

The Relationship Among Anxiety, Depression, and Problematic Smartphone Use in University Students: The Mediating Effect of Psychological Inflexibility

ABSTRACT

Objective: The number of studies that reveal the relationship between problematic smartphone use (PSU) and various health problems is increasing. In this study, we aimed to examine the relationship among PSU, depression, and anxiety and the mediating effect of psychological inflexibility (PI) in this relationship in university students.

Methods: This study was conducted with 412 university students aged between 18-35 years studying at a state university. All participants completed the Acceptance and Action Questionnaire-II, Beck Depression Inventory, Beck Anxiety Inventory, and Smartphone Addiction Scale-Short Version. PROCESS macro in SPSS was used for mediation analysis.

Results: Our analyses showed that both depression and anxiety were independent predictors of PSU even after controlling for each other. Our findings show that PI is the mediator variable in the effect of depression and anxiety on PSU.

Conclusion: Mental health professionals working with problematic smartphone use among university students should consider psychological inflexibility as well as depression and anxiety.

Keywords: Acceptance and commitment therapy, addictive behavior, anxiety, depression, smartphone

Introduction

Major changes occurred in individuals' relationships with the outside world and with others after smartphone technology's entry into daily life in 2007. Smartphones are not only a communication tool in modern life but are also indispensable for meeting various needs such as socializing, entertainment, money management, shopping, work, and education. The number of smartphone users worldwide exceeded 3 billion in 2019.¹

An increasing number of studies have suggested strong links between smartphone use and social, interpersonal, mental health, and cognitive dysfunction. Studies have provided evidence that sleep disorders, low self-esteem, depression, and anxiety are associated with problematic smartphone use (PSU), especially in adolescent and young adult populations. Smartphone use is also associated with physical effects, including neck and back pain and vision problems.²⁻⁶

According to acceptance and commitment therapy (ACT), psychological inflexibility (PI) lies at the root of psychological disorders. As such, ACT seeks to improve functionality and quality of life by reducing PI and enhancing psychological flexibility (PF).⁷

PF is defined as the ability to behave in accordance with previously chosen values in the present moment. The basic components of PF include keeping internal experiences separate, accepting one's experiences, focusing on the moment, being self-aware, acting in the light of personal values, and acting with a commitment to objectives. Verbal and cognitive processes cause pain, leading to narrowing an individual's behavioral repertoire by means of experiential avoidance.⁸



Tacettin Kuru¹ 

Sinem Çelenk² 

¹Department of Psychiatry, Alanya Alaaddin Keykubat University Alanya Training and Research Hospital, Antalya, Turkey
²Mentis Psychology Center, Antalya, Turkey

Corresponding Author:
Tacettin Kuru
✉ tkuru76@yahoo.com

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PSU, Depression, and Anxiety

Studies examining the relationship between smartphone use and mental problems have increased. A 1-year longitudinal follow-up study by Thomée et al² showed the relationships among excessive smartphone use, stress, depression, and sleep disorders. A similar longitudinal study by Bickham et al⁹ in which participants were monitored for a year found a relationship between smartphone use intensity and depression symptoms. A study by Demirci et al³ conducted on Turkish university students included 319 university students and studied the relationship between smartphone use anxiety and depression, reporting that a relationship exists among smartphone use, anxiety, depression, and sleep disorders. The review study carried out by Elhai et al¹⁰ reported 9 of 10 studies to have associated severity of depression with excessive smartphone use. That same study reported correlation values for the relationship between depression and smartphone overuse to generally be between 0.30 and 0.40.

Depression, Anxiety, and Psychological Inflexibility

A growing number of studies reveal strong evidence for PI's relationship with depression and anxiety. Masuda et al¹¹ reported increases in PI or decreases in PF to be associated with increased anxiety, depression, and somatic symptoms. Another study on 663 Japanese university students associated PI with depression and sleep disorders.¹² High PI in university students has been positively associated with the presence of stress, anxiety, general anxiety, and somatization, even after controlling for demographic covariates.¹³

The meta-analytical study conducted by Ruiz¹⁴ reported the weighted correlation for PI and depression symptoms to be 0.55 ($n = 3.323$), with correlations ranging from 0.37 to 0.77. They reported the correlation between anxiety symptoms and PI to be between $r = 0.16$ and $r = 0.76$ ($n = 3.043$). The weighted correlation across their study was $r = 0.52$.

Ruiz-Ruano et al¹⁵ showed a relationship between PI and smartphone overuse. If PI plays a role in the effect of anxiety and depression on PSU, reducing PI may be a logical therapeutic strategy for PSU, especially for comorbid depression and anxiety.

Given the theoretical framework and literature, we aim to test the following hypotheses (Hs) in this study: H1: PI mediates the link between depression scale scores and PSU; H2: PI mediates the link between anxiety scale scores and PSU.

Methods

Participants

The study included voluntary students aged 18-35 years studying at various departments of a public university in the 2017-2018 academic year. Convenience sampling was used as the sampling method. First, permission was obtained from the university authority. Face-

to-face interviews were conducted with students on the university campus. In total, 412 students agreed to participate in the study and completed the scales.

Instruments

Acceptance and Action Questionnaire-II (AAQ-II): Bond et al¹⁶ developed the AAQ-II owing to insufficient internal consistencies and psychometric features for the Acceptance and Action Questionnaire that had widely been used to measure PI. The Turkish language version of the AAQ-II exhibits good internal consistency with a Cronbach's alpha of 0.84. It also exhibits good temporal stability for a 60-day test-retest reliability analysis (Pearson's correlation coefficient $r = 0.85$).¹⁷ The 7-item AAQ-II is a 7-point Likert-type scale, with respondents answering the questions on a scale from 1 (never true) to 7 (always true). Higher scores are interpreted as showing higher PI.

Beck Depression Inventory (BDI): The BDI is a 21-question self-report measure for depression severity.¹⁸ It measures the somatic, cognitive, impulsive, and emotional signs of depression. Higher scores indicate greater effects of depression. Hisli¹⁹ investigated the validity and reliability of the Turkish language version of the BDI.

Beck Anxiety Inventory (BAI): Beck et al²⁰ developed this 21-item, Likert-type, self-report scale. The 21 items are scored from 0 (not at all) to 3 (severely). Ulusoy et al²¹ studied the reliability and validity of the Turkish language version. Higher scores indicate higher levels of anxiety.

Smartphone Addiction Scale-Short Version (SPAS-SV): Kwon et al²² developed this 6-point, Likert-type scale used to measure the risk of smartphone addiction in young people. It consists of 10 items. Noyan et al²³ studied the reliability and validity of the Turkish language version. Cronbach's alpha of reliability was measured as 0.867. The test-retest reliability coefficient has been determined as 0.926. Possible scores range from 10 to 60, with higher scores indicating a higher risk for addiction.

Ethic Committee Approval

The study procedures are carried out in accordance with the World Medical Association Declaration of Helsinki. Alanya Alaaddin Keykubat University Clinical Research Ethical Committee (dated 13.04.2018, number 2018/28) approved the study protocol. Before commencing the research, we explained the procedure to the participants and received their informed consent, after which we asked the participants to complete the scales.

Statistical Analysis

First, we investigated the observed scale characteristics and associations among the variables, checking normality assumptions using skewness and kurtosis values.

Second, the correlations among AAQ-II, BDI, BAI, and SPAS-SV were computed.

After these processes, we conducted two different mediation analyses. In the first analysis, the mediating role of AAQ-II in the effect of BDI on SPAS-SV was examined. In this analysis, BAI, age, and sex were used as covariates. In the second analysis, the mediating role of AAQ-II in the effect of BAI on SPAS-SV was examined. This analysis entered the BDI scores, age, and gender as covariates. We performed mediation analysis using the PROCESS V.2.16.1 in SPSS.²⁴

MAIN POINTS

- Correlation analysis showed that Problematic Smartphone Use (PSU) was positively associated with psychological flexibility (PI), depression, and anxiety.
- Depression and anxiety are independent predictors of PSU.
- PI is a partial mediating variable in the relationship between anxiety and PSU.
- PI showed a complete mediating effect in the relationship between depression and PSU.

Bootstrap analysis was applied to test the mediating model of PI. In these analyses, the mediational effect was regarded as significant if the 95% bias-corrected and accelerated confidence intervals (CIs) (lower limit and upper limit) for the indirect effect (IE) based on 10,000 bootstrapped samples were not equal to 0.²⁴ We set the alpha level at .05 for all analyses and calculated all statistics using SPSS version 22 (IBM Corp.; Armonk, NY, USA).

Results

The study group consisted of 412 university students aged 18-35 years (63.6% females). Participants' mean age was 20.71 (SD = 2.52) years. Demographic and clinical characteristics are shown in Table 1.

We first assumed the data to be normally distributed and checked the normality using skewness and kurtosis values. Although normal distribution has both skewness and kurtosis values equal to zero, skewness and kurtosis values between -2 to +2 are acceptable for psychometric purposes.²⁵ The skewness and kurtosis values in this analysis fell within the acceptable range of -2 to +2 (Table 2).

Table 1. Distribution of Demographic Characteristics

Characteristics	n (%)
Gender	
Female	262 (63.6)
Male	150 (36.4)
Living situation	
With family	60 (14.6)
Living apart from family with friends	123 (29.9)
Living apart from family, alone	35 (8.5)
Student dormitory	194 (47.1)
Spare time activities	
Sports	55 (13.3)
Listening to music	109 (26.5)
Reading	53 (12.9)
Computer games	23 (5.6)
Internet	152 (36.9)
Other	20 (4.9)
Social media preferences	
Facebook	19 (4.6)
Instagram	319 (77.4)
Twitter	52 (12.6)
Other	22 (5.3)
Purpose of smartphone	
Talking to others, SMS, taking photos, other	135 (32.8)
Use	
Surfing the internet	115 (27.9)
Using social media sites	162 (39.3)

Abbreviation: SMS, short message service.

Table 2. Descriptive Statistics and Correlation Analysis of Variables

	Mean (SD)	Min-Max	1	2	3	4	Skew.	Kurt.	Cronbach's α
1. BDI	15.00 (11.25)	0-62	-				1.017	0.900	0.919
2. BAI	12.92 (10.59)	0-58	0.527 ^a	-			1.258	1.754	0.910
3. SPAS-SV	29.50 (11.34)	10-60	0.254 ^a	0.250 ^a	-		0.430	-0.360	0.898
4. AAQ-II	22.50 (9.20)	7-49	0.550 ^a	0.446 ^a	0.265 ^a	-	0.313	-0.376	0.860

Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; AAQ-II, Acceptance and Action Questionnaire-II; SPAS-SV, Smartphone Addiction Scale-Short Version; SD, standard deviation; Min, minimum; Max, maximum; Skew., skewness; Kurt., kurtosis.

^a*P* < .001.

The correlation analysis showed SPAS-SV to be positively associated with AAQ-II (*r* = 0.265, *P* < .001), BDI (*r* = 0.254, *P* < .001), and BAI (*r* = 0.250, *P* < .001). As expected, the AAQ-II revealed itself to have positive correlations with BDI and BAI (*r* = 0.550, *P* < .001 and *r* = 0.446, *P* < .001, respectively).

A positive correlation was also found between BDI and BAI (*r* = 0.527, *P* < .01).

All our measurements showed significant correlations in the expected direction. We observed no multicollinearity problems, with the highest obtained correlation being *r* = 0.55.

Cronbach's alpha was calculated for all scales; it was found to be 0.91, 0.91, 0.89, and 0.86 for BDI, BAI, SPAS-SV, and AAQ-II, respectively (Table 2). All scales produced very good internal consistency results.

As a result of the mediation analysis (Figure 1), the path from BAI to AAQ-II was positive and statistically significant (β = .189, standard error (SE) = 0.041, *P* < .001). The total effect BAI had on SPAS-SV was positive and significant (β = .168, SE = 0.60, *P* = .005). When PI was included in the model, the effect of BAI on SPAS-SV was reduced but was still statistically significant (path *c'* or direct effect: β = .133, SE = 0.061, *P* = .029).

The bootstrapping results indicated a significant IE to exist from BAI on SPAS-SV through AAQ-II (IE or *ab*: β = .035, SE = 0.018, 95% bias-corrected CI = 0.005-0.076 with nothing equal to zero).

This shows that AAQ-II is a partial mediating variable in the relationship between BAI and PSU (Table 3).

In Model 2, BDI predicted AAQ-II (Path *a*: *B* = 0.355, SE = 0.039, *P* < .001) as well as SPAS-SV (Path *c* or total effects: *B* = 0.165, SE = 0.056, *P* = .004). However, when the mediator was added to the model, BDI's effect on SPAS-SV lost its significance (path *c'* or direct effect: *B* = 0.099, SE = 0.061, *P* = .105). The BDI's IE on SPAS-SV through AAQ-II

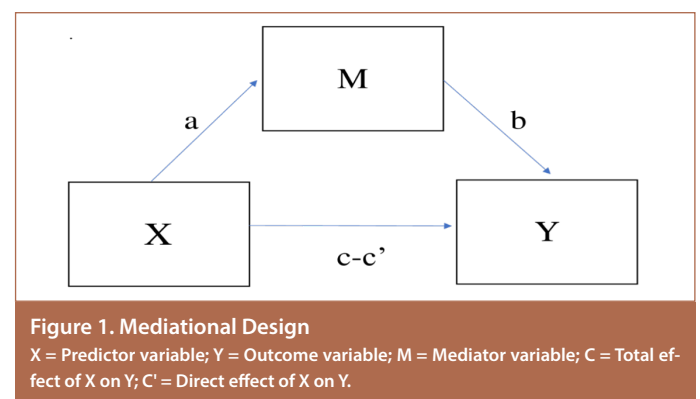


Table 3. Data From the Mediation Analyses on the Effects of Depression and Anxiety on PSU Through the Mediation of PI

Model 1	Predictor	Outcome	β	SE	P	Bootstrap BC at 95% CI for indirect effect	
						Lower	Upper
(a)	BAI	AAQ-II	.189	0.041	< .001		
(b)	AAQ-II	SAS-SV	.183	0.071	.010		
Total effect of BAI on SPAS-SV (c)			.168	0.060	.005		
Direct effect of BAI on SPAS-SV (c')			.133	0.061	.029		
Indirect effect of BAI on SPAS-SV (ab)			.035	0.018		0.005	0.076
Model 2							
(a)	BDI	AAQ-II	.355	0.039	.001		
(b)	AAQ-II	SAS-SV	.183	0.071	.010		
Total effect of BDI on SPAS-SV (c)			.165	0.056	.004		
Direct effect of BDI on SPAS-SV (c')			.099	0.061	.105		
Indirect effect of BDI on SPAS-SV (ab)			.065	0.028		0.010	0.121

Abbreviations: BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; AAQ-II, Acceptance and Action Questionnaire-II; SPAS-SV, Smartphone Addiction Scale-Short Version; PSU, problematic smartphone use; PI, psychological inflexibility; BC, bias-corrected; CI, confidence interval; SE, standard error. Bootstrapping (with 10,000 samples) was used in all mediations at a 95% CI. Mediating effect is significant when the values between the lower and upper CI contain no zeroes.

was significant (path ab or IE: $B = 0.065$, $SE = 0.028$, 95% bias-corrected CI = 0.010-0.121 with nothing equal to zero). Thus, AAQ-II was identified as a complete mediator in the relation between BDI and PSU (Table 3).

Discussion

In this study, we aimed to examine the effect of anxiety scale scores and depression scale scores on PSU and the mediating role of PI on this effect. We first examined the relationship between depression scale scores, anxiety scale scores, PSU, and PI. We found that depression scale scores and anxiety scale scores showed a significant positive relationship with both PSU and PI. We additionally determined PI to be positively associated with PSU; this relationship was at a significant level. In our study, we created two separate models for each independent variable (BDI and BAI) to examine the PI's mediating role. The other independent variable was also controlled along with age and gender in each model. Depression scale scores and anxiety scale scores still had a significant effect on PSU, even when the other was controlled for each situation, that is, an increase in the depression scale scores and anxiety scale scores was related to increases in PSU. When adding PI to the model, although the effect of anxiety scale scores on PSU had decreased, this effect was still statistically significant. In the other model that examined the effect of depression scale scores on PSU, when PI was added to the model, the effect of depression scale scores became statistically nonsignificant. Proceeding from these results, we have determined PI to show a mediating role in the effect of depression scale scores and anxiety scale scores on PSU (H1 and H2).

There is growing evidence that defines PI as the transdiagnostic conceptualization of the mental health symptomatology underlying.²⁶ For example, PI at lower levels has been associated with poor overall psychological health.²⁷

Although the number of diseases has increased in classical classification systems, transdiagnostic approaches have been able to place some of the psychiatric diseases that have been entered into different diagnostic categories under one umbrella. Transdiagnostic concepts such as repetitive negative thinking, rumination, and anxiety sensitivity have recently become the center of focus.²⁸ These con-

cepts can be viewed as a vulnerability factor for psychopathology from one perspective.

PI is a model in which behaviors are excessively controlled by the individual's thoughts, emotions, and other internal experiences where these experiences are avoided at the expense of the cost of more effective and meaningful actions.²⁹ In this sense, PI is seen to overlap very well with addiction.

Indeed, when examining studies on PI's relationship with various behavioral addictions, PI is seen to be related to compulsive sexual behavior,³⁰ technological addiction,³¹ and Internet addiction.³² In addition, studies that have performed ACT interventions aimed at minimizing PI have reported ACT to be effective in substance-related and behavioral addictions.³³⁻³⁶

Previous studies have identified PF/PI as a mediator among various psychological conditions.^{11,37}

Similarly, previously performed studies have revealed the relationship smartphone addiction has with depression and anxiety.^{2,3} Our study contributes to the literature by showing PI's mediating effect on this relationship. PI can be assessed from a dimensional perspective whose level may vary from healthy to pathological states rather than from a categorical distinction in the form of being present or not. In other words, PI is definable as tending to avoid or struggle with unwanted internal experiences (e.g., anxiety, fear), having less contact with personal values and a lower capacity to be present at the moment, and acting less in line with their values.

PI leads to a decrease in the repertoire of behaviors.

People with high levels of PI may spend more time on their smartphones to deal with the emotional distress that arises owing to anxiety and depression. In the case of PI in particular, being depressed and stuck with negative thoughts about one's self and future, having a low capacity to accept feelings such as the negative internal feelings present in anxiety, and the lessening of decisive actions in line with values may contribute to this process. In addition, the narrowing of one's behavioral repertoire may contribute to PSU.

Although rumination is associated with many psychiatric diseases, its relationship with the psychopathology of depression comes to the fore. Rumination in depression is maladaptive and is not only a triggering factor but also a maintaining factor for depression. It has been shown that experiential avoidance, which is the main component of PI, mediates the effect of rumination on depression. Although rumination was not examined separately in this study, it may be one of the factors underlying the stronger relationship between PI and depression.³⁸

When considering the high comorbidity rates among depression, anxiety, and behavioral addictions and the negative impact these comorbid conditions have on treatment, transdiagnostic models remain an important area of a treatment goal.³⁹

PSU prevention programs should address mental issues such as PI and anxiety and depression. Programs on decreasing PI in university students may assist in reducing the risk of PSU. In addition, ACT interventions aimed at reducing PI when depression and anxiety are present may also minimize PSU as well as symptoms of anxiety and depression.

Our study has some limitations. This study was cross-sectional, thus limiting the interpretation of the results. In addition, the results are based on self-reported measures to assess depression, anxiety, PI, and PSU. We did not obtain any additional information about psychiatric diagnoses by conducting a psychiatric interview. Therefore, our data are subject to bias owing to common method variance. We conducted our study on a population of university students; thus, we cannot generalize our study to other populations.

We used the AAQ-II for measuring PI. Although the AAQ-II is generally accepted for measuring PI, the scale's items are unable to express all the areas of PI (being in the moment and acting in line with values) to the same extent.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Alanya Alaaddin Keykubat University (Approval Date: April 13, 2018; Approval Number: 2018/28).

Informed Consent: Informed consent was obtained from the individuals who participated in this study.

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