

# The Relationship between Internet Addiction and Reinforcement Sensitivity Theory in Adolescents: The Mediating Role of Emotional Insecurity and Emotional Flexibility

Elahe Oboudi<sup>1</sup> (MSc), Jafar Hasani<sup>1</sup> (PhD), Maryam Moghaddasin<sup>1</sup> (PhD)

1. Department of Clinical Psychology, Faculty of Psychology and Educational Sciences, Kharazmi University, Tehran, Iran

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## Corresponding Author:

Elahe Oboudi,  
Department of Psychology,  
Kharazmi University,  
Tehran,  
Iran  
E-mail: elahe.oboudi@ut.ac.ir

## Abstract

**Introduction:** The purpose of this study was to examine a hypothesized model which considers the role of neuro-psychological components (brain-behavioral systems) and emotional insecurity and emotional flexibility in Internet addiction.

**Method:** The design of the present study was descriptive-correlational and structural equation modelling. The statistical population of the study included Iranian adolescents who lived in Shiraz in 2021. Among them, 587 adolescents (318 girls and 269 boys) were selected by cluster sampling method. Subjects filled Jackson's five-factor scale, Young's Internet addiction, emotional flexibility, and emotional insecurity questionnaires. After data collection, the relationship between variables was examined using SPSS and Lisrel software.

**Results:** The findings suggest that the Behavioral Approach System (BAS) neither directly nor indirectly had a significant correlation ( $P > 0.05$ ) with Internet addiction; the Behavioral Inhibition System (BIS) is only directly related to addiction to the Internet ( $P < 0.01$  and  $\beta = -0.18$ ), and finally the Fight-Flight-Freeze System (FFFS) is directly ( $P < 0.01$  and  $\beta = 0.29$ ); and indirectly ( $P < 0.05$  and  $\beta = 0.09$ ) correlated with the mediating role of emotional insecurity and emotional flexibility, linked to Internet addiction.

**Conclusion:** Among Gray's brain-behavioral subsystem theory, the FFFS is the strongest predictor of Internet addiction (both directly and indirectly, by influencing emotional flexibility and emotional insecurity), which may indicate that avoidance behavior plays a crucial role in Internet addiction.

**Keywords:** Behavioral Activation System, Behavioral Inhibition System, Fight-Flight-Freeze, Adolescence

## Introduction

Adolescence is often described as a developmental window of vulnerability [1] with a rise in psychopathology [2]. One of the most prevalent psychopathologies during this period is Internet Addiction (IA) [3].

IA is defined as excessive mental preoccupation with the Internet, recurring thoughts about limiting and controlling its use, inability to eliminate the urge to access it, continuous use of the Internet despite malfunctions in various areas, wasting time on the Internet, and extreme desire and craving for it, even when the Internet is not available [4].

Many studies have indicated that adolescents suffering from IA have poorer mental health compared to adolescents who do not suffer from IA [5]. Addiction to the internet is often linked with an increase in the feeling of loneliness [6], aggressive behavior [7],

depression [8-10], anxiety, stress, and poorer academic performance [8, 11-13]. More importantly, the prevalence of IA among adolescents has remained high over the last decade [14]. The global prevalence rates of IA ranges from 12.6 to 67.5% [15], and the general prevalence of severe IA in the Iranian population has been estimated about 4.2% [16].

Given the apparent implications of IA for adolescents, many researchers have been interested in the factors that predict their differences in IA [17-20]. For example, the personality theory emphasizes the significance of personality traits that makes an individual predisposed to IA. While many studies have investigated the role of big five personality traits [20-32], fewer have focused on Gray's psycho-biological personality theory.

Jeffrey Gray [33] in the Reinforcement Sensitivity Theory (RST) introduces three brain-behavioral systems: (1) Behavioral Approach (Activation) System (BAS) that its underlying function is to move the organism in a direction that ultimately leads to reinforcement in the biological level [34]. (2) The FFFS) whose outputs are avoidance behaviors and fleeing from imminent threats and fears [35]. (3) The BIS that is responsible for behavioral inhibition, increased arousal, increased information processing, attention, and the experience of anxiety [36]. Based on RST, individuals are born with different levels of sensitivity in these systems that are genetically and biologically determined. This sensitivity will be modified by environmental and learning factors throughout life [37].

Some studies have confirmed the role of FFFS [38] and passive avoidance in predicting IA [39], while others have indicated that adolescents with IA had higher scores on the BIS and BAS fun-seeking subscales [40, 41]. Accordingly, not only there is a dearth of studies in this area but also there are inconsistencies among the results. Moreover, it seems that there are other relevant variables that contribute to the relationship between personality and IA. The study pays attention to these neglected variables, namely emotional insecurity and emotional flexibility. To further understand the relationship between personality and IA, it is important to have a theoretical framework to study the function of mediating constructs such as emotional insecurity and emotional flexibility in this context. These variables and their relationships are explained according to emotional security theory [42] and the emotion regulation approach [43].

In other words, emotional insecurity and emotional flexibility are different concepts that can be studied about IA. For instance, emotional insecurity is associated with adolescent IA through mediating the relationship between parental conflicts and IA [30]. In other words, more emotional insecurity can give rise to vulnerability to IA. In the Emotional Security Theory, Davies and Cummings [42] accept the principles of family systems theory and attachment theory [44] and emphasize the child's need to maintain a sense of security in the relationship between child and parent, however, security is also seen as a necessity in other family contexts, including the relationship between parents. The child feels

insecure during parental conflicts. This sense of insecurity automatically uses internal resources to restore a sense of emotional security; thus, it can be inferred that emotional security is a person's confidence in his or her internal resources to deal with new threats and dangerous situations [45]. Emotional security theory posits that destructive parental disputes (frequent, intense, child-related disputes) increase children's or adolescents' concerns about maintaining emotional security [46, 47]. Frequent and prolonged activation of the emotional security system requires basic biological and psychological resources (regulation of attention, emotions, thought processes, and action); therefore, excessive efforts to reacquire emotional security may limit the child or adolescent's resources to achieve other fundamental development goals and programs, resulting in highly maladaptive vulnerability [48].

In relation to emotional insecurity, no research has directly examined the relationship between this construct and Gray's brain-behavioral systems. Considering that emotional insecurity theory originates from attachment theory [44], studies investigated the relationship between attachment styles and reinforcement sensitivity theory were examined. Extensive research has linked BIS with attachment insecurity [49]. Jiang and Tiliopoulos found that BAS predicted attachment anxiety [50]. Likewise, FFFS is found to be correlated with attachment anxiety [51].

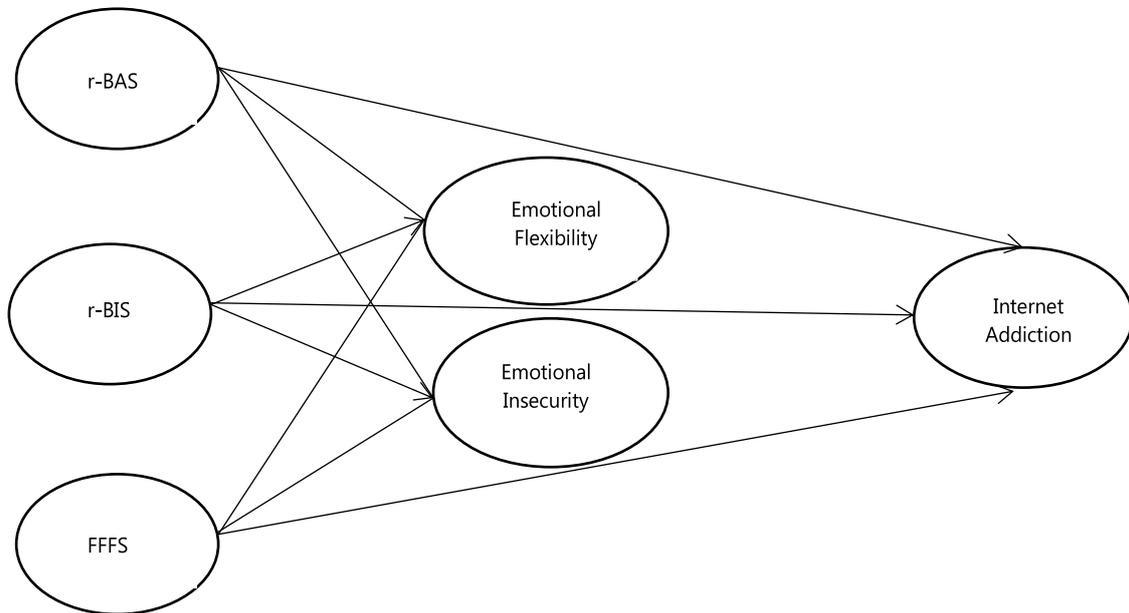
Taken together, emotional flexibility in applying different emotion regulation strategies to effectively meet the demands of a given situation [52] represents another related construct to IA [53]. Emotional flexibility is an important aspect of psychological flexibility [47], and it is a specific type of coping flexibility [54]. Coifman [55] formally defined the concept of emotional flexibility and introduced the idea of emotion as a flexible system. "The ability to suppress or express emotions according to environmental demands and necessities" is defined as emotional flexibility [48]. It is argued that higher levels of psychological flexibility predict fewer psychological symptoms [56]. Previous research has demonstrated that inappropriate uses of emotion regulation strategies, according to the context, make individual vulnerable to different psychopathologies [48]. On the other hand, studies have indicated that adolescents with IA are less able to use effective emotion regulation strategies [57]. So we hypothesized that emotional flexibility would be associated with IA. Reinforcement sensitivity has been postulated as predictors of emotion regulation capacity [58]. For example, Tull et al. found that BIS and FFFS were positively associated with difficulties in emotion regulation [59]. Moreover, some studies have highlighted the role of emotion regulation in mediating the relationship between reinforcement sensitivity and psychopathologies [60]. Thus, we hypothesized that flexibility in emotion regulation would mediate the relationship between brain-behavioral systems and IA.

Finally, based on the diathesis-stress model, psychological disorders are better understood concerning the three biological-genetic factors, personality, and stressful events. These three factors, in combination with social

and familial factors, make individuals vulnerable [61]. Alongside, selecting RST as a personality and a biological-genetic factor, emotional insecurity as a family-related variable, and emotional flexibility as an individual element, this study aimed to indicate some of the underlying mechanisms of IA by examining the process of how Gray's

personality theory influences IA, through the mediating role of emotional insecurity and emotional flexibility in adolescents.

The theoretical model of the research is presented in Figure 1.



**Figure 1.** The theoretical model of the research.

## Method

This research was a correlational-descriptive study in which the relationship between variables was examined by Structural Equation Modeling using Lisrel software. Meyers et al. [62] suggest that the general rule for structural equation models is that a sample size of between 200 and 400 is considered appropriate. Therefore, to select a representative and accurate sample, 600 adolescents from the high school student population of Shiraz were selected by multistage cluster sampling, in 2021. For his purpose, five schools were randomly selected from each of the four districts and 30 students were randomly selected from each school. The research population was 14-18 high school students living in Shiraz in 2021. The mean age was 15.69 with a standard deviation of 1.13. Also, 13 incomplete data were excluded from the analysis process and therefore the analysis was performed on 587 (269 boys (45.8%) and 318 girls (54.2%)) students.

The questionnaires were attached in a random order to neutralize the effect of fatigue while answering. The inclusion criteria included using the internet and being 14-18 years old and the exclusion criteria included reluctance to participate in the study and having severe or chronic physical illness and/or psychological disorder. To observe ethics, after explaining the research objectives and procedure, the researcher distributed the research tools among those students who announced their readiness to participate. They were also assured that their information would be confidential and they could leave the study whenever they desired.

The tools used in this study were as follows:

**Internet Addiction Test:** This test consists of 20 items that are scored on a 6-point Likert scale Young [63] from "not applicable to me" to "always". The higher the score, the higher the level of IA, which indicates: 0-30 normal range, 31-49 mild addiction, 50-79 moderate addiction, and 80-100 severe addiction [63]. In a critical review of the IA scales, Laconi et al. [64] stated that this scale has a high psychometric property and reported its retest reliability as appropriate (between 0.73 and 0.88). In the Persian version, Cronbach's alpha was 0.70 [65].

**Emotional Flexibility Scale (EFS):** The Emotional Flexibility Scale (EFS) was designed by Fu et al. [54] to assess the degree of emotional flexibility in adolescents rescued from an earthquake. It consists of 10 items and three factors: The first factor is related to experiencing and expressing positive emotions in intrapersonal and interpersonal relationships, which is called "tuning of positive emotions" (including items 1, 2, 3, and 4). The second factor is related to the experience and expression of negative emotions in intrapersonal and interpersonal relationships and is called "tuning of negative emotions" (including items 5, 6 and 7) and the third factor is "emotional communication" which refers to the emotional connection between two people (including items 8, 9 and 10). The internal consistency of this questionnaire was evaluated and Cronbach's alpha was 0.80. Cronbach's alpha for all three factors "tuning of negative emotion", "emotional connection" and "tuning of positive emotion" were 0.72, 0.78, and 0.68, respectively. The scale comprised 10 items, each measured with a 7-point Likert scale, ranging from strongly disagree (1) to strongly

agree (7), with higher scores indicating greater ability to regulate emotions to the internal and external context. The results of a study in an Iranian sample for Cronbach's alpha coefficient was 0.87 and the four-week test-retest coefficient was 0.93 [66].

**Jackson 5-scale:** This scale, designed by Jackson [67], is used to assess r-RST. This scale consists of 30 items (six items for each of BAS, BIS, Fight, Flight, and Freeze) in which the respondent must agree with each item on a 5-point Likert scale. Jackson [41] reported Cronbach's alpha for each of these systems as follows: BAS 0.83, BIS 0.76, and fight-flight-freeze 0.74 (for each subsystem 0.78, 0.74, 0.70, respectively). Hassani et al. [68] examined the validity and reliability of the Iranian version of this scale from the perspective of internal consistency, correlation of a set of items, retesting, factor analysis, correlation between subscales, and criterion validity. Cronbach's alpha was 0.72 to 0.88, retest coefficients were 0.64 to 0.78 and the total correlations of the items were 0.28 to 0.68.

**Security in the Interparental Subsystem Scales (SIS):**

This scale has 37 items in the original version, developed by Davies and Foreman [47]. The SIS includes seven subscales including emotional reactivity, behavioral dysregulation, avoidance, involvement, constructive family representations, destructive family representations, and conflict spill over representations. It is based on a four-point Likert scale (1= not at all true of me, 2= a little true of me, 3= somewhat true of me, 4= very true of me). The evaluated alpha coefficient in six scales is more than 0.70. In the subscale of behavioral dysregulation, the alpha coefficient is 0.65. The test-retest reliability coefficients, which were calculated over two weeks with a sample of children, were within an acceptable range (exceeding = 0.70) for all subscales except behavioral regulation disorders [34]. The Iranian version of this questionnaire includes 34 items and 9 subscales, and

Cronbach's alpha in the Iranian sample is reported to be 0.80 [69].

**Results**

The data obtained from 597 questionnaires were used for further analysis, these include 284 boys (47.6%) and 313 girls (52.4%), and the age range of participants was 14 to 18 with a mean of 15.69. First of all, the data were monitored in terms of normality, path analysis assumptions, collinearity, and variance inflation factor. Since the tolerance index for BAS (0.78), BIS (0.75), FFFS (0.80), Emotional Insecurity (0.82), and Emotional Flexibility (0.87) was greater than 0.10 and the Variance Inflation Factor (VIF) for BAS (1.27), BIS (1.31), FFFS (1.24), Emotional Insecurity (1.21), and Emotional Flexibility (1.13) was smaller than 10, this assumption was confirmed. The Durbin-Watson statistic was used to check the independence of errors. Since this statistic (1.73) ranged between 1.5 and 2.5, this assumption was confirmed, as well. The descriptive information of research variables is presented in Table 1. As shown in Table 1, the skewness and kurtosis of data distribution ranged between  $2 \pm 2$ . The Kolmogorov-Smirnov test, also demonstrated that the Z-statistic level was not statically significant, confirming the normality of data distribution. To evaluate the fit of a model, the following criteria are commonly considered: Comparative-Fit index (CFI; good fit:  $\geq 0.90$ ); Normed Fit Index (NFI; good fit:  $\geq 0.90$ ); Root Mean Square Error of Approximation (RMSEA; good fit:  $\leq 0.06$ ); Goodness of Fit Index (GFI; good fit:  $\geq 0.09$ ); Standardized Root Mean Square Residual (SRMR; good fit:  $\leq 0.08$ ); Adjusted Goodness of Fit Index (AGFI; good fit:  $\geq 0.90$ ); Non normed Fit Index (NNFI; good fit:  $\geq 0.90$ );  $\chi^2$ .df (good fit:  $< 3$ ) [70]. Figure 2 presents the final research model, and the indices of model fit are shown in Table 2.

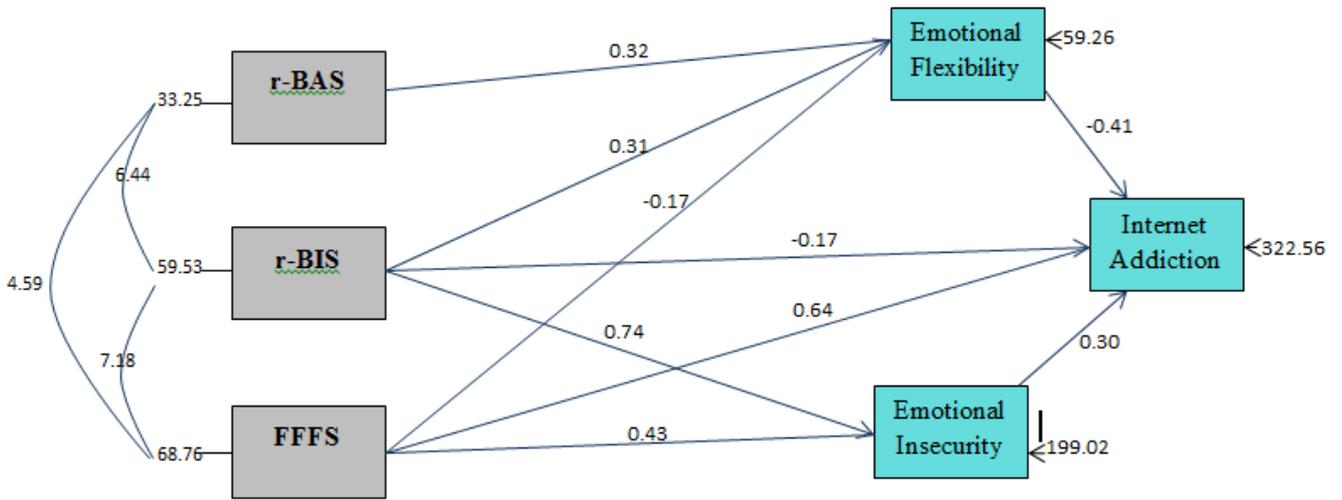
**Table 1. Mean, SD, Skewness, and Kurtosis of Research Variables**

Variable	Mean $\pm$ SD	Skewness	Kurtosis	Internet addiction	Pearson Correlation							
					BAS	BIS	Fight	Flight	Freeze	Emotional flexibility	Emotional insecurity	
IA	34.63 $\pm$ 21.003	0.51	-0.18	1								
BAS	22.08 $\pm$ 3.90	-0.87	0.86	0.20	1							
BIS	23.46 $\pm$ 4.41	-0.70	0.15	-0.051	0.41**	1						
Fight	19.06 $\pm$ 4.91	-0.14	-0.051	0.410**	0.047	0.059	1					
Flight	17.31 $\pm$ 4.51	-0.66	-0.36	-0.008	0.19**	0.21**	-0.073	1				
Freeze	16.06 $\pm$ 4.63	0.10	-0.22	0.290**	0.17**	0.179**	0.099*	0.474**	1			
Emotional flexibility	76.60 $\pm$ 14.08	-.33	0.59	0.298**	0.18**	0.292**	0.149**	0.212**	0.323**	1		
Emotional Insecurity	48.3 $\pm$ 8.05	-0.45	0.83	-0.298**	0.19**	0.124**	-0.173**	-0.009	-0.217**	-0.130**	1	

SD: Standard Deviation

\*\* . Correlation is significant at the 0.01 level

\*. Correlation is significant at the 0.05 level



Chi-Square=5.13, df=3, P-value=0.16272, RMSEA=0.035

Figure 2. Final results of the theoretical model of the research.

Table 2. Model Fit Indices

	RMSEA	RMSR	$\chi^2$ .df	GFI	AGFI	NNFI	CFI	NFI
Index value	0.035	0.05	2.58	0.99	0.98	0.98	0.98	0.90
Acceptable value	Less than 0.08	Equal or less than 0.08	Less than 3	Over 0.9	Over 0.9	Over 0.9	Over 0.9	Equal or less than 0.90

Table 3. BAS Relations with IA, Emotional Flexibility, and Emotional Insecurity

Independent variable	Dependent variables	effect	Standard impact coefficient (direct)	T value
BAS	Internet Addiction	direct	0.05	0.93
		Indirect	0.01	-0.89
		Total	0.03	0.62
	Emotional flexibility	Direct	0.14	3.35**
	Emotional insecurity	Direct	0.05	1.30
BIS	Internet Addiction	direct	-0.18	-4.31**
		Indirect	0.02	0.99
		Total	-0.16	-3.89**
	Emotional flexibility	Direct	0.17	3.87**
	Emotional insecurity	direct	0.19	4.57**
FFFS	Internet addiction	direct	0.29	7.40**
		Indirect	0.09	5.47**
		Total	0.38	9.92**
	Emotional flexibility	direct	-0.20	-5.08**
	Emotional insecurity	direct	0.26	6.75**

According to what is reported in the table above, the relationship between BAS IA is neither directly nor indirectly significant ( $P > 0.05$ ). Also, the relationship between BAS and emotional insecurity is not significant ( $P > 0.05$ ); however, the relationship between BAS and emotional flexibility is positive and statistically significant ( $P < 0.01$  and  $\beta = 0.14$ ).

Considering the table above, BIS has a significant and negative relationship with IA ( $P < 0.01$  and  $\beta = -0.18$ ). The indirect relationship between the BIS variable and IA by the mediating role of emotional flexibility and emotional insecurity is not significant ( $P > 0.05$  and  $\beta = 0.02$ ). Moreover, the relationship between BIS and emotional flexibility ( $P < 0.01$  and  $\beta = 0.17$ ) and emotional insecurity ( $P < 0.01$  and  $\beta = 0.19$ ) is significant and positive.

Results indicate that FFFS has a significant and positive relationship with IA ( $P < 0.01$  and  $\beta = 0.29$ ). Also, the indirect relationship between FFFS and IA mediated by emotional flexibility and emotional insecurity is significant ( $P < 0.05$  and  $\beta = 0.09$ ). The relationship between FFFS and emotional flexibility is negative and significant ( $P < 0.01$  and  $\beta = -0.20$ ). In addition, the relationship between FFFS and emotional insecurity is significant and positive ( $P < 0.01$  and  $\beta = 0.20$ ).

As it can be seen above, emotional flexibility has a negative and statistically significant relationship with IA ( $P < 0.01$  and  $\beta = -0.17$ ) and emotional insecurity has a positive and statistically significant relationship with IA ( $P < 0.01$  and  $\beta = 0.22$ ).

**Table 4.** Relationships between Emotional Flexibility and Emotional Insecurity and IA

Dependent variables	Effect	Standard impact coefficient (direct)	T value
Emotional flexibility	Internet addiction	-0.17	-4.35**
Emotional insecurity	Internet addiction	0.22	5.70**

## Discussion

In this study, we tried to examine the mediating role of emotional flexibility and emotional insecurity in relation to IA, and brain-behavioral systems in adolescents in Shiraz (Iran).

It was hypothesized that emotional insecurity would be positively associated with IA. The findings supported the hypotheses. These findings are in line with previous studies which have examined the relationship between attachment styles and IA. Actually, a positive link exists between insecure attachment styles and IA [71-74].

In this regard, Zhou et al. [30] suggest that adolescents who do not feel safe about conflicts between their parents may be attracted to the Internet in two ways: a. The Internet provides a space for teens to escape emotional distress; For example, teens may use the Internet to temporarily escape the frustration and anxiety associated with parental disputes and unstable families; B. Cyberspace provides emotional support (which is less likely to be provided by parents); For example, gaining emotional support from online friends is a reason for teens to become addicted to the Internet.

The data also yielded a negative relationship between emotional flexibility and IA. In other words, adolescents who are less flexible in emotional responses to the context can be expected to be more prone to IA, and vice versa. The results are consistent with a great deal of research which has been carried out about how difficulty in regulating emotions predicts IA [75]. Accordingly, low levels of emotion regulation have been considered to be a factor that increases the likelihood of risk behaviors in young people and minors [76] such as gambling disorder, gaming disorder, and internet related disorders [77]. Also, Yildiz [78] argues adolescents with smartphones and IA may be using smartphones and the Internet more often to develop more addiction as a way to avoid their negative emotions. In addition, Ko et al. [79] suggest that the Internet provides adolescents with a virtual world in which to escape from emotional difficulties in the real world.

Research on the relationship between brain-behavioral systems and IA is contradictory. In this regard, although some studies believe that the BAS system has a significant relationship with IA [40], other findings highlight the role of the BIS system in IA [80]. Our findings demonstrated that BAS is neither directly nor indirectly related to IA.

Furthermore, the findings of this study, which are in line with other studies [40], suggest that the BIS system has a significant relationship with IA. However, while some researchers have reported a positive relationship between IA and BIS [40, 41, 80], in our study BIS was negatively associated with IA.

One of the characteristics of cyberspace is not worrying about being evaluated, embarrassed, and frightened, which reduces the sensitivity to punishment, while BIS is sensitive to punishment [36]. Thus, reduced BIS leads

addicts not to pay attention to the negative consequences of excessive use of the Internet and also the warnings of people around, which leads to a vicious cycle and continued use of the Internet [81].

Moreover, the results indicated that the relationship between the FFFS system and IA is significant both directly and indirectly. This finding is also consistent with previous ones indicating a positive relationship between FFFS and IA [38]. Explaining this finding can be said that the responses of this system are related to fear or anger [36], and the occurrence of aggressive behaviors and defensive aggression in the virtual environment of the Internet is at a lower cost, individuals tend to overuse the Internet. Both fight and flight behaviors are more easily accomplished, given the possibility of hiding one's identity and the lack of negative consequences that may afflict individuals in the real world; Also, many addiction studies have reported a higher use of avoidance strategies to cope with life problems and the seeking of a temporary escape from reality [82-84]. As a result, people who are more sensitive in this brain-behavioral system are also more prone to excessive use of the Internet and addiction to it [39].

The results obtained from the relationship between brain-behavioral systems and emotional insecurity indicated that the BAS pathway coefficient and emotional insecurity were not statistically significant. This finding contradicts the findings of researchers who investigated the relationship between attachment styles and brain-behavioral systems [50].

This discrepancy can be explained as follows: emotional security theorists believe that people who experience emotional insecurity are concerned about their comfort and safety, and also believe that the activation of the components of emotional security is a mechanism for achieving emotional security. This mechanism put the individual on alert so that individuals can quickly deal with anxiety and maintain their well-being [34]. This is while the function and output of the BIS system (coping with threatening situations, inducing "Beware of danger" and experiencing anxiety and worry [85] is more in line with what is experienced in emotional insecurity than the function and output of the BAS system. As it can be seen, the BIS system is significantly and positively related to emotional insecurity.

Also, the direct relationship between the FFFS system and emotional insecurity was significant. Studies on the relationship between brain-behavioral systems and attachment have yielded similar results [86-88]. This finding may imply that more activity of the FFFS system makes the person experience more emotional insecurity. In RST, it is argued that the FFFS system is responsible for avoidance and escape behaviors. If the threat is actual and unavoidable, the freezing happens. Avoidable actual threat leads to either fear-related fleeing or anger-related fighting [35]. On the other hand, the emotional security hypothesis posits that the threat accompanying

destructive interparental conflicts (e.g., frequent, intense, and child related) leads individuals to respond through concrete component processes including emotional reactivity (experiencing intense fear and anger), and behavioral regulation of exposure to parent affect (avoidance or involvement). Activation of these processes in long term is maladaptive and causes more emotional insecurity [47]. Thus, more activity of the FFFS system might lead to more avoidant behavior and more experiencing fear and anger, and, indeed, more emotional insecurity in adolescents.

The results of this study showed that emotional flexibility is significantly associated with all three brain-behavioral subsystems. BAS is positively associated with emotional flexibility. As previous research has demonstrated that BAS has a unique positive association with adaptive emotion regulation [59]. The BAS system seeks to reward and experience it. Based on this, the high activity of this system motivates individuals to experience positive emotions and makes them more emotionally adaptable. Given that it is theoretically assumed that successful BAS activity is adaptive [34], it can be argued that adaptive activity, including the ability to provide context-appropriate emotional responses, is related to this subsystem.

About the BIS system, based on literature [59] it was assumed that this system has a negative relationship with emotional flexibility. Unexpectedly, our results indicated that BIS is positively associated with emotional flexibility. As some studies have shown, high BIS individuals are more likely to use avoidance-based emotion regulation strategies. These studies explain that individuals with high BIS sensitivity to the sign of punishment emphasize the dangerous aspects of avoidance-focused strategies that involve passive avoidance of risks and threatening stimuli [89]. Although emotional flexibility comprises the two behavioral channels, avoidance-experience, and expression-suppression [55], this study has not examined these two channels with brain behavioral systems, separately. So, further research needs to be conducted in this regard.

The relationship between FFFS and emotional flexibility is negative. This means that the higher the sensitivity of the FFFS system, the less emotional flexibility will be observed in people. This is in line with studies that had revealed that individuals with high FFFS sensitivity have higher levels of emotion dysregulation [59, 90]. That is to say, although emotional flexibility occurs from both behavioral channels of avoidance-experience and expression-suppression [55], in individuals with a highly sensitive FFFS system, the behavioral output of the FFFS system which is active avoidance [91] is predominant, and other flexible responses to context, experience, expression, and suppression, are less common.

This study faced some limitations that should be considered when interpreting the results. First, generalized IA has been studied (a broad term which may cover and does not differentiate between a range of specific online addictions [15] while there are specific types of IA in research literature [92], and studying the

specific uses of various internet tools can help us in better understanding the relationships between the psychological variables and the use of this technology [93]. The second limitation is related to the cross-sectional nature of the research. It is believed that patterns of brain-behavioral systems might change through the course of IA [81]. Third, we did not evaluate joint subsystem hypothesis. According to this hypothesis, different joint patterns of brain-behavioral systems may have alternate output, compared to separate patterns of each system [36]. Finally, the sample of this study was selected from Iranian students and caution should be exercised in the generalization of the findings to other populations and cultures. Therefore, it is suggested that future research attempt to address these limitations.

## Conclusion

This research evaluated the mediation role of emotional insecurity and emotional flexibility with brain behavioral systems and IA. Briefly, the findings of this study suggest that among Gray's brain-behavioral subsystem theory, the FFFS is the strongest predictor of IA (both directly and indirectly, by influencing emotional flexibility and emotional insecurity), which may indicate that avoidance behavior plays a crucial role in IA. Also, two emerging structures related to emotion, emotional flexibility, and emotional insecurity, were able to predict IA as well. Moreover, high levels of FFFS and BIS predicted more emotional insecurity. Greater activities of BAS and BIS lead to more emotional flexibility, and lower levels of FFFS predicted greater emotional flexibility.

## Conflict of Interest

The authors declare no conflicts of interest.

## Ethical Approval

All the subjects participated voluntarily and were informed about the goals, methods, potential benefits, and potential risks of this research before participating. The declaration of Helsinki (1964) was adequately addressed. All data were collected anonymously and there was no relationship between the questionnaires and the participants.

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