

## The longitudinal association between anxiety and Internet addiction in adolescence: The moderating effect of classroom extraversion

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*Background and aims:* The risk effect of anxiety on addictive behaviors, including Internet addiction (IA), has repeatedly been highlighted in the international literature. However, there is a lack of longitudinal studies examining this association in relation to proximal context effects, particularly in adolescence. Such findings would shed light on potential age- and proximal context-related variations in the anxiety–IA association that could better inform IA prevention and intervention initiatives. *Methods:* In this study, 648 adolescents, embedded in 34 classrooms, were assessed at the age of 16 and again at the age of 18 to examine the effect of anxiety on IA behaviors in relation to the average level of classroom extraversion. IA was assessed with the Internet Addiction Test (Young, 1998), anxiety with the relevant subscale of the Symptom Checklist 90 – Revised (Derogatis & Spitzer, 1982) and classroom extraversion with the synonymous subscale of the Five Factor Questionnaire (Asendorpf & van Aken, 2003). A three-level hierarchical linear model was calculated. *Results:* The present findings demonstrated that: (a) higher levels of anxiety were significantly associated with higher IA behaviors, (b) the strength of this association did not vary over time (between 16 and 18 years old), and (c) however, it tended to weaken within classrooms higher in extraversion. *Discussion:* This study indicated that the contribution of individual IA risk factors might differently unfold within different contexts.

**Keywords:** Internet addiction, online addiction, anxiety, classroom extraversion, adolescence

### INTRODUCTION

Internet use has been growing globally, becoming a significant component of work, leisure, and education (Thorsteinsson & Davey, 2014; Valkenburg & Peter, 2011; Wallace, 2014). Its benefits are wide ranging from learning advancements (Wang, Luo, Luo, Wenbin, & Kong, 2012) to enhanced socialization (Wallace, 2014). Given that Internet use is an integrated part of everyday life, its capacity to allow users to become either positively enabled and/or detrimentally affected should be carefully considered (Anderson, Steen, & Stavropoulos, 2016).

Overusing the Internet in a way that is beyond an individual's sense of self-control is of concern (Stavropoulos, Kuss, Griffiths, & Motti-Stefanidi, 2016). The detrimental consequences of unhealthy Internet use are particularly relevant to adolescents and young adults and include impacts on identity formation (Kim et al., 2012; Yuan et al., 2011), brain structure (Yuan et al., 2011), academic achievement (Gentile et al., 2011; Stavropoulos, Alexandraki, & Motti-Stefanidi, 2013), social skills (Griffiths, 2010), emotional regulation (Anderson et al., 2016), symptoms of depression (Dong, Lu, Zhou, & Zhao, 2011; Gentile et al., 2011; Kraut et al., 1998; Selfhout, Branje, Delsing, ter Bogt, & Meeus, 2009), anxiety

(Dong et al., 2011; Selfhout et al., 2009), and hostility (Gentile et al., 2011). Preference for online social interaction is also a prevalent issue that is related to excessive Internet use (Stavropoulos, Gentile, & Motti-Stefanidi, 2016). These repercussions illustrate the compelling need for at-risk individuals to be identified, helped, and (in a minority of cases) treated.

This need is acknowledged (in relation to the excessive use of Internet games in particular) in the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) that asserts “Internet Gaming Disorder” (IGD) as an area in need of further empirical study (American Psychiatric Association [APA], 2013). The proposed condition is described as a “persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress” (APA, 2013, p. 795). Five out of the nine following criteria require to be met for a diagnosis to be performed, including preoccupation, withdrawal, tolerance, loss of control, loss of interest, use

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despite problems, deception, escapism motivation, and jeopardizing other areas of life. While this proposed condition is yet to be an official clinical diagnosis, there are differing perspectives in the literature regarding broader terms and criteria of excessive Internet use behaviors.

More specifically, terms such as compulsive Internet use (Meerkerk, van den Eijnden, Vermulst, & Garretsen, 2009; Thorsteinsson & Davey, 2014; van den Eijnden, Meerkerk, Vermulst, Spijkerman, & Engels, 2008; van den Eijnden, Spijkerman, Vermulst, van Rooij, & Engels, 2010; van Rooij, Schoenmakers, van de Eijnden, & van de Mheen, 2010), problematic Internet use (Gámez-Guadix, Orue, Smith, & Calvete, 2013; Mittal, Dean, & Pelletier, 2013), problem gaming (Billieux et al., 2013; Haagsma, King, Pieterse, & Peters, 2013; King, Delfabbro, & Griffiths, 2013), pathological gaming (Gentile et al., 2011), online game addiction (Hong, You, Kim, & No, 2014; van Rooij, Schoenmakers, Vermulst, van den Eijnden, & van de Mheen, 2011), IGD (APA, 2013), and Internet addiction (IA; Dong et al., 2011; Mittal et al., 2013; Yu & Shek, 2013) have been used to describe these behaviors. To be comparable with previous studies of Greek populations (Kalaitzaki & Birtchnell, 2014; Siomos, Dafouli, Braimiotis, Mouzas, & Angelopoulos, 2008; Stavropoulos et al., 2013), this study uses the term IA and the corresponding definitions and measures (Young & Rogers, 1998). As such, in this study, IA refers to the use of the Internet in a manner that is continuous, compulsive, and causes detrimental consequences to everyday life (Young, Pistner, O'Mara, & Buchanan, 1999). This conceptual approach acknowledges the Internet as an inclusive medium without differentiating the types of online activities and applications that might be engaged by the users (Király, Nagygyörgy, Koronczai, Griffiths, & Demetrovics, 2015).

### Adolescence

Adolescents have consistently been studied in relation to IA risk because they present with high prevalence and high duration of Internet use (Anderson et al., 2016). Indeed, previous studies have supported that seeking autonomy, as a characteristic of this developmental period, combined with the sense of online independence may reinforce IA behaviors (Anderson et al., 2016). Online activities can provide both the feeling of privacy (Kuss, 2013) and rebellion or disengagement from actions dictated by parents (Anderson et al., 2016). Similarly, distinction of adolescence is a tendency to desire to escape and the Internet's many anonymous and engaging applications (i.e., multiplayer games) provide an attractive outlet (Kuss & Griffiths, 2012). Finally, addictive patterns developed in adolescence often serve as a baseline that continues in a trajectory toward adulthood (Stavropoulos, Kuss, et al., 2016). Given that late adolescence has been supported to be the particular developmental time frame, within this wider developmental period, that IA behaviors tend to consolidate (Anderson et al., 2016), the time between 16 and 18 years old will be examined here.

### Conceptual framework

This study builds on a theoretically supported integrative framework to longitudinally investigate IA behaviors from

low to high risk, with emphasis on potential age- and proximal context-related variations of the effects of individual risk factors (Stavropoulos, Kuss, et al., 2016). This integrative framework suggested by Stavropoulos, Kuss, et al. (2016) views IA symptoms along a continuum (ranging from minimum to maximum severity) and emphasizes the interplay between "push" and "pull" factors over the psychosocial development of the Internet user. Push factors include age-related changes (maturation), gender, characteristics of the individual, and factors within the individual's close personal context (i.e., school classroom), which may contribute to IA. Pull factors entail characteristics related to communicative features of the medium (i.e., flow and presence). Based on this model, this study longitudinally examined the (likely) individual risk contribution of anxiety between 16 and 18 years old, in relation to the potential buffering effect of classroom extraversion on this association.

### Anxiety

Many individual factors have been associated with the development of addictive behaviors, including IA (Anderson et al., 2016; Stavropoulos, Kuss, et al., 2016). In such a context, anxiety – as an individual risk factor – has repeatedly been associated with IA risk in cross-sectional studies (e.g., Anderson et al., 2016; Billieux et al., 2013; Dong et al., 2011; Mehroof & Griffiths, 2010). Studies examining other forms of addiction (e.g., substance use) have also observed associations between anxiety and addiction, with psychological components of anxiety – such as sensitivity to stress and emotional salience – being found to be relative to the severity of addictions (Forsyth, Parker, & Finlay, 2003). In addition, adolescence has been considered as a primary risk phase for the development of anxiety symptoms (Beesdo, Knappe, & Pine, 2009).

Given that IA provides immediate gratification and relief from negative feelings, the behavior could function as a maladaptive strategy to modify the experience of negative emotions associated with anxiety (Anderson et al., 2016; Douglas et al., 2008; Griffiths, 2005). Despite the consistent findings, associating anxiety with IA in cross-sectional studies, it should be acknowledged that anxiety-addressing strategies (i.e., Internet overuse) are known to fluctuate over time depending on maturation effects (Cairns, Cairns, Neckerman, Ferguson, & Garipey, 1989; Douglas et al., 2008). More specifically, developmental and socialization processes (Eccles et al., 1993; Kroger, 2006), occurring during adolescence, may enable individuals to be progressively more equipped (e.g., higher cognitive skills: attention focusing, abstract thinking, social reasoning, and advanced thought processing) to address their stressors without escaping online. Brain (prefrontal cortex) and executive functions' development occurring in late adolescence could result in increased inhibition, which is a key skill necessary to moderate addictive manifestations (Crews, He, & Hodge, 2007; Steinberg, 2007). In contrast to this, longitudinal findings related to other forms of addiction (i.e., gambling, alcohol abuse, etc.) provide support to the stability of the association between anxiety and addictive behaviors, with discomfort-decreasing motives dissipating and enhancement motives

(i.e., experiencing positive feelings) increasing over time (APA, 2013; Palmqvist, Martikainen, & von Wright, 2003; Parhami, Mojtabei, Rosenthal, Affi, & Fong, 2014). Furthermore, there is currently a lack of longitudinal studies investigating the possible age-related fluctuations on the influence of anxiety on IA during adolescence.

### *Classroom extraversion*

In addition to individual factors, such as anxiety, contextual influences have been found to contribute to IA (Kuss, 2013; Stavropoulos, Kuss, Griffiths, Wilson, & Motti-Stefanidi, 2017). More specifically, the influence of classmates has been found to be critical during adolescence and in relation to IA behaviors in particular (Freund, Weiss, & Wiese, 2013; Ryan & Patrick, 2001; Stavropoulos, Gentile, et al., 2016; Stavropoulos et al., 2017). Consequently, this study investigates the potential positive influence of the group-classroom characteristic of extraversion on IA development. As a personality trait, extraversion has been described as a tendency to display social behaviors, experience and express positivity, and project high energy and levels of activity (Busato, Prins, Elshout, & Hamaker, 1998). Interestingly, extraversion as a group characteristic has been associated with higher group cohesion and improved communication (Barrick, Stewart, Neubert, & Mount, 1998). Therefore, it is proposed that being in a classroom with more extraverted classmates could provide a better basis for social fulfillment for anxious students and, as such, may reduce their IA propensity. Despite the previously demonstrated associations between the classroom context and IA, as well as the association between group extraversion and well-being, no published study has yet longitudinally investigated the potential buffering effect of classroom extraversion on the anxiety–IA association (Stavropoulos, Kuss, et al., 2016; Stavropoulos, et al., 2017).

### *The present study*

To address these needs, this study investigated a normative sample of adolescents aged 16 years and again at the age of 18. The influence of anxiety was examined as a risk factor related to the individual in the light of age-related changes between 16 and 18 years old and in relation to the contextual effect of classroom extraversion. Based on the literature, to date, the following three hypotheses were formulated:

*Hypothesis 1:* Anxiety is expected to be positively associated with IA risk. Excessive Internet use may lead to immediate gratification and relief from experiences of anxiety increasing IA risk (Anderson et al., 2016; Douglas et al., 2008; Griffiths, 2005).

*Hypothesis 2:* The IA risk influence of anxiety may not vary between 16 and 18 years old. The emotion regulation effect of IA behaviors is assumed to hold over time, despite the maturational changes occurring in late adolescence, in consensus with previous longitudinal findings related to other forms of addictions (e.g., Parhami et al., 2014).

*Hypothesis 3:* The IA risk effect of anxiety may be buffered in classrooms higher on extraversion. A classroom with more extraverted classmates may accommodate social fulfillment for more anxious students and therefore reduce IA tendencies (Barrick et al., 1998).

## METHODS

### *Participants*

Recruitment occurred within the Athens metropolitan area and a chosen regional area (Korinthia) following randomized stratified selection, based on the latest data released by the Ministry of Education. The participating schools were randomly selected. The sample comprised 648 students in 34 classrooms in Greek public, academic, and vocational track high schools. The distribution of the sample did not significantly differ from that of the original population in regard to the area of residence and the type of school attended ( $\chi^2 = 3.83, p = .75$ ).

Participants were assessed twice within two school years [individual-level Wave 1: mean age = 15.75 years,  $SD = 0.57$  years, boys = 301 (46.4%), girls = 347 (53.6%), academic track high schools = 540 (83.2%), vocational track high schools = 108 (16.7%), Athens metro area = 600 (92.6%), Korinthia = 48 (7.4%); individual-level Wave 2: mean age = 17.75 years,  $SD = 0.54$  years, boys = 181 (49.9%), girls = 182 (50.1%), academic track high schools = 292 (80.3%), vocational track high schools = 71 (19.7%), Athens metro area = 326 (89.9%), Korinthia = 37 (10.1%); group-classroom-level Waves 1 and 2: 1 classroom (2.9%), vocational track Korinthia; 3 classrooms (8.8%), academic track Korinthia; 5 classrooms (14.7%), vocational track Athens metro area; 25 classrooms (73.5%), Athens metro area].

With respect to the parents' and guardians' socioeconomic profile, 78.7% were married, 8.3% of the mothers and 8.6% of the fathers were unemployed, and 89% of the mothers and 87% of the fathers had completed high school. At Time 1, Internet usage was a 100%, with 21% predominantly accessing blogs and social networking sites, 16.4% instant messengers, 14.6% information-seeking engines, 13.6% chatrooms, 13.4% online games, 13.4% *YouTube* and other video services, 2.4% pornographic sites, and 5% other applications. Parental consent was 98% and the students' response rate was over 95%. The estimated maximum sampling error with a sample size of 648 is 3.85% at the 95% confidence level ( $Z = 1.96$ ).

Retention between Waves 1 and 2 was 56% due to changes of school and research dropouts. Given the extent, systematic evaluation of the attrition effects on the examined variables was conducted, and did not indicate significant associations (see Table 1). More specifically, attrition was used as an independent variable (dummy coded 1 = attrition, 0 = not attrition) at Level 2 of hierarchical linear modeling (HLM) analyses to assess whether it affected IA score and its interaction with anxiety and classroom extraversion on IA.

Table 1. Attrition, anxiety, classroom extraversion, time, and Internet addiction

	Fixed effects with robust standard errors				
	$b_i$	$SE$	$T$	$df$	$p_i$
Attrition	3.69	1.97	1.87	32	.07
Anxiety $\times$ Attrition	0.42	2.60	0.16	33	.87
Classroom extraversion $\times$ Attrition	-4.82	9.25	-0.52	32	.61
Attrition $\times$ Time	-3.84	3.12	-1.23	33	.23

### Instruments

**Internet Addiction Test (IAT).** Although there is a wide range of psychometrically robust instruments to assess IA (Király et al., 2015) to provide comparability with previous Greek studies (e.g., Siomos et al., 2008; Stavropoulos et al., 2013), the IAT (Young, 1998) was chosen to assess IA risk. The IAT comprises 20 questions examining the occurrence of negative consequences of addictive Internet use (e.g., “How often do you find that you stay online longer than intended?” and “How often do you choose to spend more time online over going out with others?”). Each item is in the form of a 5-point Likert scale (ranging from 0 = “It does not concern me” to 5 = “always”). Scores from each question are added together with total scores ranging from 0 to 100, where 0 indicated minimum and 100 indicated maximum IA symptoms. The internal rate of reliability for the present data was very good with a Cronbach’s  $\alpha = .93$ .

**Symptom Checklist 90 – Revised (SCL-90-R): Anxiety subscale.** To assess anxiety symptoms, the anxiety subscale of the SCL-90-R was used (Derogatis & Spitz, 1999). This subscale comprises 10 items addressing anxiety-associated behaviors, and has been used to examine this construct in international studies (Cuijpers et al., 2014). Participants were required to answer on a 5-point Likert scale as how much they had experienced each of the symptoms during the past 6 months (e.g., “Worrying too much about things?” and “Trembling?”). The mean of the items compiling the subscale was calculated ranging from 0 to 4, where 0 indicated no disturbance and 4 indicated maximum disturbance. Internal consistency of the subscale was acceptable with a Cronbach’s  $\alpha = .72$  and similar to that of previous studies (e.g., Olsen, Mortensen, & Bech, 2004).

**Five Factor Questionnaire for children: Extraversion subscale.** To assess classroom extraversion, the relevant subscale of the Five Factor Questionnaire was used (Asendorpf & van Aken, 2003). The questionnaire comprises five subscales: extraversion, emotional stability, conscientiousness, agreeableness, and openness to experience (OTE). Each subscale included eight bipolar adjectives (i.e., “I have no interests – I have many interests”) that were answered on a 5-point scale (i.e., 1 = very, 2 = somewhat, 3 = neither/nor, 4 = somewhat, 5 = very) situated in between. The mean of the items compiling each subscale was calculated, resulting in a range from 1 to 5, indicating the minimum and the maximum presence of each trait. The Cronbach’s  $\alpha$ s were: extraversion = .74, emotional stability = .55, agreeableness = .63, conscientiousness = .67, and OTE = .73. To assess

classroom extraversion, individual scores within the same classroom were aggregated to produce the classroom mean average. This method has been recommended and applied for contextualizing the effect of personality traits on groups to evaluate group processes (Barrick et al., 1998; Bradley, 2013; Stavropoulos, Kuss, et al., 2016).

### Procedure

The process of data collection was the same across the two time points. A specially trained research team of 13 undergraduates, postgraduates, and PhD students of the Department of Psychology of the University of Athens collected the data in the participants’ classrooms during the first two or the last two school hours (45 min each) of a school day, in accordance with the permission provided by the Ministry of Education. The adolescents were motivated to participate in this study by the fact that they would not have to attend subjects taught during the time of the survey and they would not be considered as absent from lessons. It should be noted that in accordance with the Greek school regulation, students are allowed to progress to the next grade on the condition that they have not exceeded 50 school hours of unjustified absence per school year.

### Statistical analyses

Multilevel modeling was used to statistically analyze a data structure where measurements at two time points (Level 1) were nested within individuals (Level 2), who were nested within classrooms (Level 3) (see Figure 1). This approach was chosen to enable this study to disentangle and examine age-related changes on IA symptoms at Level 1, considering the effects of one individual push factor (i.e., anxiety) at Level 2, and in relation to its interaction with a contextual factor (i.e., classroom extraversion) at Level 3. Subsequently, the HLM 6.0.8 software was used (Raudenbush, 2004). Model testing proceeded in successive phases [i.e., unconstrained model, random intercepts model, means-as-outcome and slopes-as-outcome models for anxiety and classroom extraversion (Level 2 and Level 3 predictors), and the full model]. For reasons of succinctness, and given that the results did not significantly differ, only the full model will be reported in this study. IA symptoms (Level 1 outcome variable) were predicted for each individual at Level 1 by time in this study. Time was centered at Time 1 such that the individual intercepts referred to the initial level of IA (Wave 1 = 0 and Wave 2 = 1). The individual initial level and the individual linear change over the two assessments (slope) were predicted at Level 2 by anxiety. Finally, the random effects due to the levels of classroom extraversion were estimated through random effects equations at Level 3 in regard to both the main effect of anxiety, as well as its cross-level interaction of time with time (slope). To control misspecification (i.e., lack of linearity) and the distributional assumptions at each level (i.e., lack of normality and heteroscedacity), HLM results accounting for robust standard errors (which are insensitive to possible violations of these assumptions) were calculated.

Considering missing values, whereas they do not present a problem at Level 1 in HLM and did not occur at Level 3

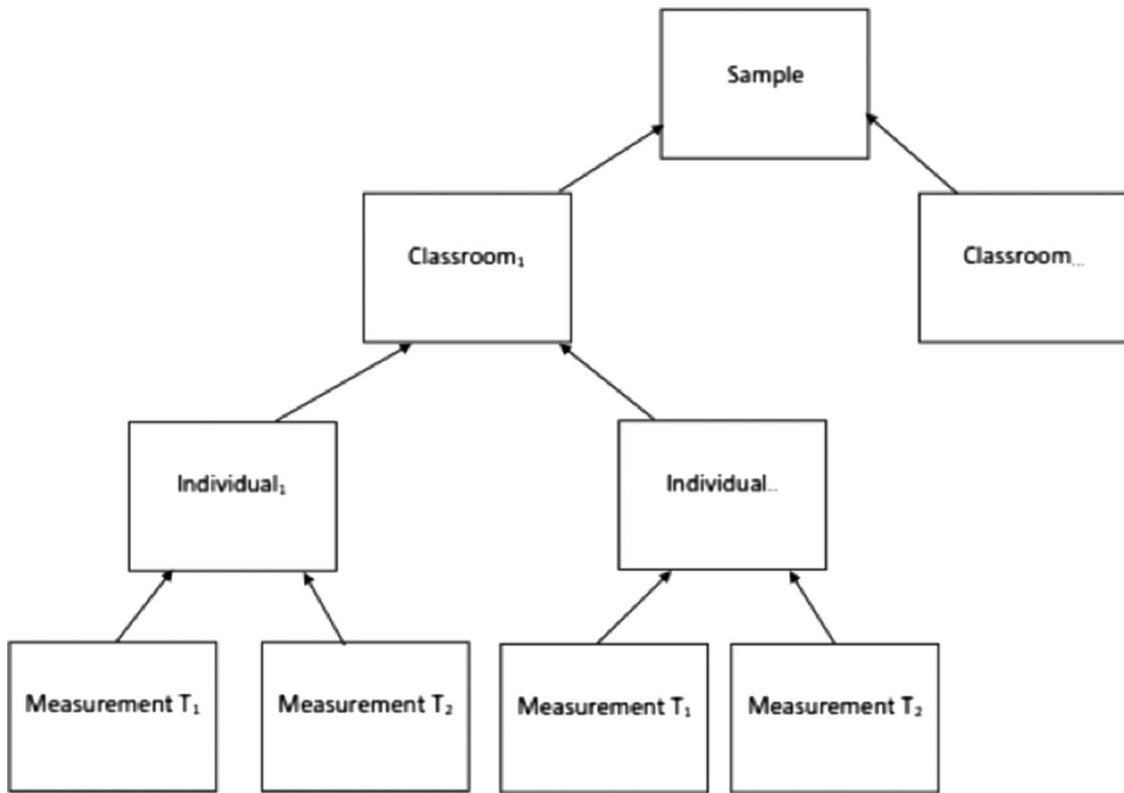


Figure 1. Data nesting

(classrooms), missing values at Level 2 (individuals) were addressed. Although they were unsystematic, to avoid list-wise deletion, multiple imputation was applied (five maximum likelihood imputations using SPSS) using all available Level 2 variables. This type of imputation was selected as outperforms list-wise deletion for parameters involving many recouped cases and results in better standard error estimates (Widaman, 2006). Based on previous literature recommendations, all multilevel analyses were calculated five times and their results were averaged (Motti-Stefanidi, Asendorpf, & Masten, 2012; Widaman, 2006).

Ethics

The study procedures were carried out in accordance with the guidelines of Declaration of Helsinki. Data collection occurred from January 2010 to March 2012 and received approval from The Greek Ministry of Education and The School Teachers' Council. This article does not contain any studies with animals performed by any of the authors.

Written informed consent was received from the parents of the participants and verbal informed consent from the participants themselves.

RESULTS

Prior to the HLM analyses, the means, standard deviations, and intercorrelations between the HLM variables were estimated (see Table 2).

To assure that the three levels contributed to variation in IA scores, the level components were calculated from the unconditional model ( $\chi^2$  Level 2 = 1,272.85,  $df$  = 596,  $p$  = .001;  $\chi^2$  Level 3 = 46.93,  $df$  = 33,  $p$  = .001). Therefore, HLM equations were calculated (see Appendix).

The Level 1 intercept for the cross-sectional findings was 29.39. This was the estimated mean IA score for adolescents of average anxiety at Time 1, situated in classrooms of average level of extraversion. Considering Hypothesis 1 in regard to how anxiety and IA symptoms were associated

Table 2. Means, standard deviations, and correlations of the HLM analysis variables

Wave	Mean	SD	1	2	3	4	5
1. Anxiety Wave 1	0.86	0.67					
2. Anxiety Wave 2	0.89	0.64	0.44**				
3. Internet Addiction 1	29.54	17.55	0.39**	2.16**			
4. Internet Addiction 2	24.47	17.64	0.14**	0.24**	0.43**		
5. Classroom EXT Wave 1	2.92	3.64	0.11	0.12	-0.33	-0.10*	
6. Classroom EXT Wave 2	2.87	3.53	0.13	0.09*	-0.32	-0.14	-0.22**

\* $p$  < .05. \*\* $p$  < .01.

with each other at Time 1, the anxiety coefficient was  $b = 9.33$  ( $p < .001$ ). Consequently, the average IA score of adolescents who scored one point higher than the estimated mean in anxiety increased by 9.33 at the age of 16. Considering *Hypothesis 2*, the effect of anxiety at Time 1 on IA at Time 2, the coefficient of the interaction of anxiety with time was  $b = -1.88$  ( $p > .05$ ), indicating that the effect of anxiety on IA symptoms did not interact with time significantly. Analyses controlled for random effects due to other individual (e.g., years of Internet use) and classroom characteristics (see Table 3). The intensity of the effect of anxiety on IA risk is, therefore, not influenced by age-related changes (holds independent of age-related changes) between 16 and 18 years old.

To address *Hypothesis 3*, the average level of extraversion for each classroom (grand-centered) was added in the third level (class) of the model. In regard to how anxiety and classroom extraversion interacted on IA symptoms at Time 1, the interaction coefficient was  $b = -16.22$  ( $p < .01$ ). Consequently, the average IA score of adolescents who scored one point higher than the estimated mean in anxiety and were situated in classrooms one point higher than the average level of extraversion decreased by 16.22 at the age of 16. Considering the effect over time of the interaction between anxiety and classroom extraversion on IA, the coefficient was  $b = 5.70$  ( $p = .531$ ), indicating that this did not significantly vary with time (Figure 2).

## DISCUSSION

This study investigated the effect of anxiety on IA and the potential moderating role of age-related changes and classroom extraversion in a normative sample of Greek adolescents aged 16 years and again aged 18 years. A supported

integrative IA framework (Stavropoulos, Kuss, et al., 2016) was adopted to examine age-related variations of the effect of anxiety as an individual-level “push” factor (i.e., factors that increase vulnerability to IA) and classroom extraversion as its proximal context moderator. Subsequently, a three-level hierarchical linear model was applied to analyze IA symptoms’ change between 16 and 18 years old with respect to anxiety and classroom extraversion. Findings supported the view that anxiety was associated with higher IA symptoms. Although this relationship did not significantly vary over time, it differed across contexts, with classroom extraversion buffering the IA risk effect of anxiety. The implications for the understanding, prevention, and treatment of IA symptoms in adolescence are discussed below.

### Anxiety and IA

More anxious adolescents demonstrated higher IA risk than their non-anxious peers. This is consistent with the conceptual framework adopted, which emphasizes the importance of establishing, at-risk status, because IA is viewed on a continuum, with various factors representing risks and resources in the course of IA development (Stavropoulos, Kuss, et al., 2016). This study acknowledged anxious adolescents as being at risk of being further along the IA continuum. This finding aligns with the addiction literature, which has previously associated anxiety with various forms of addictions (Cooper, Hildebrandt, & Gerlach, 2014; Forsyth et al., 2003). Furthermore, it is consistent with existing cross-sectional findings, which have associated IA risk with higher levels of anxiety (e.g., Akin & Iskender, 2011; De Leo & Wulfert, 2013; Mehroof & Griffiths, 2010). Given that: (a) anxiety is experienced as a negative emotional state (Akin & Iskender, 2011) and (b) addictive behaviors often function

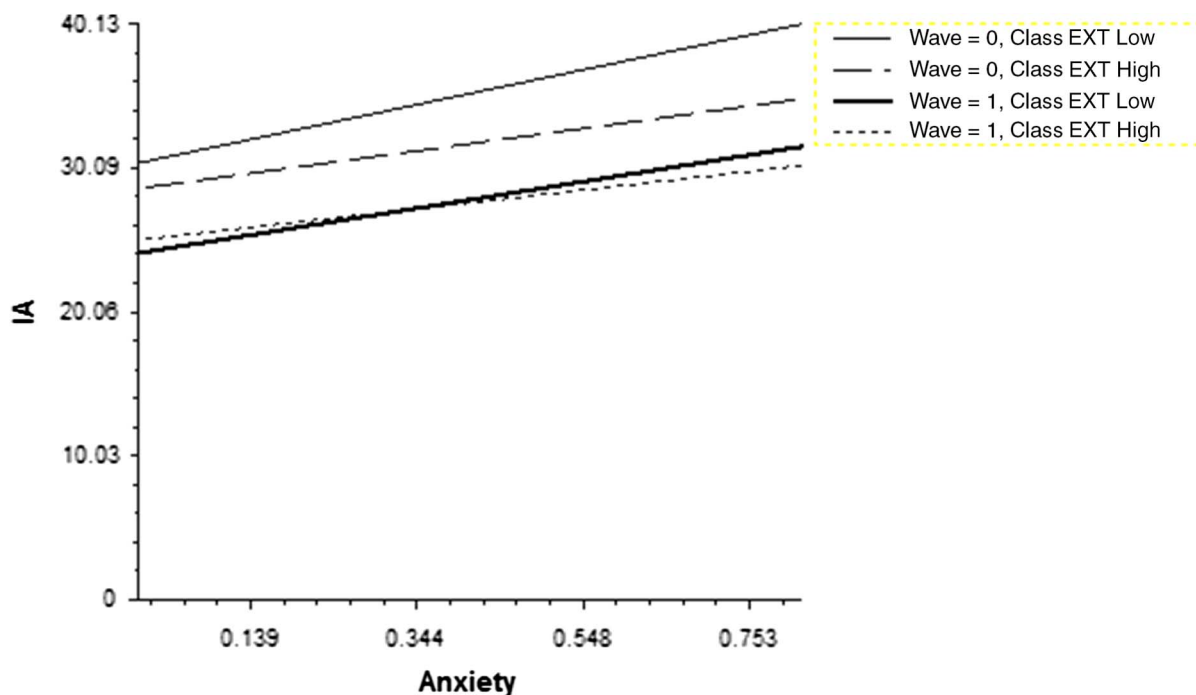


Figure 2. The over time interplay of anxiety and classroom extraversion on IA

Table 3. HLM analysis predicting adolescents' IA scores

	IAT score									
	Fixed effects without robust standard errors					Fixed effects with robust standard errors				
	$b_i$	$SE$	$T$	$df$	$p_i$	$b_i$	$SE$	$T$	$df$	$p_i$
<i>Initial level (initial level as outcome models)</i>										
Intercept (time)	29.39	0.94	31.37	32	.001	29.39	0.93	31.46	32	.001
Anxiety	9.33	1.28	7.28	32	.001	9.33	1.23	7.61	32	.001
Extraversion in classroom	-6.84	5.37	-1.28	32	.212	-6.84	4.49	-1.52	32	.137
Anxiety $\times$ Extraversion in classroom	-16.22	7.26	-2.23	32	.033	-16.22	5.16	-3.14	32	.004
<i>Slope (initial level and slope as outcome models) according to age</i>										
Intercept (time)	-4.68	1.17	-4.01	32	.001	-4.68	1.21	-3.89	32	.001
Anxiety	-1.88	1.77	-1.06	32	.297	-1.88	1.71	-1.10	32	.280
Extraversion in classroom	10.37	7.11	1.46	32	.154	10.37	6.63	1.56	32	.127
Anxiety $\times$ Extraversion in classroom	5.70	10.96	.52	32	.606	5.70	9.01	.63	32	.531

Note. Reported are (a) the significances  $p_i$  for increased fit by adding predictors of initial level and age-related changes of IAT scores and the unstandardized initial regression coefficients  $b_i$  with the Level 1 predictors; (b) wave is centered at the age of 16. Anxiety was used as predictor at Level 2 (individual) and extraversion in classroom was used as predictor at Level 3 (classroom).

as maladaptive emotion regulation strategies (Anderson et al., 2016; Griffiths, 2005), higher levels of anxiety may place adolescents at higher risk of IA.

#### *The effect of anxiety on IA over time*

This study investigated this relationship at two time points with adolescents aged 16 and 18 years, to examine the potential influence of age-related changes. The results demonstrated that the association between anxiety and IA remained stable over time, meaning that anxious adolescents consistently demonstrated higher risk of IA than their non-anxious (or less anxious) classmates. While the normative sample shifted downward in IA between the two time points (see Table 3), more anxious adolescents continued to be at higher IA risk, indicating stability in this relationship. To the best of the authors' knowledge, no prior published study has investigated the variations of this association within this particular age range, and therefore, interpretation needs to be cautious.

This finding is in line with longitudinal studies referring to other forms of addiction. For instance, gamblers considered addicted in accordance with the DSM-5 criteria have been found to experience higher levels of anxiety over time (APA, 2013; Parhami et al., 2014). These results are comparable with those from a Finnish study that longitudinally investigated alcohol abuse in adolescents, in which drinking as strategy for addressing anxiety held over time, despite the anxiety dissipating and enhancement motives being cited by participants as greater motivators for their addictive drinking behavior (Palmqvist et al., 2003). While the motive for the behavior altered from being a strategy of decreasing anxiety to being used to achieve positive feelings, the addictive patterns remained stable over time. In that context, the present finding indicates that IA manifestations initially associated with anxiety, exceed potential protective maturation effects, and are likely to continue as behavior patterns over time (Eccles et al., 1993; Kroger, 2006).

#### *The moderating effect of classroom extraversion on the anxiety-IA association*

In this context, anxious adolescents who are in a classroom with more extraverted peers were at a significantly lower position along the IA continuum than anxious individuals in a classroom with more introverted peers, at the age of both 16 and 18. These findings are in line with the adolescent literature, which identifies the influence of the classroom context as a strong predictor of behavior (Freund et al., 2013; Ryan & Patrick, 2001). Similarly, the Internet use literature has demonstrated the classroom of the adolescents to be influential over their Internet use and IA behaviors (Festl, Scharkow, & Quandt, 2013; Stavropoulos, Gentile, et al., 2016; Stavropoulos, Kuss, et al., 2016; Stavropoulos et al., 2017). Previous research has associated extraversion as an individual-level factor that lowers the risk of IA (Amichai-Hamburger & Ben-Artzi, 2003). Less extraverted (i.e., more introverted) individuals have been suggested to prefer to relate to a virtual group compared with more extraverted individuals who prefer face-to-face contact (Amichai-Hamburger & Ben-Artzi, 2003). Interestingly, group extraversion (as a contextual factor) has been associated with a higher sense of group cohesion and improved communication between group members (Barrick et al., 1998). Therefore, it follows that a classroom with more extraverted classmates may accommodate social fulfillment for more anxious students reducing their IA tendencies.

#### *Limitations and further research*

There are several limitations to this study. The data were obtained through self-report. This relies on the participants having an accurate self-perception and the practice of answering questions with the intention of being truthful (Stavropoulos, Kuss, et al., 2016). The sample obtained was from a limited and specific age group and cultural background. While the findings of this study are generalizable to the Greek population of adolescents aged 16–18 years,

care should be taken when generalizing to populations of different developmental ages and cultural heritage. In relation to the instruments used, the IAT is arguably less robust than other more recently developed scales in assessing IA. However, the IAT was used to ensure comparability with previous research on IA in Greece. It should also be noted that although the SCL-90 performs well in assessing general psychopathology, the SCL-90 subscales have high inter-correlations (Urbán et al., 2014). Therefore, more anxiety-specific instruments should be used in future replication studies. Finally, there is literature indicating that different types of Internet use have varying effects on the IA continuum (Douglas et al., 2008; King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Valkenburg & Peter, 2011). This study did not consider how different applications (e.g., chat rooms and Internet gaming) may influence IA risk differently, or how time spent online continuously compared with shorter, more frequent periods had an influence. As such, the field could benefit from future research assessing the types of applications, the quality of time online, and the formats of time spent online and offline among students of different classrooms. Ideally, future research would involve a longitudinal study over the entire developmental period of adolescence to identify a pattern in influences on IA behavior across this critical stage of development.

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APPENDIX

Level 1 equation:

$$Y = \Pi_0 + \Pi_1 \times (\text{WAVE}) + \varepsilon$$

Level 2 equations:

$$\Pi_0 = \beta_{00} + \beta_{01} \times (\text{ANX}) + \rho_0$$

$$\Pi_1 = \beta_{10} + \beta_{11} \times (\text{ANX}) + \rho_{01}$$

Level 3 equations:

$$\beta_{00} = \gamma_{000} + \gamma_{001} \times (\text{Classroom\_Extraversion}) + u_{00}$$

$$\beta_{01} = \gamma_{010} + \gamma_{011} \times (\text{Classroom\_Extraversion}) + u_{01}$$

$$\beta_{10} = \gamma_{100} + \gamma_{101} \times (\text{Classroom\_Extraversion}) + u_{10}$$

$$\beta_{11} = \gamma_{110} + \gamma_{111} \times (\text{Classroom\_Extraversion}) + u_{11}$$