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Problematic smartphone use associated with greater alcohol consumption, mental health issues, poorer academic performance, and impulsivity

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Background: This study sought to examine the occurrence of the problematic use of smartphones in a university sample and associated physical and mental health correlates, including potential relationships with risky sexual practices. *Methods:* A 156-item anonymous online survey was distributed via e-mail to a sample of 9,449 university students. In addition to problematic smartphone usage, current use of alcohol and drugs, psychological and physical status, and academic performance were assessed. *Results:* A total of 31,425 participants were included in the analysis, of whom 20.1% reported problematic smartphone use. Problematic use of smartphones was associated with lower grade point averages and with alcohol use disorder symptoms. It was also significantly associated with impulsivity (Barratt scale and ADHD) and elevated occurrence of PTSD, anxiety, and depression. Finally, those with current problems with smartphone use were significantly more sexually active. *Conclusions:* Problematic use of smartphones is common and has public health importance due to these demonstrable associations with alcohol use, certain mental health diagnoses (especially ADHD, anxiety, depression, and PTSD), and worse scholastic performance. Clinicians should enquire about excessive smartphone use as it may be associated with a range of mental health issues. Research is needed to address longitudinal associations.

Keywords: smartphone, addiction, impulsivity

INTRODUCTION

Smartphones enable ready access to the Internet and have a wide range of functions. In addition to making phone calls, users are able to play games, gamble, chat with friends, use messenger systems, access web services (e.g., blogs, homepages, social networks, and pornography), and search for information. Given their convenience and variety of functions, smartphones are widely popular, and the number of users is rapidly increasing, with more than 1.08 billion users across the globe in early 2012 (Mok et al., 2014). When the technology of the Internet was developed, there were major barriers to its use, such as waiting to "connect" the Internet, slow speeds of data transfer, and relatively high financial cost. However, advances in technology and social change now mean that individuals are frequently and continuously connected to the Internet through smartphones, with many of these earlier barriers having been obviated.

There is a growing body of research on the psychosocial problems associated with smartphone use in adolescents and young adults. Given the current state of research, there is a solid body of literature reporting an association between problematic smartphone use and various mental health issues, such as anxiety, depression, post-traumatic stress disorder (PTSD), and attention-deficit hyperactivity disorder (ADHD), as well as problems with self-esteem, interpersonal sensitivity, and impulsivity (Andreassen et al., 2016; Basu, Garg, Singh, & Kohli, 2018; Bianchi & Phillips, 2005; Billieux, 2012; Billieux, Van der Linden, & Rochat, 2008; Chen, Liang, Mai, Zhong, & Qu, 2016; Contractor, Weiss, Tull, & Elhai, 2017; Elhai, Dvorak, Levine, & Hall, 2017; Elhai, Tiamiyu, & Weeks, 2018a; Elhai, Vasquez, Lustgarten, Levine, & Hall, 2018b; Fırat et al., 2018). What is less well-known is whether there are associations between problematic smartphone use and other mental health problems, such as alcohol and substance abuse and binge eating, and how smartphone use affects functionality in young adults.

Despite this high penetrance of smartphone technology, coupled with evidence that they may have untoward public health implications for some individuals, relatively little is known about the associations between problematic use of smartphones, academic performance, and addictive behaviors in university settings. Therefore, this study sought to examine

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both the occurrence of problematic use of smartphones in a university sample and the associated emotional and functional consequences of misuse. Based on the previous literature, we sought to confirm previous findings regarding the problematic use of smartphones and its association with depression, anxiety, PTSD, and ADHD and with impulsivity and poor self-esteem, and sought to provide original data regarding possible associations between problematic smartphone use and substance use disorders, binge eating, sex-related behaviors, and impairments in academic performance.

METHODS

Survey design

The Department of Psychiatry and Behavioral Neuroscience at the University of Chicago and Boynton Health at the University of Minnesota jointly developed the *Health and Addictive Behaviors Survey* to assess mental health and well-being in a large sample of university students. The survey included basic demographics as well as questions from a number of validated screening tools examining mental health and psychological well-being.

Participants

A subsample of 10,000 college and graduate students at a large, non-denominational, and coeducational Midwestern university were chosen by randomized, computer-generated selection, from a total pool of approximately 60,000 students at the university. The survey was distributed over a 3-week period during fall semester via e-mail, with surveys completed online. Of the 10,000 e-mail invitations, 9,449 were successfully received by the recipients (i.e., without bouncing back). Of the 9,449 students with valid e-mails who received the e-mail invitation, 3,659 (38.7%) responded to a majority of the questions. This response rate is similar to other university health surveys (Baruch, 1999; Baruch & Holtom, 2008; Cook, Heath, & Thompson, 2000; Van Horn, Green, & Martinussen, 2009). The analysis of this paper was based on those who responded to the questions about problematic smartphone use.

The recipients of the e-mail were first required to view the Institutional Review Board-approved online informed consent page, which indicated that participation was voluntary, and that any information collected would be confidential and would not be linked back to them individually. Compensation was offered after the entire survey data collection had been closed, by randomly selecting respondents to receive tablet computers (three winners) or gift certificates to an online retailer in the amounts of $250 (four winners), $500 (two winners), and $1000 (one winner). Participants were required to review all survey questions to be eligible for prize drawings, but were not required to answer all questions, due to the some of their sensitive nature.

Assessments

The self-report survey consisted of 156 questions and participants took approximately 30 min to complete. Smartphone addiction was measured using the Smartphone Addiction Scale – Short Version (SAS-SV). The SAS-SV is a validated scale that contains 10 items rated on a dimensional scale [ranging from 1 (*strongly disagree*) to 6 (*strongly agree*)]. The total score ranges from 10 to 60, with a score of ≥32 being defined as problematic usage of smartphones (Kwon, Kim, Cho, & Yang, 2013). This definition was based on concurrent validity as compared to detailed expert clinical assessment (Kwon et al., 2013) and had excellent sensitivity and specificity. Survey questions also assessed demographic information, sexual behavior, self-reported academic achievement [i.e., grade point average (GPA)], and clinical characteristics, including mental health and substance use issues.

Participants also completed the following measures:

Alcohol Use Disorders Identification Test (AUDIT). The AUDIT is a well-validated, 10-item questionnaire used to assess alcohol use behaviors and related problems (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). A score of 8 or greater indicates hazardous or harmful alcohol use.

Patient Health Questionnaire (PHQ-9). The PHQ-9 is a 9-item measure of depressive symptoms directly based on DSM-IV-TR criteria for major depressive disorder (Kroenke, Spitzer, & Williams, 2001).

Generalized Anxiety Disorder 7 (GAD-7). The GAD-7 is a 7-item screening tool for GAD (Spitzer, Kroenke, Williams, & Löwe, 2006). Cut-off points of 5, 10, and 15 are interpreted as representing mild, moderate, and severe levels of anxiety, respectively, on the GAD-7.

Adult ADHD Self-Report Scale (ASRS-v1.1). The ASRS is a 6-item screening tool for ADHD (Kessler et al., 2005).

Rosenberg Self-Esteem Scale (RSES). The RSES is a 10-item scale measuring global feelings of self-worth or self-regard (Rosenberg, 1965).

Minnesota Impulsive Disorders Interview (MIDI). The MIDI is used to screen impulse-control binge eating disorder (Grant, 2008).

Barratt Impulsiveness Scale, Version 11 (BIS-11). The BIS-11 is a 30-item measure designed to assess impulsivity across three dimensions: attentional (inability to concentrate), motor (acting without thinking), and non-planning (lack of future orientation; Stanford et al., 2009).

Body Dysmorphic Disorder Questionnaire (BDD-Q; Phillips, Atala, & Pope, 1995). Using the DSM criteria, the BDD-Q asks participants whether they are very concerned about the appearance of some part or parts of their body they consider unattractive. To screen positive for BDD, the participant must fulfill all the criteria by reporting preoccupation with appearance and experiencing at least moderate distress or impairment in functioning as a result.

Data analysis

Only respondents who answered the question regarding smartphone use were included in the analyses ($N = 3{,}425$). Participants were grouped into: those with a current problem of smartphone use and those without based on a score of ≥32 on the SAS-SV. The significant main effects of group were identified for demographic and clinical

measures using independent sample *t*-tests for continuous variables (or equivalent nonparametric tests, as indicated in the text) and χ^2 tests for categorical variables. Odds ratios were reported except the instances wherever the cell sizes were zero. Effect sizes were calculated for all significant differences, which were determined for *t*-tests using Hedges' *g* ($g = 0.2$ is a small effect size, 0.5 is medium, and 0.8 is large) and for χ^2 with φ coefficient (Cramer's *V*) ($V = 0.1$ is considered a small effect size, 0.3 is medium, and 0.5 is large). All statistical analyses were performed using SPSS software (version 24; IBM Corp., Armonk, NY, USA). Statistical significance was defined as $p \leq .05$, Bonferroni corrected for the number of tests taken per class of variable.

Ethics

The study procedures were conducted in accordance with relevant ethical guidelines including informed consent. The study was approved by the Institutional Review Board of the University of Minnesota.

RESULTS

Of the 3,425 participants, 687 (20.1%) reported current problematic smartphone use based on total scores from the SAS-SV. The demographic variables for the entire sample are presented in Table 1. Those who reported a current problem with smartphone use were more likely to be female, undergraduates, having lower GPAs, and were more likely to live in fraternity/sorority houses.

Alcohol and drug use by the participants is presented in Table 2. Current problematic smartphone use was significantly associated with more alcohol problems, but not with any other drug problems.

The sexual behavior of students based on problematic smartphone use is presented in Table 3. Students who reported problematic use of smartphones had significantly more sexual partners in the past 12 months.

The mental health of participants is presented in Table 4. Problematic use of smartphones was significantly associated with higher impulsivity on the Barratt Impulsivity Scale, poorer self-esteem, higher rates of ADHD, PTSD, and worse anxiety and depressive symptoms. Problematic use of smartphones was not significantly associated with binge eating disorder or with taking prescribed medication.

DISCUSSION

This study examined the problematic use of smartphones in a large sample of university students and ways in which smartphone use was related to a range of demographic/clinical measures and questionnaire-based measures of impulsivity. We found that 20.1% of the sample reported problematic smartphone use based on total scores from a previously validated instrument. The rate of problematic smartphone use is fairly similar to that reported previously in an adolescent sample using this instrument (16.6% in boys and 26.6% in girls; Kwon et al., 2013) and to the rate reported in an adult Belgian sample (21.5%), but is somewhat higher than that observed in a Spanish adult sample (Lopez-Fernandez, 2017). Certainly, different prevalence rates may reflect differences arising from a number of local factors including relative availability and social acceptability of such technologies.

This study found a number of significant associations between problematic use of smartphones and certain demographic and clinical measures. These significant associations were generally of small effect size, except for the relationship between problematic smartphone use and Barratt impulsiveness, which was of medium effect size. Prior literature examining some associations with problematic smartphone use similarly reported a mix of mostly small but occasionally medium effect sizes (Elhai et al., 2017).

Beginning with demographic features, problematic smart phone use was associated with female gender, being younger (undergraduate rather than a graduate), with lower GPAs, and with involvement in a fraternity/sorority house. Several previous studies reported higher rates of problematic smartphone use in females (Augner & Hacker, 2012; Beranuy, Oberst, Carbonell, & Chamarro, 2009;

Table 1. Demographics of university students based on problematic use of smartphones

Variable	Current problem with smartphone use (≥32) (*N* = 687)	No current problem with smartphone use (<32) (*N* = 2,738)	Odds ratio (OR)	Likelihood ratio χ^2	*p* value	Effect size (Cramer's *V*)
Sex: female [*n* (%)]	441 (64.2)	1,578 (57.6)	1.32	18.44, *df* = 3	<.001*	0.073
Year in college [*n* (%)]				30.523, *df* = 2	<.001*	0.092
Undergraduate	513 (74.7)	1,754 (64.1)	1.65			
Graduate	173 (25.2)	966 (35.3)	0.62			
Non-degree	1 (0.1)	18 (0.7)	0.22			
GPA				12.655, *df* = 1#	<.001*	0.061
Less than 3.00	95 (14.0)	254 (9.3)	1.57			
3.00 or higher	586 (86.0)	2,451 (90.7)	0.68			
Involved in a fraternity or sorority [*n* (%) yes]	93 (13.6)	267 (9.8)	1.45	8.368, *df* = 1#	.004*	0.049

Note. All numbers are % (*N*) unless otherwise stated.
*$p < .05$ Bonferroni corrected (threshold 0.05/4 = 0.0125).
#Results based on Pearson's χ^2 test.

Table 2. Alcohol and illicit drug use in students based on problematic use of smartphones

Variable	Current problem with smartphone use (≥32) ($N = 687$)	No current problem with smartphone use (<32) ($N = 2,738$)	Odds ratio (OR)	Likelihood ratio χ^2	Raw (p value)	Effect size (Cramer's V)
AUDIT total				34.590, $df = 1$[#]	<.001*	0.101
Score < 8	457 (66.7)	2,120 (77.5)	0.58			
Score 8 or higher	228 (33.3)	614 (22.5)	1.72			
Non-prescription amphetamines				2.821, $df = 4$	.588	0.028
Never	669 (97.8)	2,672 (98.0)	0.92			
In past, not within past 12 months	7 (1.0)	34 (1.2)	0.82			
Rarely	7 (1.0)	15 (0.6)	1.87			
Occasionally	1 (0.1)	4 (0.1)	1.0			
Daily	2 (0.1)	0 (0)	N/A			
Cocaine				3.919, $df = 3$	.270	0.036
Never	628 (91.9)	2,512 (92.5)	0.96			
In past, not within past 12 months	28 (4.1)	128 (4.7)	0.87			
Rarely	20 (2.9)	65 (2.4)	1.23			
Occasionally	7 (1.0)	12 (0.4)	2.34			
Daily	0 (0)	0 (0)	N/A			
Prescription amphetamines				3.716, $df = 4$	.446	0.034
Never	591 (86.3)	2,408 (88.3)	0.84			
In past, not within past 12 months	40 (5.8)	156 (5.7)	1.02			
Rarely	28 (4.1)	95 (3.5)	1.18			
Occasionally	20 (2.9)	53 (1.9)	1.52			
Daily	6 (0.9)	16 (0.6)	1.50			
Inhalants				5.559, $df = 3$	.135	0.035
Never	671 (98.4)	2,687 (98.8)	0.80			
In past, not within past 12 months	10 (1.5)	24 (0.9)	1.67			
Rarely	0 (0)	8 (0.3)	N/A			
Occasionally	1 (0.1)	2 (0.1)	2.0			
Daily	0 (0)	0 (0)	N/A			
Hallucinogens	617 (90.3)	2,416 (88.6)	1.17	6.551, $df = 4$	.162	0.046
Never	35 (5.1)	184 (6.7)	0.75			
In past, not within past 12 months	19 (2.8)	91 (3.3)	0.83			
Rarely	11 (1.6)	37 (1.4)	1.19			
Occasionally	1 (0.1)	0 (0)	N/A			
Daily	35 (5.1)	184 (6.7)	0.75			
Marijuana				3.422, $df = 4$[#]	.490	0.032
Never	408 (59.5)	1,673 (61.2)	0.93			
In past, not within past 12 months	69 (10.1)	305 (11.2)	0.89			
Rarely	95 (13.8)	368 (13.5)	1.03			
Occasionally	88 (12.8)	290 (10.6)	1.24			
Daily	26 (3.8)	99 (3.6)	1.05			
Prescription pain medication				5.031, $df = 4$	.284	0.043
Never	630 (92.2)	2,528 (92.8)	0.92			
In past, not within past 12 months	34 (5.0)	145 (5.3)	0.93			
Rarely	13 (1.9)	44 (1.6)	1.18			
Occasionally	4 (0.6)	7 (0.3)	2.28			
Daily	2 (0.3)	1 (0.0)	8.00			
Sedatives				8.420, $df = 4$	.077	0.053
Never	651 (95.3)	2,604 (95.5)	0.93			
In past, not within past 12 months	13 (1.9)	77 (2.8)	0.67			
Rarely	13 (1.9)	24 (0.9)	2.18			
Occasionally	4 (0.6)	20 (0.7)	0.79			
Daily	2 (0.3)	2 (0.1)	4.00			

Note. All numbers are % (N) unless otherwise stated.

*$p < .05$ Bonferroni corrected (threshold $0.05/9 = 0.0056$).

[#]Results based on Pearson's χ^2 test.

Table 3. Sexual behavior in university students based on problematic smartphone use

Variable	Current problem with smartphone use (≥32) ($N = 687$)	No current problem with smartphone use (<32) ($N = 2,738$)	Odds ratio (OR)	Likelihood ratio χ^2	Raw (p value)	Effect size (Cramer's V)
Has been sexually active?				2.746[#]	.097	0.028
Yes	487 (70.9)	2,025 (74.0)	0.86			
No	200 (29.1)	711 (26.0)	1.17			
During the past 12 months, how many sexual partners have you had?				42.496, $df = 6$[#]	<.001*	0.130
Not applicable – not sexually active past 12 months	33 (6.8)	147 (7.3)	0.89			
1	271 (55.8)	1,328 (65.6)	0.69			
2	63 (13.6)	258 (12.7)	0.97			
3	46 (9.5)	138 (6.8)	1.35			
4	32 (6.6)	54 (2.7)	2.43			
5	8 (1.6)	39 (1.9)	0.82			
6 or more people	33 (6.8)	61 (3.0)	2.21			

Note. All numbers are % (N) unless otherwise stated.
*$p < .05$ Bonferroni corrected (threshold $0.05/2 = 0.025$).
[#]Results based on Pearson's χ^2 test.

Table 4. Mental health of university students based on problematic smartphone use

Variable	Current problem with smartphone use (>/=32) ($N = 687$)	No current problem with smartphone use (<32) ($N = 2,738$)	Odds ratio (OR)	Likelihood ratio χ^2 (ANOVA)*	Raw (p value)	Effect size (Cramer's V)
Binge eating disorder?			1.32	1.154, $df = 1$[#]	.283	0.019
Positive screen	20 (3.0)	61 (2.3)				
Currently taking prescribed mental health medication(s)			1.20	2.289, $df = 1$[#]	.130	0.026
Yes	105 (15.4)	359 (13.2)				
PHQ-9 total				20.707, $df = 1$[#]	<.001*	0.079
Score of less than 10	610 (92.1)	2,576 (96.3)	0.50			
Score of 10 or more	52 (7.9)	100 (3.7)	2.16			
PTSD			1.41	9.265, $df = 1$[#]	.002*	0.052
Positive screen	122 (18.1)	364 (13.5)				
BDD				4.834, $df = 1$[#]	.028	0.038
Positive screen	18 (2.6)	39 (1.4)	1.86			
Anxiety total (grouped)				63.921, $df = 3$[#]	<.001*	0.139
No anxiety (score 0)	307 (46.2)	1,624 (61.2)	0.55			
Mild (score 5)	180 (27.1)	627 (23.6)	1.20			
Moderate (score 10)	108 (16.2)	253 (9.5)	1.83			
Severe (score 15)	70 (10.5)	151 (5.7)	1.94			
ADHD			2.04	52.859, $df = 1$[#]	<.001*	0.126
Positive screen	179 (27.1)	403 (15.1)				
RSE total (mean, SD)	18.75 (5.63)	20.63 (5.79)	N/A	$F(1, 3284) = 55.344$	<.001*	0.326 (Cohen's d)
BIS total (mean, SD)	63.63 (10.17)	58.36 (9.88)	N/A	$F(1, 3157) = 140.36$	<.001*	0.530 (Cohen's d)

Note. All numbers are % (N) unless otherwise stated; BDD: body dysmorphic disorder; RSE: Rosenberg Self-Esteem Scale; BIS: Barratt Impulsiveness Scale; PHQ-9: Patient Health Questionnaire; ADHD: attention-deficit hyperactivity disorder; PTSD: post-traumatic stress disorder; ANOVA: analysis of variance.
*$p < .05$ Bonferroni corrected (threshold $0.05/9 = 0.0056$).
[#]Results based on Pearson's χ^2 test.

Kwon et al., 2013), but not all (Lopez-Fernandez et al., 2017). Higher problematic use in younger versus older people is consistent with previous data (Augner & Hacker, 2012; Lopez-Fernandez et al., 2017). The association between problematic smartphone use and lower GPA is an important finding. Even a small negative impact on GPA in young people due to problematic smartphone use could have very profound effects on their academic and vocational opportunities in later life. The significant association found with fraternity/sorority membership could reflect an expectation of people to engage with smartphone communication as a part of these socializing processes, such as, peer norms and expectations. This is also in keeping with the finding that problematic smartphone use was linked with higher numbers of past-year sexual partners. Smartphones may act as a social avenue for sexual contact, whether through sustained partnerships or more casual sex.

We found that alcohol misuse (as indexed by AUDIT scores) was the only type of substance misuse that was significantly higher in those with problematic smartphone use compared to the control group. If problematic smartphone use is viewed through the lens of being an addiction, one might expect it to be associated with the broad swathe of substance misuse problems, at least in a large sample as used in this study. These data indicate a particularly unique relationship between problematic smartphone use and higher alcohol use problems. One possible explanation is that common personality features underlie both alcohol use problems and smartphone problems (e.g., harm avoidance) and this gives rise to these two particular problematic behaviors (Martinotti, Cloninger, & Janiri, 2008). Another, non-mutually exclusive explanation could be that socially isolated individuals (and those with depressive symptoms or anxiety) may be more prone to excessive smartphone use, as well as to using alcohol. It seems unlikely that excessive smartphone use per se would directly lead to higher alcohol use disorder, unless through some third mediating variable. Smartphone use likely develops earlier in life than alcohol use problems and so we feel it unlikely that alcohol use leads to smartphone use.

In terms of other mental health problems, we found that problematic smartphone use was significantly associated with lower self-esteem, higher impulsive problems (ADHD and Barratt Impulsiveness Scale scores), depression, anxiety, and PTSD. In a previous meta-analysis of the literature, problematic smartphone use was significantly associated with depression, anxiety, and lower than expected self-esteem (Elhai et al., 2017). Thus, our findings add to growing evidence of multiple deleterious mental health impact of excessive use of smartphones and the Internet per se (Fineberg et al., 2018). Impulsivity has been linked with problematic smartphone use previously with a variety of impulsivity scales (not only the Barratt; Billieux, Van der Linden, d'Acremont, Ceschi, & Zermatten, 2007) and with ADHD symptoms. The link with ADHD is particularly intriguing, since screen time (including smartphone use) was previously associated with inattentive and impulsive symptoms cross-sectionally (Montagni, Guichard, & Kurth, 2016), as has also been found to be the case with problematic Internet use more broadly (Kim, Lee, Lee, Namkoong, & Jung, 2017), especially in younger compared to older Internet users (Ioannidis et al., 2018).

This study into the problematic use of smartphones has the advantage of being relatively large. Nonetheless, there are several limitations that should be considered. The study was cross-sectional and hence the direction of causality of any effects cannot be established – this would require longitudinal research on the topic; however, we hope that such cross-sectional data will support such follow-up. Given that associations were generally of small effect size, we did not attempt to examine mediation between variables. There are limitations inherent in the study being conducted using an online interface via the Internet – diagnostic assessment may be less accurate via such an online survey compared to in-person assessment by a clinician; there may be responder biases; and there may be underreporting (although this possibility is reduced by individuals' responses not lacking personally identifiable information) (for an analysis of the complex relationship between anonymity and reporting stimulant use, see Zander, Norton-Baker, De Young, & Looby, 2016). In addition, self-report questions pertaining to substance use and other potentially socially embarrassing behaviors, such as having multiple sexual partners, have their own limitations: for example, individuals may not disclose the full extent of their actions or may not report it accurately due to bias. Finally, we used an instrument to assess problematic smartphone use that was previously validated and appears to have excellent psychometric properties; due to time constraints (length of the survey), we did not assess the extent to which individuals engaged in different forms of problematic smartphone use (e.g., gaming vs. gambling vs. social media). This issue warrants further examination in future work.

In summary, we found in a large sample of university students that problematic smartphone use was common, and associated with worse self-esteem and a number of mental health problems notably higher impulsivity and alcohol use disorder, as well as with greater fraternity/sorority membership and more past-year sexual partners. It remains to be seen whether smartphones constitute an avenue for the manifestation of other primary disorders (e.g., compulsive sex disorder and gambling disorder) or rather whether their excessive use may constitute a separable mental disorder. This issue also applies to other types of technology-related behaviors as well as to Internet use per se, which are interconnected statistically (Baggio et al., 2018). In conclusion, it would be valuable to examine mediation and possible causality between particular variables in future work using a longitudinal design.

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