



Internet Addiction in Adolescents: A Rational Emotive and Cognitive Behavior Therapy Perspective

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Abstract

Internet addiction has gained increased scientific attention during the last decades. However, theoretical models explaining mechanisms underlying Internet addiction are scarce, impeding further development of prevention and treatment approaches. In the present study, we applied the principles of Rational Emotive and Cognitive Behavior Therapy (RE&CBT) to gain insight into relevant predictors of Internet addiction. We hypothesized that irrational beliefs are positively, and rational beliefs negatively related to Internet addiction, and that these relationships are mediated by psychopathological tendencies. A sample of 300 adolescents (151 girls and 149 boys, age range 15–18 years, $M = 16.21$, $SD = 1.03$) completed the following questionnaires: Internet Addiction Test, Serbian Version of the General Attitude and Belief scale, and Symptom Checklist-90-Revised. Irrational beliefs were positively correlated with Internet addiction, while rational beliefs were unrelated to Internet addiction. The relationship between irrational beliefs and Internet addiction was partially mediated through phobic anxiety and obsessive–compulsive tendencies. The results suggest that the RE&CBT approach might be useful in the prevention and treatment of Internet addiction.

Keywords Internet addiction · Irrational beliefs · Rational-emotive and cognitive behavioral therapy · Obsessive compulsiveness · Phobic anxiety · Psychopathology

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Introduction

Internet Addiction

During the last decades, the Internet has become a widespread means of gaining information, communication, and developing social networks. The number of Internet users is increasing worldwide with the majority being adolescents and young people (e.g., Gibson et al., 2013). The use of the Internet may be beneficial for persons as it facilitates relationships, provides avenues to find alternate forms of support (Matsuba, 2006), and to explore important age-related issues such as identity, sexuality and a sense of self-worth among adolescents (Greenfield & Yan, 2006). However, some persons develop excessive Internet use, which has a negative impact on their relationships, academic and professional performance (Young, 1998). Several terms are used in the literature to designate this phenomenon: problematic internet use, compulsive internet use, pathological internet use, and internet addiction. The variety of terms reflects differing conceptualizations of dysfunctional Internet use. Young's (1997) conceptualization of Internet addiction as an impulse control disorder, sharing characteristics with pathological gambling has been the most widely endorsed by researchers.

According to Young (1997), Internet addiction is characterized by excessive Internet use and its negative consequences, and through motivation to use the Internet as a way of escaping from problems or of relieving a dysphoric mood. Excessive use of the Internet is manifested through cognitive preoccupation with the Internet (thinking about it when not on-line), not being able to control the amount of time and needing increasing amounts of time spent using the Internet and feeling distressed when trying to stop the use. Negative consequences that persons with Internet addiction face are conflicts with significant persons related to the Internet use, and jeopardized social relationships, educational or professional achievements.

Internet Addiction and Psychopathology

Research and clinical practice demonstrate that a variety of mental disorders co-occur with Internet addiction (Cash et al., 2012). According to Block (2008), about 86% of persons with Internet addiction have some other mental disorder present. Most research on the relationship between Internet addiction and psychopathology has focused on depression and anxiety. It has been generally shown that Internet addiction is related both to depressive disorder at a clinical level (e. g. Farahani et al., 2018; Seki et al., 2019) and to depressive tendencies in the general population (Bisen & Deshpande, 2020; Kitazawa et al., 2018; Kumar & Mondal, 2018; Li et al., 2019; Yücens & Üzer, 2018). Likewise, Internet addiction is associated with anxiety disorders (e.g., Farahani et al., 2018) and with anxiety tendencies in general population, which has been shown for general anxiety (e.g., Bisen & Deshpande, 2020; Kitazawa et al., 2018; Kumar & Mondal, 2018; Li et al., 2019), and for social anxiety as well (Dong et al., 2018; Yücens & Üzer, 2018). Other psychopathological tendencies such as impulsivity (Bisen & Deshpande, 2020), interpersonal

sensitivity (Kumar & Mondal, 2018), ADHD tendencies (Kitazawa et al., 2018), obsessive–compulsive tendencies (Kumar & Mondal, 2018; Laconi et al., 2018), alcohol and substance use (e.g. Rücker et al., 2015; Yen et al., 2009) and delinquent behavior (e.g. Evren et al., 2014) have also been related to Internet addiction (for a meta-analysis on the relationships between Internet addiction and psychopathology see Fumero et al., 2018).

A growing number of longitudinal studies support the hypothesis that various forms of psychopathology and problem behavior predispose individuals for Internet addiction or contribute to its persistence (e.g., Cho et al., 2013; Li et al., 2019; Strittmatter et al., 2016). There is also growing empirical evidence of a bidirectional relationship between psychopathology and Internet addiction as suggested by a systematic review of longitudinal research in adolescents and young adults (Anderson et al., 2017).

More recently, fear of missing out (FOMO) and craving have stood out among constructs supposed to be relevant for this relationship. FOMO has been recognized in relation to the problematic use of online social networks. It is defined as a fear of missing rewarding experiences that other persons might be having (Przybylski et al., 2013). The mediating role of FOMO in the relationship between psychopathological tendencies and problematic internet use, or problematic use of online social networks and applications, has been established in numerous studies (e.g., Sela et al., 2020; Wegmann et al., 2017). Similarly, craving, or a strong and prevalent desire to engage repeatedly in addictive behaviors (Niu et al., 2016), which was first investigated in relation to substance addictions, is also recognized as important in Internet addiction and other behavioral addictions. Empirical studies have shown that craving is related to Internet addiction (e.g., Moretta & Buodo, 2018; Niu et al., 2016). Brand et al. (2016) propose a model according to which craving is one of the factors that mediate the relationship between psychopathology (and other personal characteristics) and internet use disorders.

It seems that Internet addiction and other mental health problems may mutually influence each other, turning the condition into a vicious cycle. Given the association between Internet addiction and psychopathology, an important question for theory and treatment planning is how this relationship can be explained.

Cognitive Behavioral Framework and Internet Addiction

Within a cognitive-behavioral framework, Davis (2001) proposed a model of pathological internet use which is applied in some cognitive behavioral approaches to treatment, e. g. Young (2007, 2011, 2013). According to the model, pathological internet use develops as a function of distal and proximal causes. Various forms of psychopathology represent distal causes that lead to the development of maladaptive cognitions as proximal causes of pathological internet use.

Davis distinguishes two main subtypes of maladaptive cognitions: thoughts about the self, and thoughts about the world. Cognitive distortions about the self are self-doubt, low self-efficacy, and negative self-appraisal (e.g., “I am only good on the Internet”) (Davis, 2001). Davis notes that cognitive distortions about

the self tend to be guided by a ruminative cognitive style. Rumination involves constantly thinking or talking to one's friends about overusing the Internet. Individuals prone to rumination experience more severe and prolonged pathological Internet use. Cognitive distortions about the world involve generalizing and all-or-nothing thinking (e.g., "The Internet is the only place I am respected"). Cognitive distortions are automatically enacted by stimuli associated with the Internet and symptoms of pathological Internet use ensue. Davis' model emphasizes cognitive symptoms such as obsessive thoughts about the Internet, thinking about the Internet while offline, anticipating future time online. These symptoms, and behavioral symptoms of pathological Internet use, reinforce maladaptive cognitions, forming a vicious cycle.

Rational Emotive and Cognitive Behavior Therapy (RE&CBT) is an approach within cognitive—behavior tradition which postulates, as CBT generally, that cognition is the most important determinant of emotion (DiGiuseppe et al., 2014). RE&CBT differs from other approaches in distinguishing between rational and irrational beliefs (DiGiuseppe et al., 2014). Rational beliefs are evaluative cognitions that are preferential in nature, consistent with reality and logical, whereas irrational beliefs are absolutistic evaluations, inconsistent with reality and illogical (Ellis & Dryden, 1997). RE&CBT theory defines four types of rational beliefs: non-dogmatic preferences, non-awfulising beliefs, high frustration tolerance beliefs, and self-other-, and life-acceptance beliefs. Opposed to them are four types of irrational beliefs: demands, awfulising beliefs, low frustration tolerance beliefs, and self-, other-, and life-depreciation beliefs. While rational beliefs lead to functional emotional and behavioral consequences, irrational beliefs lead to dysfunctional emotions and behaviors.

According to RE&CBT, irrational beliefs contribute to the development and maintenance of psychological disorders (Ellis & Dryden, 1997). Studies have established a relationship between irrational beliefs and emotional disturbances such as depression, anxiety, guilt, hostility, and anger (for a review, see Browne et al., 2010). On the other hand, RE&CBT theory assumes that rational beliefs have a protective role during stress and prevent or attenuate dysfunctional emotional and behavioral responses, which has also been empirically supported (for a review, see Caserta et al., 2010).

Research on Internet addiction from the RE&CBT perspective has indicated that irrational beliefs are related to Internet addiction. Ko et al. (2008) showed that frustration intolerance beliefs are elevated among persons with Internet addiction. Specifically, they found that Internet addiction was related to higher intolerance to frustration of entitlement and emotional discomfort among male adolescents and to lower tolerance to frustration of achievement and emotional discomfort among female adolescents. Vukosavljevic-Gvozden et al. (2015) investigated the role of irrational and rational beliefs in internet gaming addiction. Based on the RE&CBT theory, they formulated and confirmed a model of the mediating role of psychopathology in the relationship between irrational beliefs and internet gaming addiction. They showed that irrational beliefs indirectly—via the symptoms of psychopathology—increase Internet gaming addiction.

Current Study

The present study aims to test whether the model posited by Vukosavljević-Gvozden et al. (2015), referring to internet gaming addiction, holds for Internet addiction as well. We hypothesize that irrational beliefs are positively, and rational beliefs negatively related to Internet addiction, and that psychopathological tendencies play a mediating role in these relationships. By investigating various psychopathological tendencies, we aim to establish possible specific mediators between beliefs and Internet addiction. Since previous research has shown that different types of psychopathology are related to both irrational/rational beliefs and to Internet addiction, we have no hypotheses on specific types of mediators.

We believe that this model may be valuable for the understanding of the phenomenon of Internet addiction for the following reasons: the model is in accordance with the basic premises of the RE&CBT theory on the relationship between beliefs and psychopathological tendencies, and it includes the empirically well-established relationship between various forms of psychopathology and Internet addiction. We also think that RE&CBT approach to Internet addiction may contribute to a better understanding of mechanisms of Internet addiction as well as further development of theory-based forms of prevention and treatment, which are much needed in the field.

Method

Participants and Procedure

The sample included 300 adolescents (151 girls and 149 boys) from one college preparatory high school in Belgrade, Serbia. Participants' age ranged from 15 to 18 years ($M = 16.21$, $SD = 1.03$).

Informed consent from parents of all pupils who attended classes included in the sample and from school authorities was obtained prior to data collection. All adolescents present at the school at the time of the assessment consented voluntarily to participate. Participants completed questionnaires in classroom groups at their schools, taking approximately thirty minutes. Adolescents received no material compensation for their participation.

Measures

Serbian Version of the General Attitude and Belief scale (SGABS)

Irrational and rational beliefs were assessed using the Serbian Version of the General Attitude and Belief Scale (SGABS; Marić, 2002, 2003), an adaptation of the General Attitude and Belief Scale (GABS; Bernard, 1998; DiGiuseppe et al., 1988). The GABS

has been demonstrated to be a reliable and valid measure of beliefs in accordance with RE&CBT theory (Bernard, 1998; David et al., 2002).

The scale adapted for the Serbian population (Marić, 2002, 2003) consists of 37 items, 29 of them reflecting irrational and 8 reflecting rational beliefs. Participants are asked to indicate the extent to which they agree with each of the 37 statements on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In accordance with the recommendations by the author of the SGABS to determine the appropriate scale structure within each study, we performed a Principal component analysis with Promax rotation on the SGABS items. The Scree plot indicated a five-factor solution, which was further confirmed by Horn's Parallel Analysis (performed with the use of parallel macro for SPSS, O'Connor, 2000, see Appendix A). The factors are interpreted as (1) Self-downing (SD), (2) Demands for fairness (DFF), (3) Need for approval (NFAP), (4) Rationality (RAT), and (5) Need for achievement (NFAC). In further analyses, we used mean scores, obtained by averaging the items with the highest pattern coefficients (and loadings, provided in Appendix A) for the corresponding factors. We also calculated an irrationality score by averaging all items referring to irrational beliefs.

Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1992)

SCL-90-R is a widely used 90-item self-report symptom inventory. For each of the 90 items, participants indicated the degree of distress experienced during the past 7 days, using a 5-point scale (from 0 to "not at all" to 4- "extremely"). Apart from a global score, the questionnaire provides measures of nine symptom dimensions: somatization (SOM), obsessive-compulsive (O-C), interpersonal sensitivity (INT), depression (DEP), anxiety (ANX), hostility (HOS), phobic anxiety (PHOB), paranoid ideation (PAR), and psychoticism (PSY). Research shows that SCL-90-R scales have adequate reliability (Derogatis, 1992), which was also established in the present study (Cronbach's alphas from 0.78 to 0.87).

Internet Addiction Test (IAT; Young, 1998)

IAT is a self-report measure of the compulsive use of the Internet for adults and adolescents. It consists of 20 items covering a broad range of characteristics of excessive Internet use, and its consequences. For each item, respondents are asked to select the response that best describes them on a 6-point Likert scale (0-not applicable; 1-rarely; 2-occasionally; 3-frequently; 4-often; 5-always). IAT is a widely used instrument and shows adequate psychometric characteristics (Laconi et al., 2014). In this study, we used the Serbian adapted version of IAT (Popović-Čitić & Marković, 2013), which showed high internal consistency both in the original study as well as this one (Cronbach's $\alpha=0.88$).

Results

Descriptive Statistics

Descriptive statistics for all used measures are given in Table 1. All variable scores except for Need for achievement deviated from normality, as indicated by the Shapiro–Wilk’s test. The majority were positively skewed, which was to be expected since clinical instruments were administered to a nonclinical sample. Therefore, in subsequent analyses, we used normalized scores (using Blom’s formula).

Distribution of subjects in IAT categories according to classification by Young (2011) is presented in Table 2.

Correlations between all variables and their (Cronbach’s α) reliabilities are provided in Table 3. Internet addiction and SCL subscales showed good reliability and SCL total score reliability was excellent. Reliabilities for GABS-37 scores ranged from acceptable (for Rational beliefs and Need for achievement) to good (for Self-downing and Demands for Fairness), and the reliability was the highest for the irrational beliefs total score.

Table 1 Descriptive statistics for instruments used in the study

Measure	Min	Max	M	SD	Skewness		Kurtosis		Shapiro–Wilk’s	
					Statistic	SE	Statistic	SE	Statistic	Sig
IAT	0.00	90.00	33.09	16.91	0.46	0.14	− 0.10	0.28	.98	.001
SD	1.00	4.78	2.00	0.81	0.93	0.14	0.57	0.28	.93	.000
DFP	1.00	5.00	2.41	0.88	0.64	0.14	− 0.07	0.28	.96	.000
NFAP	1.00	5.00	2.84	0.90	0.03	0.14	− 0.52	0.28	.99	.012
RAT	1.00	5.00	3.60	0.74	− 0.34	0.14	− 0.31	0.28	.98	.000
NFAC	1.00	5.00	2.91	0.78	0.05	0.14	− 0.25	0.28	.99	.142
IRAT	1.00	4.45	2.48	0.64	0.56	0.14	0.35	0.28	.98	.000
SCL-SOM	0.00	3.25	0.97	0.65	0.92	0.14	0.51	0.28	.93	.000
SCL-O-C	0.00	4.00	1.55	0.83	0.36	0.14	− 0.23	0.28	.98	.000
SCL-INT	0.00	3.78	1.07	0.76	0.86	0.14	0.53	0.28	.94	.000
SCL-DEP	0.00	3.77	1.22	0.79	0.70	0.14	− 0.14	0.28	.95	.000
SCL-ANX	0.00	3.80	1.02	0.86	0.94	0.14	0.16	0.28	.91	.000
SCL-HOS	0.00	4.00	1.26	0.93	0.85	0.14	0.09	0.28	.93	.000
SCL-PHOB	0.00	3.71	0.48	0.67	2.00	0.14	4.13	0.28	.73	.000
SCL-PAR	0.00	3.67	1.23	0.88	0.57	0.14	− 0.36	0.28	.95	.000
SCL-PSY	0.00	2.70	.56	0.59	1.57	0.14	2.32	0.28	.83	.000
SCL total	0.06	3.03	1.04	0.58	0.73	0.14	0.11	0.28	.96	.000

IAT Internet addiction test, *SD* Self-downing, *DFP* Demands for fairness, *NFAP* Need for approval, *RAT* Rationality, *NFAC* Need for achievement, *IRAT* Irrationality score, *SCL-SOM* *SCL* Somatization, *SCL-O-C* *SCL* Obsessive–compulsive dimension, *SCL-INT* *SCL* Interpersonal sensitivity, *SCL-DEP* *SCL* Depression, *SCL-ANX* *SCL* Anxiety, *SCL-HOS* *SCL* Hostility, *SCL-PHOB* *SCL* Phobic anxiety, *SCL-PAR* *SCL* Paranoid ideation, *SCL-PSY* *SCL* Psychoticism

Table 2 Distribution of subjects in IAT categories according to classification by Young (2011)

IAT category (score range)	N	%
Normal internet use (0–30)	148	49.3
Mild internet addiction (31–49)	102	34.0
Moderate internet addiction (50–79)	48	16.0
Severe internet addiction (80–100)	2	0.7
Total	300	100

Internet addiction was consistently positively correlated to irrational beliefs, in a low to moderate intensity, most notably with SD. The correlation with rational beliefs, on the other hand, was not significant. The correlations of IAT with SCL subscales and total score were also all positive and low to moderate in magnitude. The highest correlations with symptomatology were obtained with SCL total score, Obsessive–compulsive dimension, Depression, and Psychoticism.

All irrational beliefs were also moderately correlated among themselves, and the correlation with the irrational beliefs total score was high, as would be expected, while correlations with rational beliefs were mostly non-significant (except for a low negative correlation between RAT and SD and irrational beliefs total score). Moreover, all SCL subscales were moderately to highly positively correlated, and all correlations between subscales and the total score were high.

Symptomatology measures were mostly lowly to moderately positively associated with irrational beliefs as well (although correlations were not significant for all subscales). Rational beliefs did not correlate with any of the SCL subscales or the total score.

Mediating Effect of Symptomatology

Since rational beliefs were not correlated to either Internet addiction or measures of symptomatology, we only tested the mediating effect of symptomatology on the relationship between irrational beliefs and Internet addiction. We used a parallel multiple mediation model within the Process macro (Hayes, 2017), in which all mediators are tested simultaneously. Since irrational belief scales all correlated highly with the total score and showed a similar pattern of correlations to other variables, we opted to perform the mediator analysis using the irrational beliefs total score. Also, since we were interested in exploring the role of specific psychopathological tendencies, instead of the global symptomatology score, we used the nine symptom dimensions.

Irrational beliefs had a direct positive effect on Internet addiction, $c' = 0.29$ [0.18, 0.40], $p < 0.001$. Regarding mediation effects, as can be seen in Table 4, irrational beliefs significantly predicted practically all symptomatology subscales (save Somatization). On the other hand, only Obsessive–compulsive dimension, Phobic anxiety, and marginally Paranoid ideation predicted Internet addiction. The significance of the indirect effects was determined based on the bootstrapped confidence intervals, and only in case of Obsessive–compulsive dimension and Phobic anxiety, the 95% confidence interval did not include zero. This is to say,

Table 3 Correlations between used measures

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
IAT	.88																
SD	.35**	.84															
DFP	.25**	.54**	.83														
NFAP	.22**	.35**	.33**	.77													
RAT	-.11	-.24**	-.10	.00	.65												
NFAC	.15*	.44**	.41**	.23**	-.01	.65											
IRAT	.33**	.81**	.82**	.60**	-.12*	.65**	.89										
SCL-SOM	.18**	.05	.07	.11	.02	.08	.09	.80									
SCL-O-C	.31**	.18**	.01	.09	-.01	.22**	.15*	.54**	.83								
SCL-INT	.23**	.23**	.09	.14*	-.04	.29**	.23**	.46**	.62**	.81							
SCL-DEP	.29**	.20**	.11	.12*	-.06	.27**	.20**	.56**	.66**	.74**	.85						
SCL-ANX	.23**	.27**	.18**	.21**	-.02	.31**	.30**	.61**	.60**	.59**	.68**	.87					
SCL-HOS	.26**	.15**	.34**	.19**	.03	.19**	.29**	.42**	.43**	.45**	.51**	.56**	.81				
SCL-PHOB	.29**	.21**	.13*	.18**	-.08	.13*	.21**	.39**	.43**	.50**	.48**	.51**	.35**	.81			
SCL-PAR	.16**	.16**	.21*	.13*	.07	.32**	.27**	.40**	.46**	.60**	.58**	.50**	.47**	.41**	.78		
SCL-PSY	.27**	.21**	.08	.10	-.03	.19**	.18**	.40**	.50**	.62**	.61**	.54**	.40**	.54**	.54**	.78	
SCL total	.34**	.24**	.15**	.17**	-.02	.28**	.26**	.72**	.79**	.80**	.87**	.83**	.65**	.63**	.69**	.72**	.96

* $p < .05$, ** $p < .01$

IAT Internet addiction test, SD Self-downing, DFP Demands for fairness, NFAP Need for approval, RAT Rationality, NFAC Need for achievement, IRAT Irrationality score, SCL-SOM SCL Somatization, SCL-O-C SCL Obsessive-compulsive dimension, SCL-INT SCL Interpersonal sensitivity, SCL-DEP SCL Depression, SCL-ANX SCL Anxiety, SCL-HOS SCL Hostility, 0, SCL-PAR SCL Paranoid ideation, SCL-PSY SSCL Psychoticism. All variables have been normalized

Table 4 Direct and indirect effects of irrational beliefs on internet addiction

Variable	Direct effects of irrational beliefs on symptomatology			Direct effects of symptomatology on internet addiction			Indirect effects		
	A	SE	95%CI	B	SE	95%CI	AB	SE	95%CI
SCL_SOM	.09	.06	[-.02, .20]	-.01	.07	[-.13, .13]	-.001	.008	[-.016, .017]
SCL_O-C	.14*	.06	[.03, .26]	.22**	.08	[.07, .37]	.032	.017	[.004, .071]
SCL_INT	.22***	.06	[.11, .33]	-.12	.09	[-.29, .05]	-.027	.019	[-.068, .007]
SCL_DEP	.20***	.06	[.09, .31]	.17	.09	[-.01, .35]	.034	.020	[.000, .078]
SCL_ANX	.30***	.05	[.19, .40]	-.16	.10	[-.33, .01]	-.047	.031	[-.115, .008]
SCL_HOS	.28***	.05	[.18, .39]	.10	.07	[-.03, .24]	.030	.022	[-.009, .078]
SCL_PHOB	.19***	.05	[.08, .29]	.16*	.07	[.02, .30]	.030	.017	[.001, .069]
SCL_PAR	.26***	.05	[.15, .37]	-.14†	.07	[-.28, .01]	-.036	.020	[-.079, .001]
SCL_PSY	.18***	.05	[.07, .28]	.13	.08	[-.02, .28]	.023	.016	[-.003, .060]
Total							.038	.032	[-.022, .102]

† $p < .06$, * $p < .05$, ** $p < .01$, *** $p < .001$

SCL-SOM SCL Somatization, *SCL-O-C* SCL Obsessive–compulsive dimension, *SCL-INT* SCL Interpersonal sensitivity, *SCL-DEP* SCL Depression, *SCL-ANX* SCL Anxiety, *SCL-HOS* SCL Hostility, *SCL-PHOB* SCL Phobic anxiety, *SCL-PAR* SCL Paranoid ideation, *SCL-PSY* SCL Psychoticism. All variables have been normalized. Indirect effects are rounded to 3 decimal places, due to small values

these two dimensions mediated the association between irrational beliefs and Internet addiction. The total effect of irrational beliefs on Internet addiction was thus $c = 0.33$ [0.22, 0.43], $p < 0.001$ and the total explained variance of Internet addiction was $R^2 = 0.23$, $p < 0.001$.

To further test the mediating effect, we examined several structural equation models. In Models 1a and 2a the latent irrational beliefs factor was defined by the four irrational belief scores, whereas in models 1b and 2b, the rational beliefs score was included as well. In all models, the latent symptomatology factor was defined by nine symptomatology scales, and Internet addiction was included as a manifest variable in the model. In Models 1a and 1b we assumed that Internet addiction would be predicted by both irrational beliefs and symptomatology, while in Models 2a and 2b we only included a regression path from symptomatology, but not from irrational beliefs. A regression path from irrational beliefs to symptomatology was included in both models. In other words, Models 1a and 1b include both a direct and indirect effect of irrational beliefs on Internet addiction, whereas Models 2a and 2b only include the indirect effect via measures of symptomatology. All models were tested using the lavaan package for R (Rosseel, 2012), under the robust maximum likelihood estimator.

The fit of the models is provided in Table 5. Good models are characterized by $\chi^2/df \leq 2-3$, $CFI \geq 0.95$, $RMSEA \leq 0.06$, and $SRMR \leq 0.05$. Values of $CFI \geq 0.90$, $RMSEA \leq 0.08$ and $SRMR \leq 0.08$ can also be considered as indicative of acceptable model fit. AIC is typically used to compare non-nested models fitted on the same data with lower values indicating better fit (Brown, 2006; Harrington, 2009).

Table 5 Model fit for tested SEM models

Model	χ^2 (df)	χ^2 /df	CFI	RMSEA	SRMR	AIC
Model 1a	218.90 (75)	2.92	.908	.080	.058	10,078.58
Model 1b	242.96 (88)	2.76	.902	.077	.059	10,915.07
Model 2a	240.31 (76)	3.16	.894	.085	.066	10,100.19
Model 2b	265.92 (89)	2.99	.888	.081	.067	10,938.04
Model 3	141.55 (70)	2.02	.954	.058	.051	10,002.25

CFI Comparative fit index, *RMSEA* Root mean square error of approximation; *SRMR* Standardized root mean squared residual; *AIC* Akaike information criterion

Models 1a and 1b had an acceptable fit, whereas the fit of models 2a and 2b was slightly below acceptable. A χ^2 difference test showed that Model 1a fit the data better compared to Model 2a, χ^2 diff (1)=20.73, $p < 0.001$. The same was true for the comparison of Models 1b and 2b—Model 1b fit the data better than Model 2b, χ^2 diff (1)=22.10, $p < 0.001$. This is to say that removing the direct effect of irrational beliefs on Internet addiction significantly deteriorated the model, suggesting that the mediation by symptomatology is only partial.

Regarding the comparison of models 1a and 1b, as well as 2a and 2b, their fit indices were generally similar, though AIC favored models 1a and 2a as more parsimonious. Moreover, rational beliefs had a low standardized loading on the corresponding factor of irrational beliefs ($w = -0.21$ for Model 1b and $w = -0.19$ for Model 2b). Thus, we concluded that the best fitting model is Model 1a.

Upon inspecting the modification indices for Model 1a, we decided to include additional five error covariances in the model (Demands for fairness with Obsessive–compulsive dimension and Hostility, Anxiety with Somatization and Interpersonal sensitivity and Phobic anxiety with Psychoticism). This led to an improvement in model fit, such that all indices reached recommended values (Model 3 in Table 4). The final model is shown in Fig. 1.

Discussion

In the field of Internet use research, there is a wealth of studies on Internet addiction and its associations to psychopathology. However, studies on mechanisms underlying the development of Internet addiction and its relation to psychopathology are scarce. In this study, we aimed to elucidate these mechanisms from the perspective of RE&CBT (DiGiuseppe et al., 2014; Ellis & Dryden, 1997). Our assumption that the relationship between beliefs and Internet addiction is mediated by psychopathological symptoms was partially confirmed. The results show that two dimensions of psychopathology, obsessive–compulsive and phobic anxiety tendencies partially mediate the relationship between irrational beliefs and Internet addiction, and that there is also a significant direct effect of irrational beliefs on Internet addiction.

The established relationship between irrational beliefs and internet addiction contributes to theoretical conceptualizations within the cognitive-behavioral framework,

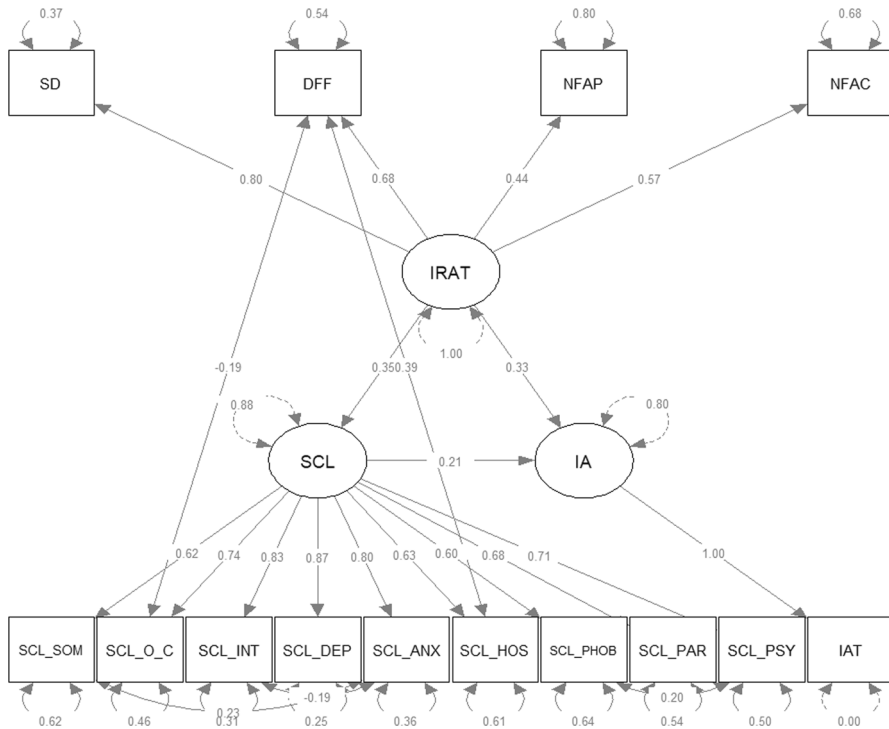


Fig. 1 Final SEM model of the relationship between irrational beliefs, symptomatology and internet addiction

which sees maladaptive cognitions as a central factor leading to Internet addiction. Both Davis (2001) and Young (2007, 2011) understand maladaptive cognitions from the cognitive perspective introduced by Beck (1963). The RE&CBT theoretical framework may also be useful for conceptualizing the development of Internet addiction and its prevention and treatment, as suggested by previous studies by Ko et al. (2008) and Vukosavljevic-Gvozden et al. (2015) and the present study.

The finding that there is a direct, non-mediated relationship between irrational beliefs and Internet addiction suggests that Internet addiction may not be explained solely because of psychopathological tendencies. Although the question of whether Internet addiction represents a distinctive disorder is out of the scope of this research, our results show that it presents a domain of, at least partly, independent maladaptive functioning.

Internet Addiction

Among adolescents in our sample, around one-half show a normal level of internet use, and around one-third mild level of Internet addiction, based on IAT score classification proposed by Young (2011). Sixteen percent of participants exhibit moderate and less than one percent severe Internet addiction. Other studies using

IAT to assess Internet addiction have yielded varied rates of Internet addiction. For example, in a recent study on a large sample of Greek adolescents (Tsimtsiou et al., 2017), the percentage of moderate and severe Internet addiction (which the authors of the study designate as pathological internet use) was approximately 10 percent, which is somewhat lower than in our sample. On the other hand, among Japanese adolescents, the reported percentage of moderate and severe Internet addiction was considerably higher—around 35% (Tateno et al., 2018). As our sample is not a representative one, our data cannot be used to assess the prevalence of Internet addiction in a general population. However, the distribution of Internet addiction scores in our sample, with substantial frequencies of participants in various categories of internet use (save severe Internet addiction to which only two persons belong), allow further analyses of the relationship between Internet addiction and other study variables.

Irrational Beliefs and their Relation to Internet Addiction and Psychopathological Tendencies

The exploratory factor analysis of the scale of irrational and rational beliefs (SGABS; Marić, 2002, 2003) produced four factors of irrational beliefs—Self Downing, Demands for Fairness, Need for Approval, and Need for Achievement, and a Rational beliefs factor. All factors of irrational beliefs are related to Internet addiction. This is in accordance with the findings by Vukosavljevic-Gvozden et al. (2015) that all types of irrational beliefs are related to internet gaming addiction. It follows that, in the prevention and treatment of Internet addiction, the focus should be on challenging and replacing different types of irrational beliefs by their rational alternatives. This can be done through various cognitive, evocative, imaginal and behavioral RE&CBT techniques (see DiGiuseppe et al., 2014).

There is empirical evidence on the effectiveness of CBT in treating Internet addiction (Malinauskas & Malinauskiene, 2019; Winkler et al., 2013; Young, 2013). However, the studies mostly don't describe the therapeutic process, i.e. which problems were tackled and in which way. Moreover, an investigation of the mechanisms of therapeutic change, which is an important step in further development of treatment approaches hasn't been undertaken in relation to Internet addiction. In the field of RE&CBT, it has been shown that a decrease in irrational beliefs is a mediator between therapeutic interventions and a decrease in various indices of psychological problems (e.g., David et al., 2019; for a review of earlier studies, see Browne et al., 2010). This suggests that a change in irrational beliefs using the RE&CBT approach may be a promising field for prevention and treatment of Internet addiction as well.

The total score of irrational beliefs was positively correlated with all SCL-90-R subscales of psychopathological tendencies, save Somatization, and with the general distress score. This is in accordance with a meta-analysis that showed a robust relationship between irrational beliefs and various types of psychological distress (Víslá et al., 2016), albeit correlations obtained in our study were lower than the overall correlation obtained in meta-analysis. It is interesting to note the differences in the results obtained in the present study and in previous study by Vukosavljevic-Gvozden et al. (2015). In contrast to the results of the present study on the partial

mediation between irrational beliefs and Internet addiction by psychopathological tendencies, the latter study showed a complete mediation through symptoms of the psychopathology of the relationship between irrational beliefs and internet gaming addiction. We hypothesize that this indicates that internet gaming addiction is more closely related to psychopathological tendencies, whereas Internet addiction might also develop in persons who do not have elevated other psychopathological tendencies.

Further, the study by Vukosavljevic-Gvozden et al. (2015) also using SGABS, replicated the factorial structure of the original GABS scale (DiGiuseppe et al., 1988; Bernard, 1998). Originally, besides the factors obtained in our study, the scale includes two more factors: Need for Comfort and Other Downing (Bernard, 1998). However, the factor solution obtained on our data corresponds to the factorial structure in another study using SGABS (Vukosavljević-Gvozden et al., 2010). We assume that age differences may explain the discrepancy in the obtained factorial structures of the scale. Namely, factors of Need for Comfort and Other Downing were obtained on a sample encompassing both adolescents and young adults (Vukosavljevic-Gvozden et al., 2015), but not in the present study and the study by Vukosavljević-Gvozden et al. (2010), which both used samples of adolescents. Presumably, Need for Comfort and Other Downing become differentiated from other irrational beliefs after the adolescent period.

We obtained a low negative correlation between the rational beliefs factor and the total score of irrational beliefs. This is in accordance with the conceptualization that rational and irrational beliefs are not opposite ends of the same dimension but rather two independent constructs (Ellis et al., 2010). However, the finding that Rational beliefs are unrelated to psychopathological tendencies is incongruent with RE&CBT theory and previous empirical findings. A meta-analysis established a negative correlation of medium size (-0.31) between rational beliefs and various types of psychological distress (Oltean & David, 2018). Regarding SGABS, Marić (2002, 2003) found negative associations between rational beliefs and psychopathological symptoms, whereas Vukosavljevic-Gvozden et al. (2015), similarly to the present study, report mostly nonsignificant correlations between rational beliefs and psychopathological tendencies. Given these unexpected findings and the low reliability of the factor of Rational beliefs in our study, further investigations of the structure of Rational beliefs, possibly leading to its refinement, are recommendable.

Mediators Between Irrational Beliefs and Internet Addiction: Obsessive–Compulsive and Phobic Anxiety Tendencies

The finding that obsessive compulsive tendencies are associated with Internet addiction replicates results of several previous studies showing that obsessive-compulsiveness is concurrently related to and predicts Internet addiction over time (e.g., Cecilia et al., 2013; Kumar & Mondal, 2018; Laconi et al., 2018; Stavropoulos et al., 2016). There are two types of explanations of the relationship between obsessive-compulsiveness and Internet addiction. One presumes that they are both expressions of a certain common underlying mechanisms. Recently, a research focus has been

on compulsiveness as a transdiagnostic category relevant for obsessive compulsive disorders and addictions and its underlying mechanisms. In a review study, Figeo et al. (2016) point to the following processes that underlie compulsivity in obsessive compulsive disorders and drug and behavioral addictions: impaired reward and punishment processing, cognitive and behavioral inflexibility, and habitual responding regardless of its consequences. Lubman et al. (2004) provide neuropsychological evidence of deficient inhibitory control over maladaptive behavior seen in both addictions and obsessive–compulsive disorders. Albertella et al. (2019), assume that interindividual differences in attentional capture by reward-related cues, i. e. the ability of reward or safety signals to acquire incentive salience for persons and to elicit behavioral responses in those persons, may explain proneness to compulsive behaviors. That is, contextual stimuli associated with the addictive activity may provoke approach responses in addicted persons, or stimuli related to ritualistic behaviors in obsessive–compulsive disorders may become triggers for such behaviors. In interview studies, some persons report that they experience a compulsive need to check social network sites (e.g., Throuvala et al., 2019). Similarly, we may presume that persons with obsessive compulsive tendencies, due to intolerance of uncertainty, may tend to meticulously explore various internet contents thus developing maladaptive internet use.

Another explanation of the relationship between obsessive–compulsive tendencies and Internet addiction is based on the assumption that Internet addiction is a way of coping with symptoms of obsessive and compulsive symptoms and difficulties that may result from them. This explanation is in congruence with Davis' model of Internet addiction (2001) and the model of compensatory internet use by Kardefelt-Winther (2014) and is endorsed by some researchers (e.g., Bipeta et al., 2015). Similar to the present study, Vukosavljević-Gvozdent et al. (2015) found that obsessive compulsive tendencies mediate the relationship between irrational beliefs and internet gaming addiction. This suggest that irrational beliefs play a role in the development of obsessive–compulsive tendencies which in turn may be related to both problematic general internet use and problematic internet games' use through mechanisms considered above.

Previous research has shown that irrational beliefs are related to anxiety (see Višlā et al., 2016 for a meta-analysis), and that general anxiety (Bisen & Deshpande, 2020; Kitazawa et al., 2018; Kumar & Mondal, 2018; Li et al., 2019) and social anxiety (Dong et al., 2018; Yücens & Üzer, 2018) are related to Internet addiction. In the present study phobic anxiety mediated the relationship between irrational beliefs and Internet addiction. Phobic anxiety refers to agoraphobia symptoms (Derogatis & Cleary, 1977), i.e., to anxiety related to open and public spaces. That phobic anxiety may lead to problematic internet use is in accordance with Kardefelt-Winther's model of compensatory internet use (Kardefelt-Winther, 2014). That is, persons with agoraphobic anxiety tendencies may seek escape from threatening situations and thoughts about these situations through maladaptive internet use and may compensate for diminished experiences in the real life which take place in open and public spaces through virtual experiences for example, through online-shopping, socializing through social internet platforms, and seeking various forms of entertainment through internet. The results of the meditational analysis in this study give directions

for treating both phobic anxiety and Internet addiction ensuing from it through the RE&CBT approach of decreasing irrational beliefs and their replacement by alternative rational beliefs.

Limitations

The present study examined general rational and irrational beliefs. However, according to Ellis (1994), specific beliefs may be more closely related to specific outcomes, and they may mediate the effects of general beliefs on these outcomes (DiLorenzo et al., 2011). For a better understanding of Internet addiction from the RE&CBT perspective, the construction of a specific measure of irrational and rational beliefs concerning internet use could be beneficial. Next, our study used self-report data, while it would also be worthwhile to investigate irrational and rational beliefs in a real-life setting, in situations which are potentially Internet addiction provoking (for example, when persons are under some type of stress). These situations contribute to the accessibility of beliefs (David & Szentagotai, 2006), so that they may be more clearly detected, compared to using questionnaires. Although, in accordance with the RE&CBT theory, we hypothesized that beliefs influence Internet addiction, longitudinal studies investigating temporal relations between them are necessary to definitively support this assumption. Finally, there are several different conceptualizations of Internet addiction—some see it as a unitary construct, while in others it encompasses various types of maladaptive functioning which are performed through internet as a means and which are not necessarily related (Starcevic & Aboujaoude, 2017). Therefore, the potential diversity of addictive Internet activities should be considered in future applications of RE&CBT theory to the maladaptive use of the Internet.

Conclusion

The present study adds to the emerging body of research showing that the RE&CBT perspective may be useful for conceptualizing the mechanisms underlying Internet addiction, and more broadly for conceptualizing mechanisms of other forms of behavioral addictions. Our results suggest that the relationship between irrational beliefs and Internet addiction is both direct and partly mediated through psychopathological tendencies. These results have implications for the prevention and treatment of Internet addiction, suggesting that changing irrational beliefs and their replacement by alternative rational beliefs may be effective in helping persons not to develop or to overcome their maladaptive internet use.

Appendix 1

See (Tables 6 and 7).

Table 6 Results of Horn's parallel analysis

Factor	Empirical eigenvalue	Mean random eigenvalue	95% percentile for random eigenvalue
1	7.69	1.73	1.82
2	3.18	1.64	1.71
3	2.31	1.58	1.64
4	2.07	1.52	1.57
5	1.78	1.47	1.52
6	1.40	1.42	1.46
7	1.30	1.38	1.42

The lowest 30 eigenvalues omitted. The horizontal line delineates factors with higher eigenvalues than observed on random data, i.e., factors to be retained

Table 7 Results of exploratory factor analysis on GABS-37

Item	Factor	Pattern coefficients					Factor loadings				
		1	2	3	4	5	1	2	3	4	5
gabs11	Self-downing	0.61	-0.17	-0.03	-0.19	0.20	0.61	0.14	0.13	-0.29	0.29
gabs15		0.82	-0.07	-0.05	-0.04	-0.05	0.77	0.27	0.19	-0.23	0.13
gabs18		0.45	0.22	0.03	0.05	0.15	0.59	0.47	0.26	-0.04	0.32
gabs20		0.71	0.00	0.03	-0.04	-0.03	0.73	0.33	0.26	-0.20	0.15
gabs21		0.51	0.02	0.01	-0.09	0.34	0.62	0.33	0.20	-0.15	0.46
gabs26		0.77	0.01	-0.03	-0.02	-0.12	0.74	0.32	0.22	-0.20	0.07
gabs29		0.48	0.18	0.04	0.13	0.15	0.59	0.44	0.26	0.04	0.33
gabs34	0.70	0.15	-0.02	0.04	-0.24	0.69	0.40	0.24	-0.14	-0.02	
gabs36	0.61	0.09	0.07	0.20	-0.09	0.60	0.36	0.28	0.05	0.11	
gabs4	Demands for fairness	-0.11	0.49	-0.19	0.19	0.32	0.09	0.45	-0.06	0.27	0.42
gabs7		-0.09	0.70	0.07	-0.33	-0.05	0.31	0.67	0.29	-0.33	0.05
gabs16		0.05	0.66	0.10	-0.32	-0.07	0.43	0.70	0.35	-0.35	0.06
gabs19		-0.09	0.70	-0.05	0.17	0.20	0.22	0.69	0.16	0.21	0.36
gabs22		0.10	0.70	0.05	-0.20	-0.02	0.47	0.76	0.32	-0.23	0.14
gabs25		0.15	0.38	-0.07	0.33	0.07	0.24	0.44	0.10	0.31	0.24
gabs28		0.08	0.61	-0.09	0.12	0.16	0.34	0.66	0.15	0.13	0.34
gabs31		0.05	0.71	0.14	-0.21	-0.14	0.42	0.75	0.39	-0.25	0.01
gabs33		0.07	0.69	-0.07	0.01	-0.02	0.35	0.69	0.18	-0.01	0.15
gabs6		-0.14	-0.04	0.73	0.06	0.15	0.11	0.18	0.68	0.08	0.15
gabs9	0.11	-0.12	0.69	-0.12	0.20	0.35	0.21	0.70	-0.15	0.22	
gabs17	-0.01	0.07	0.74	0.21	0.03	0.22	0.31	0.75	0.18	0.11	
gabs24	-0.06	0.02	0.77	0.13	0.08	0.19	0.27	0.76	0.12	0.13	
gabs35	0.22	0.01	0.62	0.09	-0.02	0.41	0.31	0.69	0.01	0.08	
gabs1 ^a	0.04	-0.01	- 0.44	0.28	0.20	-0.12	-0.10	- 0.43	0.32	0.22	

Table 7 (continued)

Item	Factor	Pattern coefficients					Factor loadings				
		1	2	3	4	5	1	2	3	4	5
gabs5	Rationality	-0.01	0.01	-0.08	0.22	0.11	-0.05	0.01	-0.09	0.24	0.13
gabs10		-0.10	-0.10	0.01	0.52	0.18	-0.21	-0.11	-0.07	0.56	0.20
gabs14		0.05	-0.34	0.14	0.55	-0.03	-0.18	-0.28	0.02	0.53	-0.01
gabs23		-0.25	0.35	0.16	0.51	-0.18	-0.20	0.25	0.17	0.53	-0.09
gabs27		0.11	-0.13	0.06	0.60	-0.01	-0.06	-0.07	0.03	0.57	0.07
gabs32		-0.19	0.02	0.08	0.52	-0.05	-0.29	-0.06	-0.01	0.55	-0.02
gabs37		0.18	0.02	0.03	0.71	-0.33	-0.04	0.03	0.04	0.62	-0.19
gabs2		0.11	-0.09	0.18	-0.10	0.50	0.27	0.13	0.22	-0.07	0.50
gabs3		0.05	0.08	0.04	0.22	0.40	0.15	0.21	0.09	0.26	0.46
gabs8		-0.25	0.00	0.06	-0.04	0.70	-0.04	0.07	0.02	0.10	0.64
gabs12	-0.04	0.17	0.09	-0.16	0.50	0.22	0.30	0.17	-0.08	0.51	
gabs13	0.01	0.00	0.05	-0.10	0.72	0.23	0.19	0.10	0.00	0.72	
gabs30	0.22	0.22	-0.02	0.12	0.40	0.39	0.41	0.14	0.12	0.52	

^aThe item was inverted before calculating the factor score

The highest pattern coefficient/loading for each item is given in italic. All coefficients ≥ .40 are given in boldface. Coefficients which are ≥ .40 and are also the highest pattern coefficient/loading for a given item are given in both italic and boldface

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Data Availability The data on which the findings of this study are based are openly available in figshare at <https://figshare.com/s/bc07bd97e13a7f239540>

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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