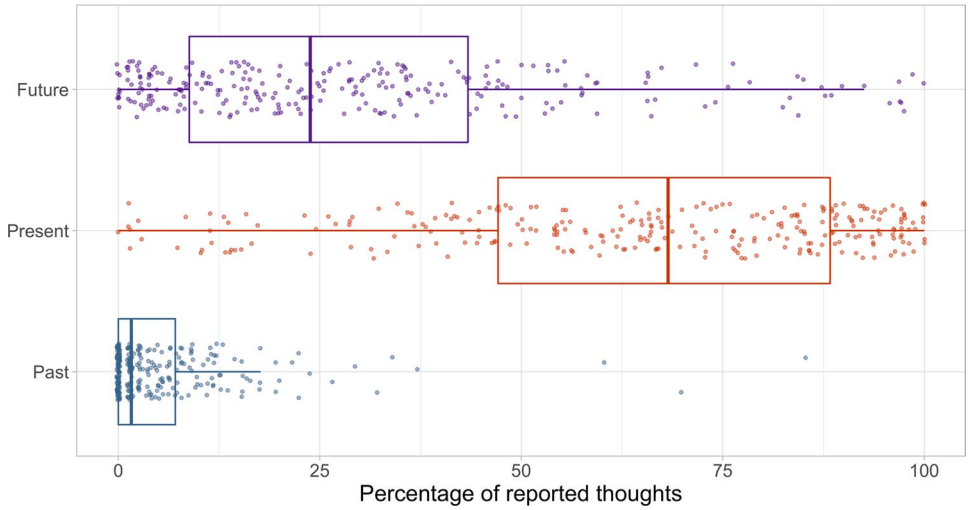

Figure 3. Within-participants prevalence of past, present, and future-related thoughts.

Table 7. Multilevel model analyses of social well-being variables, predicted by concurrent and lagged ($t - 1$) EMA mind wandering (MW).

	Loneliness			Connection			School belonging		
Predictors	Estimates (unstandardized)	95% CI	*p*	Estimates (unstandardized)	95% CI	*p*	Estimates (unstandardized)	95% CI	*p*
(Intercept)	1.340	1.162, 1.518	<.001	3.057	2.874, 3.239	<.001	5.303	5.047, 5.559	<.001
Concurrent MW	0.172	0.130, 0.215	<.001	−0.189	−0.242, −0.135	<.001	−0.148	−0.223, −0.072	<.001
Lagged ($t - 1$) MW	0.053	0.018, 0.088	.003	0.016	−0.026, 0.059	.453	−0.086	−0.159, −0.013	.021
Day of study	0.050	0.040, 0.060	<.001	−0.051	−0.063, −0.039	<.001	−0.049	−0.068, −0.029	<.001
Weekly cyclicity (sine)	0.039	0.018, 0.061	<.001	−0.130	−0.156, −0.104	<.001	−0.140	−0.181, −0.099	<.001
Time of day	0.008	−0.006, 0.021	.279	0.097	0.079, 0.116	<.001	–	–	–
Day × day interaction	−0.002	−0.002, −0.001	<.001	0.002	0.001, 0.002	<.001	0.001	0.0004, 0.002	.005
Baseline loneliness	0.469	0.318, 0.621	<.001	–	–	–	–	–	–
Baseline social support	–	–	–	0.460	0.353, 0.568	<.001	–	–	–
Baseline social/ academic fit	–	–	–	–	–	–	0.870	0.747, 0.993	<.001
Gender (female)	−0.128	−0.280, 0.024	.099	−0.168	−0.318, −0.019	.027	0.161	−0.053, 0.375	.139
Ethnicity (White)	0.013	−0.177, 0.203	.894	−0.002	−0.188, 0.183	.981	0.090	−0.178, 0.359	.508
Ethnicity (East Asian)	0.002	−0.176, 0.181	.980	−0.151	−0.325, 0.022	.087	−0.127	−0.378, 0.124	.321
Year of study (second)	0.129	−0.019, 0.276	.088	0.061	−0.084, 0.207	.407	0.011	−0.197, 0.218	.920
Random effects									
σ^2	0.480			0.790			0.741		
$\tau_{00\ ID}$	0.337			0.391			0.663		
$\tau_{11\ ID/MW}/\tau_{11\ ID/lagged\ MW}$	0.045/0.017			0.070/0.012			0.054/0.027		
$\rho_{01\ MW}/\rho_{01\ lagged\ MW}$	.211/−.161			−.463/−.495			−.350/−.027		
ICC	.441			.306			.468		
N_{ID}	264			264			262		
Observations	11950			11950			4028		
Marginal R^2/ conditional R^2	.090/.491			.107/.381			.304/.630		

σ^2: level-1 variance after adjusting for predictors; $\tau_{00\ ID}$: variance in individual intercepts; $\tau_{11\ ID}$: variance in individual slopes; ρ_{01}: correlation between intercepts and slopes; ICC: intraclass correlation coefficient; N_{ID}: number of participants; marginal R^2: proportion of variance in the outcome explained by fixed effects only; conditional R^2: proportion of variance explained by fixed and random effects together.

associated with all three social well-being outcomes: higher loneliness, lower felt connection, and lower school belonging. Mind wandering predicted higher loneliness and lower school belonging at the next time point but did not predict felt connection. These results were replicated with a different measure of lack of present-focused attention, the State Mindful Attention Awareness Scale (MAAS),[49] except that it did not predict school belonging at the next time point (see Supplemental Table 3). Sensitivity analyses showed that mind wandering was concurrently related to all social well-being outcomes, while controlling for the quantity and diversity of interactions (see Supplemental Tables 4 and 5).

To examine whether past-, present-, and future-focused thoughts were differentially predictive of and related to social well-being, we dummy-coded the time focus variable using present time as a reference group. We controlled for gender in the social connection model and removed non-significant demographic variables from all models. Mind wandering into both the past and the future was associated with higher loneliness, lower connection, and school belonging relative to the present time focus (see Supplemental Table 3). However, the negative effect of future-oriented thought was less pronounced than that of past-oriented thought, as evidenced by the larger regression coefficients of the latter. Lagged past- or future-oriented thoughts did not significantly predict any of the three social well-being outcomes.

Brief discussion

This study aimed to test whether higher levels of mind wandering were related to lower momentary social well-being among college students. Consistent with our hypotheses, mind wandering predicted greater loneliness, both concurrently and at the next time point of the day, as well as lower concurrent connection and school belonging. The sensitivity analysis showed that these results remained robust when we used another measure of lack of present-focused attention (State MAAS) and controlled for the quantity and diversity of daily interactions. A more detailed analysis showed that consistent with suggestions by Smallwood and O'Connor,[24] past- and future-related thoughts were linked to worse social well-being (higher loneliness, lower connection, and school belonging) than present-related thoughts. The impact of past-related thoughts was more detrimental than that of future-related thoughts.

General discussion

The present study investigated temporal changes in EMA-measured social well-being (measured as loneliness, felt connection to others, and school belonging) of college students across academic terms and their connection with daily mind wandering and presence of mind. The temporal patterns of social well-being were replicated across multiple independent samples, using its three distinct aspects: loneliness, felt connection, and school belonging. While changes in college student loneliness have been previously investigated, trends in connection and school belonging received less attention. Loneliness showed an overall increase in all samples throughout the terms studied. These results extend previous studies that measured first-year college students' loneliness at discrete time points: before and after their transition to college[7] or at the beginning and end of a semester[8] by providing a more detailed picture of the changes in loneliness throughout the academic term. Connection (three samples) and school belonging (two samples) showed an overall decrease throughout the terms studied. This research shows that social well-being is an ever-increasing challenge for early college career students as they move through an academic term, not just a temporary reaction to the academic, social, and other challenges faced at the beginning of a term. Maintaining social well-being appears to be more challenging for students who do not identify as White or male, although this was not consistent across all samples. This may be explained by language barriers, perceived cultural difference barriers, discrimination, prejudice, or microaggressions based on race, ethnicity, or gender leading to feelings of isolation, exclusion, or lower levels of belonging.[50] Students with such identities may also face limited access to the hidden curriculum[2] of the university, which in turn restricts their opportunities for academic support, mentorship, participation in extracurricular activities, leadership roles, and ultimately impacts their level of social engagement.[51]

Importantly for this study series, the current investigation provides evidence of a connection between daily mind wandering and social well-being. Consistent with our hypotheses, mind wandering was related to higher loneliness, both concurrently and predictively, as well as lower concurrent connection and school belonging. These results corroborate previous research that found relations between (lack of) present moment attention and social well-being in community samples.[38,40] Our findings also extend previous research that linked more frequent mind wandering with poorer physical[22] and emotional well-being.[20]

Several mechanisms may explain the associations found in this study. First, similar to previous research,[38] lower presence of mind may be conducive to less frequent interactions with a wider array of people. However, when we included the quantity and diversity of interactions in the statistical models (see Supplementary Materials), mind wandering remained significantly associated with all three social well-being outcomes. In other words, greater mind wandering predicted poor social well-being even when the effect of social interaction quantity was accounted for. Increased interaction quality is another factor that could account for the effects of different states of mind on social well-being. Lindsay et al.[38] showed that mindfulness training positively affected both the quantity and quality of interactions only when that training featured the development of acceptance toward feelings of loneliness or social disconnection. Such a nonreactive attitude may help in regulating emotions, thereby reducing social threat perceptions that hinder social engagement, and freeing up cognitive resources to better perceive social cues.[33–36] Finally, attending to present moment experience might buffer the influence of negative interaction experiences on social well-being in the same way that it buffers against stress[52,53] and amplifies the influence of positive interaction experiences through upward spirals of positive affect and cognition.[54] Future studies should examine how states of attention affect interaction quantity and quality, as well as the above-mentioned buffering and amplifying effects to elucidate the nature of these pathways.

The results of exploratory analyses examining differential relationships between the temporal focus of thoughts and social well-being were in line with our hypotheses: thoughts about the past and future were associated with worse social well-being than present-focused thoughts. Yet past-focused thoughts were related to lower social well-being than

future-focused thoughts, a finding that complements previous research showing that past-focused mind-wandering was associated with unhappy mood and depressive symptoms.[24] This might be because at least some future-related thought is adaptive, helping a person mentally simulate and prepare for future scenarios,[55] whereas past-related thought often takes the form of rumination. Engaging in rumination increases negative affect,[26] potentially causing individuals to withdraw from or avoid social interactions; but this relationship remains to be studied. Future studies should discriminate between types of thought content during past-focused mind wandering. For example, despite the overall negative impact of mind wandering on social well-being, daydreaming about past experiences with close friends and family is related to lower loneliness and greater perceived social support,[21] as well as greater felt connection and school belonging.[56]

The findings of this study should be considered in the light of several limitations. First, the question on the temporal focus of thoughts contained three possible choices: past, present, and future. However, some thoughts may not be temporally allocated, and this mixed category might constitute a substantial share of thoughts.[57] Future studies should include this additional category to allow a more precise classification of mind wandering experiences. Second, Study 2 did not involve the manipulation of mind wandering (e.g., through intervention); thus, causal inferences regarding the associations between mind wandering and social well-being are provisional. Experimental research is required to test causal pathways. Finally, although EMA helps reduce the influence of memory decay and retrospection bias, it is still a self-report format. Using objective measures of social interactions, such as those collected through passive smartphone sensing, might help remedy this limitation in future studies. Future studies should also examine the emotional and behavioral implications of attention-based improvements in social well-being. Finally, data were collected before the COVID-19 pandemic, which substantially affected college students' social well-being. Replicating the study in a post-pandemic sample could reveal whether the results can be generalized to current conditions.

The results of this study highlight possible targets for interventions aimed at alleviating feelings of loneliness and isolation that college students often experience in their first and second years. Universities may incorporate mindfulness training into their curricula or extracurricular activities. Such programs will help students develop attention regulation skills that buffer social well-being decline throughout the academic term. Educators may create learning environments that support mindful learning and ultimately positively impact students' social well-being. This can involve designing classrooms or study spaces that minimize distractions, promoting collaborative learning techniques, and fostering positive student-instructor relationships, all of which contribute to reducing mind wandering and improving social engagement. Finally, universities should consider offering targeted support to students with marginalized identities. This may include establishing support systems that address the social and emotional well-being of these students, such as safe spaces, affinity groups, or counseling services that specifically cater to the experiences and challenges faced by individuals with such identities. Universities should also prioritize training and education for faculty, staff, and administrators to promote cultural competence and awareness, and create a more inclusive and supportive environment for all students.

Notes

1. The minimum possible value for the one-item mind wandering measure was zero (a participant did not report any mind wandering throughout the study), and the maximum possible value was four (a participant reported mind wandering in each EMA survey).
2. The hidden curriculum refers to the unspoken norms, values, and beliefs prevalent in affluent and upper-middle-class White contexts, which are conveyed to students through schooling and are less accessible to those who did not grow up in similar environments.[51]

Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States and received approval from the Institutional Review Boards of The University of Washington and Carnegie Mellon University.

Funding

This research has been funded by the National Science Foundation under Grant Number IIS7974751, EDA-2009977, CHS-2016365, and CHS-1941537; the National Institute on Disability, Independent Living and Rehabilitation Research under Grant Number 90DPGE0003-01; Carnegie Mellon University Office of the Provost, University of Washington College of Engineering, Department of Electrical Engineering, and School of Computer Science & Engineering; Samsung Research America Inc.; Google LLC.

ORCID

Polina Beloborodova http://orcid.org/0000-0002-2242-3739
Janine M. Dutcher http://orcid.org/0000-0002-8678-8585

Data availability statement

The data, analysis scripts, and materials are available at Open Science Framework: https://osf.io/hq72x/.

References

1. Baumeister RF, Leary MR. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychol Bull.* 1995;117(3):497–529. doi:10.1037/0033-2909.117.3.497.
2. Ryan RM, Deci EL. *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. New York, NY: The Guilford Press; 2017:xii, 756. doi:10.1521/978.14625/28806.
3. Ryan RM, Deci EL. On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annu Rev Psychol*. 2001;52(1):141–166. doi:10.1146/annurev.psych.52.1.141.

4. Barreto M, Victor C, Hammond C, Eccles A, Richins MT, Qualter P. Loneliness around the world: Age, gender, and cultural differences in loneliness. *Pers Individ Dif*. 2021;169:110066. doi:10.1016/j.paid.2020.110066.
5. Astin AW, Green KC, Korn WC, Schalit M. *The American Freshman National Norms for Fall 1987*. Higher Education Research Institute, UCLA; 1988. https://eric.ed.gov/?id=ED290371. Accessed August 21, 2022.
6. Stolzenberg EB, Aragon MC, Romo E, et al. *The American Freshman National Norms for Fall 2019*. Higher Education Research Institute, UCLA; 2020. https://eric.ed.gov/?id=ED290371. Accessed August 21, 2022
7. Drake EC, Sladek MR, Doane LD. Daily cortisol activity, loneliness, and coping efficacy in late adolescence: A longitudinal study of the transition to college. *Int J Behav Dev*. 2016;40(4):334–345. doi:10.1177/0165025415581914.
8. Jia Z, Wang Y, Yang Y, Yang L. Chinese university students' loneliness and generalized pathological Internet use: A longitudinal cross-lagged analysis. *Soc Behav Pers*. 2018;46(5):861–870. doi:10.2224/sbp.6807.
9. Wang R, Chen F, Chen Z, et al. StudentLife: Using smartphones to assess mental health and academic performance of college students. In: Rehg JM, Murphy SA, Kumar S, eds. *Mobile Health: Sensors, Analytic Methods, and Applications*. Cham, Switzerland: Springer International Publishing; 2017:7–33. doi:10.1007/978-3-319-51394-2_2.
10. Cacioppo JT, Cacioppo S. Loneliness in the modern age: An evolutionary theory of loneliness (ETL). In: Olson JM, ed. *Advances in Experimental Social Psychology*. Vol. 58. Cambridge, MA: Academic Press; 2018:127–197. doi:10.1016/bs.aesp.2018.03.003.
11. Leontiev D. The dialectics of aloneness: Positive vs. negative meaning and differential assessment. *Couns Psychol Q*. 2019;32(3–4):548–562. doi:10.1080/09515070.2019.1640186.
12. Cacioppo JT, Patrick W. *Loneliness: Human Nature and the Need for Social Connection*. New York, NY: W. W. Norton & Co; 2008:xiv, 317.
13. Holt-Lunstad J, Smith TB, Layton JB. Social relationships and mortality risk: A meta-analytic review. *PLOS Med*. 2010;7(7):e1000316. doi:10.1371/journal.pmed.1000316.
14. Leary MR, Kelly KM, Cottrell CA, Schreindorfer LS. Construct validity of the need to belong scale: Mapping the nomological network. *J Pers Assess*. 2013;95(6):610–624. doi:10.1080/00223891.2013.819511.
15. Slaten CD, Ferguson JK, Allen KA, Brodrick DV, Waters L. School belonging: A review of the history, current trends, and future directions. *Educ Dev Psychol*. 2016;33(1):1–15. doi:10.1017/edp.2016.6.
16. Dutcher JM, Lederman J, Jain M, et al. Lack of belonging predicts depressive symptomatology in college students. *Psychol Sci*. 2022;33(7):1048–1067. doi:10.1177/09567976211073135.
17. Mrazek M, Smallwood J, Schooler JW. Mindfulness and mind-wandering: Finding convergence through opposing constructs. *Emotion*. 2012;12(3):442–448. doi:10.1037/a0026678.
18. Smallwood J, Schooler JW. The science of mind wandering: Empirically navigating the stream of consciousness. *Annu Rev Psychol*. 2015;66(1):487–518. doi:10.1146/annurev-psych-010814-015331.
19. Kane MJ, Brown LH, McVay JC, Silvia PJ, Myin-Germeys I, Kwapil TR. For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychol Sci*. 2007;18(7):614–621. doi:10.1111/j.1467-9280.2007.01948.x.
20. Killingsworth MA, Gilbert DT. A wandering mind is an unhappy mind. *Science*. 2010;330(6006):932–932. doi:10.1126/science.1192439.
21. Mar RA, Mason MF, Litvack A. How daydreaming relates to life satisfaction, loneliness, and social support: The importance of gender and daydream content. *Conscious Cogn*. 2012;21(1):401–407. doi:10.1016/j.concog.2011.08.001.
22. Epel ES, Puterman E, Lin J, Blackburn E, Lazaro A, Mendes WB. Wandering minds and aging cells. *Clin Psychol Sci*. 2013;1(1):75–83. doi:10.1177/2167702612460234.
23. Smallwood J, Fishman DJ, Schooler JW. Counting the cost of an absent mind: Mind wandering as an underrecognized influence on educational performance. *Psychon Bull Rev*. 2007;14(2):230–236. doi:10.3758/BF03194057.
24. Smallwood J, O'Connor RC. Imprisoned by the past: Unhappy moods lead to a retrospective bias to mind wandering. *Cogn Emot*. 2011;25(8):1481–1490. doi:10.1080/02699931.2010.545263.
25. Skinner E, Pitzer J, Steele J. Coping as part of motivational resilience in school: A multidimensional measure of families, allocations, and profiles of academic coping. *Educ Psychol Meas*. 2013;73(5):803–835. doi:10.1177/0013164413485241.
26. Moberly NJ, Watkins ER. Ruminative self-focus, negative life events, and negative affect. *Behav Res Ther*. 2008;46(9):1034–1039. doi:10.1016/j.brat.2008.06.004.
27. Bishop SR, Lau M, Shapiro S, et al. Mindfulness: A proposed operational definition. *Clin Psychol Sci Pract*. 2004;11(3):230–241. doi:10.1093/clipsy.bph077.
28. Kabat-Zinn J. *Full Catastrophe Living: How to Cope with Stress, Pain and Illness Using Mindfulness Meditation*. 1st ed. New York, NY: Delacorte Press; 1990.
29. Brown KW, Creswell JD, Ryan RM. *Handbook of Mindfulness: Theory, Research, and Practice*. New York, NY: Guilford Publications; 2015.
30. Amaro A. A holistic mindfulness. *Mindfulness* 2015;6(1):63–73. doi:10.1007/s12671-014-0382-3.
31. Pétrement S. *Simone Weil: A Life*. New York, NY: Pantheon; 1976.
32. Bavelas JB, Coates L, Johnson T. Listeners as co-narrators. *J Pers Soc Psychol*. 2000;79(6):941–952. doi:10.1037/0022-3514.79.6.941.
33. Burgoon JK, Berger CR, Waldron VR. Mindfulness and interpersonal communication. *J Soc Issues* 2000;56(1):105–127. doi:10.1111/0022-4537.00154.
34. Adair KC, Boulton AJ, Algoe SB. The effect of mindfulness on relationship satisfaction via perceived responsiveness: Findings from a dyadic study of heterosexual romantic partners. *Mindfulness* 2018;9(2):597–609. doi:10.1007/s12671-017-0801-3.
35. Barnes S, Brown KW, Krusemark E, Campbell WK, Rogge RD. The role of mindfulness in romantic relationship satisfaction and responses to relationship stress. *J Marital Fam Ther*. 2007;33(4):482–500. doi:10.1111/j.1752-0606.2007.00033.x.
36. Donald JN, Sahdra BK, Zanden BV, et al. Does your mindfulness benefit others? A systematic review and meta-analysis of the link between mindfulness and prosocial behaviour. *Br J Psychol*. 2019;110(1):101–125. doi:10.1111/bjop.12338.
37. Jones SM, Hansen W. The impact of mindfulness on supportive communication skills: Three exploratory studies. *Mindfulness* 2015;6(5):1115–1128. doi:10.1007/s12671-014-0362-7.
38. Lindsay EK, Young S, Brown KW, Smyth JM, Creswell JD. Mindfulness training reduces loneliness and increases social contact in a randomized controlled trial. *Proc Natl Acad Sci USA*. 2019;116(9):3488–3493. doi:10.1073/pnas.1813588116.
39. Creswell JD, Irwin MR, Burklund LJ, et al. Mindfulness-based stress reduction training reduces loneliness and pro-inflammatory gene expression in older adults: A small randomized controlled trial. *Brain Behav Immun*. 2012;26(7):1095–1101. doi:10.1016/j.bbi.2012.07.006.
40. Fredrickson BL, Arizmendi C, Van Cappellen P, et al. Do contemplative moments matter? Effects of informal meditation on emotions and perceived social integration. *Mindfulness* 2019;10(9):1915–1925. doi:10.1007/s12671-019-01154-2.
41. Crosswell AD, Coccia M, Epel ES. Mind wandering and stress: When you don't like the present moment. *Emotion*. 2020;20(3):403–412. doi:10.1037/emo0000548.
42. Maas CJM, Hox JJ. Sufficient sample sizes for multilevel modeling. *Methodology* 2005;1(3):86–92. doi:10.1027/1614-2241.1.3.86.
43. Green P, MacLeod CJ. SIMR: An R package for power analysis of generalized linear mixed models by simulation. *Methods Ecol Evol*. 2016;7(4):493–498. doi:10.1111/2041-210X.12504.

44. Russell DW. UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *J Pers Assess*. 1996;66(1):20–40. doi:10.1207/s15327752jpa6601_2.
45. Shakespeare-Finch J, Obst PL. The development of the 2-Way Social Support Scale: A measure of giving and receiving emotional and instrumental support. *J Pers Assess*. 2011;93(5):483–490. doi:10.1080/00223891.2011.594124.
46. Walton GM, Cohen GL. A question of belonging: Race, social fit, and achievement. *J Pers Soc Psychol*. 2007;92(1):82–96. doi:10.1037/0022-3514.92.1.82.
47. Bryk AS, Raudenbush SW. *Hierarchical Linear Models: Applications and Data Analysis Methods*. Sage Publications, Inc; 1992:xvi, 265.
48. Pinheiro J, Bates D. nlme: Linear and nonlinear mixed effects models. Published Online 2022. https://CRAN.R-project.org/package=nlme.
49. Brown KW, Ryan RM. The benefits of being present: Mindfulness and its role in psychological well-being. *J Pers Soc Psychol*. 2003;84(4):822–848. doi:10.1037/0022-3514.84.4.822.
50. Choi S, Weng S, Park H, et al. Sense of belonging, racial microaggressions, and depressive symptoms among students of Asian descent in the United States. *Smith Coll Stud Soc Work*. 2021;91(2):115–141. doi:10.1080/00377317.2021.1882922.
51. Laiduc G, Covarrubias R. Making meaning of the hidden curriculum: Translating wise interventions to usher university change. *Transl Issues Psychol Sci*. 2022;8(2):221–233. doi:10.1037/tps0000309.
52. Bergin AJ, Pakenham KI. The stress-buffering role of mindfulness in the relationship between perceived stress and psychological adjustment. *Mindfulness* 2016;7(4):928–939. doi:10.1007/s12671-016-0532-x.
53. Creswell JD, Lindsay EK. How does mindfulness training affect health? A mindfulness stress buffering account. *Curr Dir Psychol Sci*. 2014;23(6):401–407. doi:10.1177/0963721414547415.
54. Garland EL, Geschwind N, Peeters F, Wichers M. Mindfulness training promotes upward spirals of positive affect and cognition: Multilevel and autoregressive latent trajectory modeling analyses. *Front Psychol*. 2015;6:15. doi:10.3389/fpsyg.2015.00015.
55. Schacter DL, Addis DR, Buckner RL. Episodic simulation of future events: Concepts, data, and applications. In: *The Year in Cognitive Neuroscience 2008. Annals of the New York Academy of Sciences*. Malden, MA: Blackwell Publishing; 2008:39–60. doi:10.1196/annals.1440.001.
56. Poerio GL, Totterdell P, Miles E. Mind-wandering and negative mood: Does one thing really lead to another? *Conscious Cogn*. 2013;22(4):1412–1421. doi:10.1016/j.concog.2013.09.012.
57. Jackson J, Weinstein Y, Balota D. Can mind-wandering be timeless? Atemporal focus and aging in mind-wandering paradigms. *Front Psychol*. 2013;4:742. doi:10.3389/fpsyg.2013.00742.