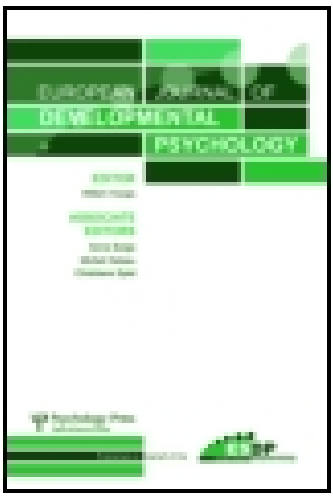

European Journal of Developmental Psychology

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/pedp20

A multilevel longitudinal study of adolescent Internet addiction: The role of obsessive-compulsive symptoms and classroom openness to experience

Vasilis Stavropoulos[a], Douglas Gentile[b] & Frosso Motti-Stefanidi[a]

[a] Department of Psychology, University of Athens, Athens, Greece

[b] Department of Psychology, Iowa State University, Ames, IA, USA

Published online: 19 Aug 2015.

To cite this article: Vasilis Stavropoulos, Douglas Gentile & Frosso Motti-Stefanidi (2015): A multilevel longitudinal study of adolescent Internet addiction: The role of obsessive-compulsive symptoms and classroom openness to experience, European Journal of Developmental Psychology, DOI: 10.1080/17405629.2015.1066670

To link to this article: http://dx.doi.org/10.1080/17405629.2015.1066670

EUROPEAN JOURNAL OF DEVELOPMENTAL PSYCHOLOGY, 2015
http://dx.doi.org/10.1080/17405629.2015.1066670

A multilevel longitudinal study of adolescent Internet addiction: The role of obsessive–compulsive symptoms and classroom openness to experience

Vasilis Stavropoulos[1], Douglas Gentile[2], and Frosso Motti-Stefanidi[1]

[1]Department of Psychology, University of Athens, Athens, Greece
[2]Department of Psychology, Iowa State University, Ames, IA, USA

Internet addiction (IA) in adolescence was longitudinally examined in relation to individual obsessive–compulsive symptoms and the personality trait of openness to experience (OTE) at the classroom level. The study consists of a two-point measure of a normative sample comprising 648 Greek adolescents (retention = 363, age 16–18 years, wave 1: age = 15.75 years, SD = 0.57, males = 46.2%, females = 53.8%). IA was assessed with the IA Test (Young, K. S. [1998]. *Caught in the net: How to recognize the signs of internet addiction—And a winning strategy for recovery*. New York, NY: Wiley), obsessive–compulsive symptoms with the Symptom check list 90 revised (Derogatis, L. R., & Savitz, K. L. [1999]. The SCL-90-R, brief symptom inventory, and matching clinical rating scales. In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment* (2nd ed., pp. 679–724). Mahwah, NJ: Lawrence Erlbaum Associates Publishers) and OTE with the FFFK (Asendorpf, J. D., & van Aken, M. A. G. [2003]. Validity of big five personality judgments in childhood: A 9 year longitudinal study. *European Journal of Personality, 17*, 1–17). A three-level hierarchical linear model investigated individual- and classroom-level effects on IA score and its changes over time. The findings revealed that IA at the initial level was associated with the obsessive–compulsive symptoms of the individual and negatively related to classroom-level OTE. However, adolescents high on obsessive–compulsive symptoms in high on OTE classrooms presented higher IA scores over time.

Keywords: Adolescence; Internet addiction; Obsessive–compulsive symptoms; Classrooms; Openness to experience.

Correspondence should be addressed to Vasilis Stavropoulos, Research Fellow of the University of Athens, Greece. E-mail: vasilisstavropoylos80@hotmail.com

This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) – Research Funding Program: Heracleitus II. Investing in knowledge society through the European Social Fund.
No potential conflict of interest was reported by the authors.

Internet use promotes social interactions, access to information and political engagement (Papacharissi, 2002). In contrast, Internet addiction (IA) is detrimental to the well-being of individuals (Kuss, Griffiths, Karila, & Billieux, 2014). The behaviour has received different definitions, such as "Problematic Internet Use" or "Internet Dependency" (Kuss et al., 2014). Young's widely used 1998 definition and measure of IA are used in this study. These have been adopted by other Greek and international researchers, and adjusted for assessing Greek adolescents (Kuss et al., 2014; Stavropoulos, Alexandraki, & Motti-Stefanidi, 2013). Subsequently, IA is defined as an excessive preoccupation with the Internet that causes impairment or distress. The severity of IA may vary, ranging from no or modest to extreme symptoms (Kuss et al., 2014). Neurological impairments, psychological distress and socialization issues have been suggested as its possible repercussions (Kuss et al., 2014). Consequently, identifying factors that explain IA severity is significant.

To address this need, an integrative, multilevel conceptualization was introduced. Guidelines from addiction studies (Griffiths, 2005), the IA conceptual model (Douglas et al., 2008), the bio-ecological model of human development (Bronfenbrenner & Morris, 2006) and the risk and resilience developmental framework (Masten, 2007) were merged. The latter has been suggested for explaining the effects of media on behaviour (Prot & Gentile, 2013). These approaches describe how behaviour emerges and constantly evolves, due to the interplay of individual and contextual factors. In the present study, a normative sample of adolescents was longitudinally assessed to describe these changes. Subsequently, three levels of analysis are applied, emphasizing the effects of age, the individuals and their context.

Adolescence and IA development

This study focuses on the period between 16 and 18 years. Adolescence is a risk period for IA development (Kuss et al., 2014). IA has been associated with adolescents' need for independence, identity exploration and relationship challenges. Difficulties in these areas may be addressed through the Internet, often increasing the risk of IA (Kuss et al., 2014). Addictive behaviours initially observed in adolescence tend to continue into adulthood (Coffey, Carlin, Lynskey, Li, & Patton, 2003).

The period between 16 and 18 years is critical for Greek adolescents and their Internet use patterns. This period overlaps with the first two grades of lyceum, during which adolescents become entitled to choose for the first time the type of education they want to pursue (academic or vocational track). Interestingly, these 2 years of increased independence and responsibility precede the period of highest prevalence of Internet use both in Greece and internationally (Society of Information Observatory, 2010; Van Deursen & Van Dijk, 2014). Additionally, this period coincides with the highest use of potentially high-risk applications

(i.e., social networking sites) in Greece (Society of Information Observatory, 2010). Therefore, a study of IA symptoms during this developmental period is important.

OC symptoms and IA

Several associations between IA and clinical issues have been described, including obsessive–compulsive (OC) symptoms (Jang, Hwang, & Choi, 2008; Kuss et al., 2014). OC symptoms entail recurrent and persistent thoughts that are experienced as inappropriate, but cannot be ignored (obsessions). Individuals often address them by repetitive physical or mental acts (compulsions). The severity of OC symptoms has been suggested to be normally distributed in the general population (Mataix-Cols, do Rosario-Campos, & Leckman, 2005). Consequently, the normative sample of this study is assessed with a continuous OC scale.

In contrast to other co-morbid disorders, such as depression and anxiety (Kuss et al., 2014), there are very few studies (particularly longitudinal studies) of the OC–IA association in adolescence. This gap is important given that regardless of gender, age and the length of Internet experience, adolescents high on OC symptoms present higher IA risk (Jang et al., 2008). Furthermore, although IA has been typically described as a secondary condition resulting from various primary disorders, findings in young adult samples have suggested that within a range of psychopathologies, only OC symptoms preceded IA, while depression and anxiety symptoms succeeded IA emergence (Dong et al., 2011; Ko, Yen, Yen, Chen, & Chen, 2012).

Addictive behaviours and OC symptomatology present common characteristics and high comorbidity, which has caused some to define IA as compulsive computer use (Kuss et al., 2014). Theoretically, in either condition, individuals aim to regulate arousal through manifesting their OC or IA behaviour, respectively. However, OC symptoms function mainly as harm-avoidant behaviours, whereas addictions are primarily driven by seeking gratification (Robbins & Clark, 2015). Subsequently, OC symptoms have been described as more compulsive and ego-dystonic than IA, which is more impulsive and ego-syntonic (Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000). Within this frame, IA may serve as a strategy for relieving pre-existing OC psychopathology, which could in turn reinforce further symptomatology, although more research is needed (Ko et al., 2012).

This study addresses this need by prospectively examining OC symptoms as a predictor of IA in adolescence. This is significant given that individuals with OC and/or IA exhibit age-related symptom variations (Selles, Storch, & Lewin, 2014; Vollmer, Randler, Horzum, & Ayas, 2014). In fact, younger individuals demonstrate poorer insight and control of compulsions (Selles et al., 2014; Vollmer et al., 2014). Similarly, IA symptoms appear to decline among older and

more experienced users, possibly due to maturation and saturation effects (Vollmer et al., 2014; Young, 1998).

Classroom openness to experience and IA

In addition to individual differences in OC symptoms, the present study examines the role of openness to experience (OTE) as a trait at the classroom level. OTE has been described as a trait that entails creativity, flexibility, curiosity and an adventurous attitude towards life (McCrae & Sutin, 2009). In this research, the mean level of students' OTE in each Classroom (nested data) is defined as classroom OTE. The literature supports that personality characteristics at a team level can influence individual and group behaviour, with OTE as a group characteristic leading to more positive outcomes by improving communication between group members (Bradley, Klotz, Postlethwaite, & Brown, 2013). Groups of individuals higher on OTE may promote socialization as they tend to seek feedback and to have positive perceptions of relationships (McCrae & Sutin, 2009). These socially proactive characteristics, along with novelty seeking and tolerance to differences, could promote positive relations in classroom, which is an important space for socialization (Bronfenbrenner & Morris, 2006). However, individuals who find face-to-face communication more challenging may escape online, where relationships are less demanding, increasing their IA risk (Kuss et al., 2014). Consequently, it may be argued that factors promoting face-to-face classroom relations reduce IA severity.

Very few IA studies have examined the effects of proximal context variables. The lack of such studies is restricting for understanding the IA among adolescents, whose development is critically influenced by their peers and classmates (Bronfenbrenner & Morris, 2006). In that line, school–class context has been recently linked with the quality of Internet engagement, and particularly with adolescents' cyberbullying behaviour (Festl, Scharkow, & Quandt, 2013).

The effect of any contextual factor (such as classroom OTE) may be moderated by individual difference characteristics, such as OC symptomatology (Douglas et al., 2008; Griffiths, 2005). Specifically, the discrepancy between characteristics of individuals and characteristics of their context could cause difficulties in their face-to-face relationships (Jackson et al., 1991), potentially inducing IA symptoms (Kuss et al., 2014). Previous studies revealed a negative association between OC- and OTE-related behaviours (Rector, Hood, Richter, & Michael Bagby, 2002). OC rigidity and performance compulsion (Nadeau, 2013) may marginalize adolescents in a high-on-OTE classroom, which is novelty seeking and flexible (McCrae & Sutin, 2009), increasing in turn their IA risk.

Cross-sectional findings illustrated the associations of IA with OC and OTE at the individual level (Jang et al., 2008; Ko et al., 2010). Nevertheless, previous studies have neither longitudinally examined the link of OTE as

a classroom-level characteristic with adolescent IA symptoms, nor have they assessed the effect of OC on IA within a high-on-OTE context.

Research questions

This research focuses on individual differences in IA symptoms from 16 to 18 years in a normative sample of Greek adolescents. These differences are examined across the two time points, both between and within groups, by using three-level hierarchical linear modelling (HLM) for analysing nested data (Motti-Stefanidi, Asendorpf, & Masten, 2012). This process enables the investigation of intra-individual change along with group differences, taking into consideration classroom effects. The following research questions are addressed:

(1) How do OC symptoms at 16 years associate with IA symptoms at 16 and 18 years?
(2) How does classroom OTE at 16 years associate with IA symptoms at 16 and 18 years?
(3) How does the interaction of classroom OTE with OC symptoms at 16 years affect IA symptoms at 16 and 18 years?

METHODS

Participants

This survey received approval by (i) the Ministry of Education, (ii) the Teachers' Council, and (iii) parents' consent. The sample was selected from the Athens metro area and a specific regional area using the method of randomized stratified selection based on the latest inventory card of the Ministry of Education (2010). The ratios of high schools and students were identified (1) between the metro area and the selected regional population and (2) between academic versus vocational-track high schools. Based on these quotas, participants were randomly (by lottery) selected at the classroom level.

The sample consisted of 648 Greek students embedded in 34 classrooms. A χ^2 analysis confirmed ($\chi^2 = 3.83$, d$f = 3$, $p > .05$) that the sample did not differ from the original population regarding the area of residence and the type of school of the participants. With respect to parents' and guardians' socio-economic 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. At time 1, Internet usage was at 100%, while 21.00% used predominantly blogs and social networking sites, 16.40% instant messengers, 14.60% information-seeking engines, 13.60% chatrooms, 13.40% online games, 13.40% You-Tube and videos, 2.40% pornographic sites and 5.00% other applications. Parents' consent was 98% and the students' response

rate was over 95% at time 1. The estimated maximum sampling error with a size of 648 was 3.85% ($Z = 1.96$, CI = 95%).

Participants were assessed twice, two school years apart, using a re-identifiable code (wave 1: age = 15.75 years, SD = 0.57, age range 15.5–16.5; wave 2: age = 17.75 years, SD .0.54, age range 16.5–17.5). Retention was 56% due to changes of school, and school and research

Ddropouts. To evaluate the attrition effects (Widaman, 2006), (a) participants' means were compared in terms of the studied variables (Table 1) and (b) attrition was used as an independent variable (dummy coded 1 = attrition, 0 = no attrition) at level 2 of the HLM analyses to assess whether it affects IA score and its associations with the other independent variables. The results confirmed that attrition did not have significant effects (Tables 1 and 2).

Instruments

Internet addiction test. The 20-item Internet Addiction Test (IAT) (Young, 1998) measures negative behaviours of Internet overuse. Questions 2, 3 and 8 were modified to reflect appropriate age/adolescence-related content (e.g., "How often does your job performance or productivity suffer because of the Internet?" was modified to be "How often does your school performance or productivity suffer because of the Internet?). There were six possible answers for each question (1 = "not at all", 2 = "occasionally", 3 = "frequently", 4 = "often", 5 = "-always" and 0 = "it does not concern me"). The items are summed (score range 0–100: 0 = no IA symptoms to 100 = maximum IA symptoms), yielding high internal reliability (Cronbach's $\alpha = 0.93$).

Symptom check list 90 revised. To assess OC symptoms, the relevant subscale of the Symptom check list 90 revised questionnaire (Derogatis & Savitz, 1999) was used. The OC subscale includes 10 items, ranging from disturbances of concentration to obsessive–compulsive symptoms (e.g., "Having to check and double check what you do?"). Adolescents reported the intensity of their symptoms on a 5-point Likert scale (0 = "not at all", 1 = "a little", 2 = "moderate", 3 = "very much" and 4 = "all the time"). The mean of the items for each subscale was calculated (score range 0–4: 0 = no symptoms and 4 = maximum symptoms) with high internal reliability rates: OC, Cronbach's $\alpha = .79$; somatization $\alpha = .85$; interpersonal sensitivity $\alpha = .82$; hostility, $\alpha = .85$; phobic anxiety, $\alpha = .82$; depression, $\alpha = .83$; anxiety, $\alpha = .72$; paranoia, $\alpha = .73$; and psychoticism, $\alpha = .75$.

Five-factor Questionnaire for children (Fünf-Faktoren-Fragebogen für Kinder). To assess OTE as a classroom characteristic, individual scores within the same classroom were aggregated to produce the classroom mean. This method has

TABLE 1
Comparisons of the means of the studied variables according to attrition

		IAT					*Obsessive–compulsive symptoms*					*Openness to experience in classroom*				
Waves' attrition	N	*Mean*	*SD*	T	*df*	p	*Mean*	*SD*	t	*df*	p	*Mean*	*SD*	t	*df*	p
No	363	28.95	17.97	−2.04	985	.04	1.19	.70	.332	1009	.740	2.86	.18	1.81	971	.07
Yes	285	26.37	17.65				1.21	.69				2.89	.24			

TABLE 2
Assessment of the attrition effects in HLM analyses

	Fixed effects with robust standard errors				
	b_i	*SE*	*T*	df	p_i
Attrition	.81	2.49	.32	32	.75
OC symptoms × attrition	1.37	1.32	1.04	32	.31
Classroom OTE × attrition	8.25	7.25	1.14	32	.27
Attrition × time	−2.75	2.44	1.13	32	.27

Note: Wave 1 = 0, wave 2 = 0; not attrition = 0, attrition = 1.

been applied for contextualizing the effect of personality traits on groups to evaluate group processes (Bradley et al., 2013). The Five-Factor Questionnaire for Children (FFFK) OTE subscale was used (Asendorpf & van Aken, 2003). The questionnaire consists of five subscales: extraversion, emotional stability, conscientiousness, agreeableness and OTE. Each subscale included eight bipolar adjectives (e.g., "I have no interests–I have many interests") that were answered on a 5-point scale, (1 = very, 2 = somewhat, 3 = neither/nor, 4 = somewhat and 5 = very) situated in between. The mean for each subscale was calculated, resulting in a range from 1 to 5, indicating the minimum and the maximum presence of each trait. The internal consistency rates were as follows: extraversion, Cronbach's $\alpha = .64$; emotional stability, $\alpha = .55$; agreeableness, $\alpha = .63$; conscientiousness, $\alpha = .67$; and OTE, $\alpha = .73$.

Analyses

Multilevel modelling was used to analyse a data structure where measurements at two time points (level 1) were nested within individuals (level 2) who were nested within classrooms (level 3). The HLM 6.0.8 software was used (Raudenbush, Bryk, & Congdon, 2002). IA symptoms (level 1 outcome variable) were predicted for each individual at level 1 by wave in the study. Wave was centred at wave 1, such that the individual intercepts referred to the initial level of IA (wave 1 = 0, wave 2 = 1). The individual initial level and the individual linear change over the two assessments (slope) were predicted at level 2 by OC symptoms at time 1. Finally, the classroom characteristic of OTE (time 1 grand centred) was added to test both its main effects and its cross-level interactions (slopes) with the two previous levels' variables. To control for misspecification (i.e., lack of linearity) and the distributional assumptions at each level (lack of normality, 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 (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 the available level 2 variables. All multilevel analyses were calculated five times and their results were averaged (Motti-Stefanidi et al., 2012; Widaman, 2006).

Results

Prior to the HLM analyses, the means, standard deviations, inter-correlations, VIF and tolerance between the HLM variables were estimated (see Table 3).

To assure that the three levels contributed to IA variation, the level components were calculated from the unconditional model (χ^2 level $2 = 1272.85$, $df = 596$, $p = .000$, χ^2 level $3 = 46.93$, $df = 33$, $p = .000$). Therefore, HLM equations were calculated (see the appendix).

The level 1 intercept for the cross-sectional findings was 29.43. This was the estimated mean IA score for adolescents of average OC symptoms situated in classrooms of average OTE at time 1. Considering how OC and IA symptoms relate at time 1 (research question 1), the OC symptoms' coefficient was $b = 8.60$ ($p = .000$). Consequently, the average IA score of adolescents who scored one point higher than the estimated mean in OC increased to 38.03 ($29.43 + 8.60 = 34.46$). Considering the effect of OC symptoms at time 1 on IA at time 2, the coefficient was $b = -1.81$ ($p = .269$), indicating that the effect of OC at time 1 on IA at time 2 was insignificant.

Considering how classroom OTE levels and IA symptoms relate (research question 2), the coefficient for classroom OTE was $b = -6.52$ ($p = .010$). This indicated that IA scores of adolescents who were situated in classrooms with one

TABLE 3
Means, standard deviations, correlations, VIF and tolerance of OC symptoms, classroom OTE and IA scores at the two time points

Wave	*Mean*	*SD*	*1*	*2*	*3*	*4*	*5*	*VIF*	*Tolerance*
1. OC symptoms wave 1	1.17	.70						.99	1.00
2. OC symptoms wave 2	1.24	.69	.44**					.99	1.00
3. Classroom OTE wave 1	2.88	.22	−.04	−.04				.99	1.00
4. Classroom OTE wave 2	3.82	.17	−.05	−.05	−.05			.99	1.00
5. IA wave 1	29.54	17.55	.39**	.18**	−.16**	−.08			
6. IA wave 2	24.47	17.64	.14**	.24**	−.12*	−.02	.43**		

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

Note: VIF (variance influence factor) and tolerance were assessed through multiple linear regression analyses with SPSS, as HLM does not produce such indices. Any VIF > 2 and tolerance < .05 provided indications of multi-collinearity, and did not apply in the current model(s) and were calculated only for the independent variables.

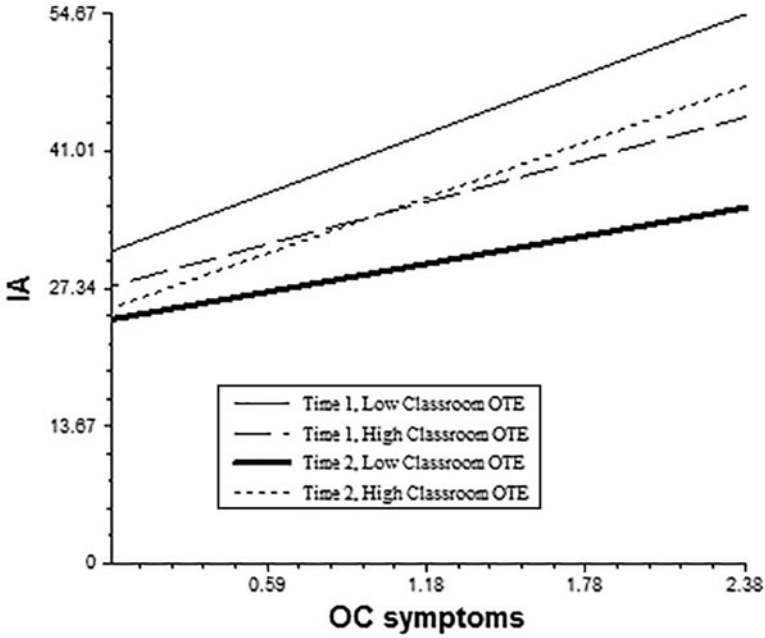

Figure 1. The interaction of OC symptoms with classroom OTE on IA scores at the two time points

point higher than the estimated mean of classroom OTE decreased to 22.91 (29.43 − 6.52 = 22.91) at time 1. The effect of classroom OTE at time 1 on IA at time 2 was insignificant; however, $b = 8.69$ ($p = .071$).

Considering the interaction of classroom OTE with OC symptoms (research question 3), the coefficient of their interaction on IA at time 1 was insignificant ($b = -5.44$, $p = .103$). However, the coefficient of the interaction of classroom OTE with OC symptoms at time 1 on IA scores at time 2 was $b = 14.11$ ($p = .004$). Consequently, an adolescent with one point higher than the average OC symptoms at time 1, situated in a classroom with one point higher than the average classroom OTE at time 1, would have an increase of 14.11 points on his/her IA score at time point 2 (see Figure 1). The complete model explained 14.44% of the overall IA variance resulting from 5.13 %, 8.23% and 1.04% of levels 1, 2 and 3, respectively. Analyses were controlled for random effects due to other individual (e.g., gender) and classroom characteristics (Table 4).

DISCUSSION

This study examined IA symptoms at two time points (16–18 years) in a normative sample of adolescents enrolled in Greek high schools. Three-level

TABLE 4
HLM analysis predicting adolescents' IA scores

	Cross-sectional findings									
	IAT score									
	Fixed effects without robust standard errors					*Fixed effects with robust standard errors*				
	b_i	*SE*	*T*	*df*	p_1	b_i	*SE*	T	df	p_1
Intercept	29.44	.89	33.27	32	.000	29.43	.88	33.46	32	.000
Individual level										
Obsessive–compulsive symptoms	8.60	1.49	5.77	32	.000	8.60	1.42	6.04	32	.000
Contextual level										
Openness to experience within the classroom	−6.51	2.86	−2.28	32	.029	−6.52	2.38	−2.74	32	.010
Cross-level interactions										
Obsessive–compulsive symptoms × openness to experience within the classroom	−5.44	4.77	−1.14	32	.263	−5.44	3.24	−1.68	32	.103
	Over time findings									
	IAT score									
	Fixed effects without robust standard errors					*Fixed effects with robust standard errors*				
	b_i	*SE*	*T*	*df*	p_1	b_i	*SE*	*T*	*df*	p_1
Intercept (time)	−4.69	1.16	−4.05	32	.000	−4.69	1.22	−3.83	32	.001
Individual level										
Obsessive–compulsive symptoms	−1.81	1.77	−1.02	32	.314	−1.81	1.61	−1.13	32	.269
Contextual level										
Openness to experience within the classroom	8.69	4.31	2.02	32	.052	8.69	4.66	1.87	32	.071
Cross-level Interactions										
Obsessive–compulsive symptoms × openness to experience within the classroom	14.11	6.58	2.15	32	.039	14.11	4.50	3.13	32	.004

Notes: HLM produces two final tables of fixed effects—one without and one with robust standard errors. Robust standard errors are standard errors that are insensitive to misspecification (i.e., lack of linearity, collinearity) and the distributional assumptions (i.e., normality, homoscedacity) at each level. Therefore, the table is divided into four parts. The upper left part presents the cross-sectional findings without controlling for random effects. The lower left part presents the over-time change results without controlling for random effects. The upper right part presents the cross-sectional findings after controlling for random effects at levels 2 (individual) and 3 (classroom). The lower right part presents the over-time change results after controlling for random effects at levels 2 (individual) and 3 (classroom).Only the results after controlling for random effects are reported in the text (right side of the table). Significances (p_i) are produced by adding at the initial regression coefficient (b_i), the predictors' coefficients of the initial level, time and their interactions on IA scores. Wave is centred at age 16 years. Obsessive–compulsive symptoms were used as a predictor at level 2 (individual) and openness to experience within the classroom as a predictor at level 3 (classroom).

HLM analyses tested the effect of OC symptoms (as an individual trait) and the average level of OTE (as a classroom trait) at age 16 years on IA symptoms concurrently at age 16 years and prospectively at age 18 years. The findings revealed that OC symptoms at 16 years constituted an individual-level risk, while higher classroom OTE at 16 years functioned as a protective factor for IA symptoms at 16 years. These general effects were moderated, however, by a significant longitudinal interaction. Adolescents higher on OC symptoms in classrooms and higher on OTE at 16 years presented higher IA symptoms at 18 years. These results indicate the need to emphasize individual differences in IA symptoms in adolescence.

OC symptoms and IA

Controlling for random individual-level (e.g., gender) and classroom-level effects, OC symptoms at 16 years were a risk factor for IA at 16 years. The results are consistent with cross-sectional studies (Jang et al., 2008) and implications about the role of IA as a secondary symptom (Ko et al., 2012). Specifically, IA behaviours may emerge as a way to address and relieve the tension caused by pre-existing OC symptoms. This association could be further reinforced by underlying mechanisms shared by OC and IA behaviours (Ko et al., 2012). Particularly, both addictions and compulsive behaviours constitute repetitive manifestations to improve one's feelings, either by achieving immediate gratification or by de-escalating the distress triggered by obsessive thoughts (Robbins & Clark, 2015). However, IA behaviours might at a later stage magnify symptoms they initially relieved, and therefore, the OC–IA association could become circular (Ko et al., 2012). Given the dearth of relevant longitudinal findings and the theoretical conceptualization of IA as a repercussion of other psychopathological forms, the current study prioritized examining the effect of OC on IA symptoms.

However, the revealed relationship was insignificant at time 2, indicating that it may be subject to age-related influences between 16 and 18 years. Such hypothesis is reinforced by both OC and neuropsychological studies. Older individuals demonstrate higher insight and control of compulsions (Selles et al., 2014; Vollmer et al., 2014). Furthermore, subcortical limbic structures (e.g., amygdala) develop earlier in adolescence and associate with higher impulsivity, while prefrontal regions that associate with inhibitory control develop gradually later (Loth, Carvalho, & Schumann, 2011).

Classroom OTE and IA

Classroom-level OTE at 16 years predicted lower levels of IA symptoms at 16 years. This contradicts the findings that suggest OTE to be an IA risk when studied as an individual characteristic (Ko et al., 2010). This contradiction may

be explained by a differential effect on IA risk of individual-level versus classroom-level OTE. OTE at the individual level defines an adolescent's relationship with the medium (Ko et al., 2010), whereas at the classroom level, it defines his/her peer group's relationship with him/her (Bradley et al., 2013). Experimentation, curiosity and novelty-seeking, associated with individual-level OTE, increase the risk for involvement with addictive Internet applications (Ko et al., 2010). In contrast, they may enhance socialization opportunities and promote relationship-building when they occur as a group characteristic (Bradley et al., 2013; McCrae & Sutin, 2009). Such a classroom might provide a more accommodating socialization context, reducing the need for escaping online. This finding is an extension of previous work suggesting the significance of contextual factors for the development of addictions and IA in particular (Griffiths, 2005).

Additionally, the results indicated that the context of risks and resources may eventuate different interactions and outcomes. Specifically, although classroom-level OTE at 16 years was an overall protective factor for IA, it was a risk factor for IA at 18 years if adolescents also presented higher OC symptoms at 16 years. This indicates that an OC adolescent may find it more demanding to sufficiently relate within a classroom higher on OTE, possibly increasing the desire to escape to the digital world (Kuss et al., 2014). OC ritualistic tendencies, intolerance to uncertainty, and control needs (Nadeau, 2013) may generate relationship difficulties in a classroom higher on OTE that could be curious and novelty-seeking (McCrae & Sutin, 2009), likely pushing these students to the more predictable Internet context. This alienation risk could escalate at the age of 18 years, when due to the transition to adulthood, decreased limitations and greater capacities to experiment emerge, widening the potential challenges in higher OTE classrooms (McCrae & Sutin, 2009). This finding supports the idea of multi-finality, which suggests that various outcomes may result from similar factors, depending on the way these interact (Cicchetti & Toth, 2009).

Limitations, further research and conclusion

As with all research, this study has limitations. Measurements were based on self-report questionnaires. The sample was measured only two times, there was attrition between the two measurements, while the age range between 16 and 18 years coincides with a specific educational transition for Greek adolescents, which may narrow the applicability of the findings. Moreover, participants were exclusively students in Greek public high schools, which may impose limitations on the generalizability of the results.

This study theoretically assumed that OC symptoms would precede IA symptoms (Dong et al., 2011). However, other studies demonstrated that IA symptoms can precede mental health problems (e.g., Gentile et al., 2011). It is likely that there is no single path for primary and secondary dysfunction, and that

as with many mental health issues, IA may be found to be bidirectionally associated with other disorders. Longer-term longitudinal studies with more waves may be required to clarify that.

Finally, although measured, the preferred online activities of the participants were not considered in these analyses. Overall, the innovative nature of our research questions and, in many cases, the lack of previous findings reduce the certainty of our interpretations, which need to be further studied.

Despite these limitations, our study has several unique strengths. First, classroom OTE was assessed for the first time in relation to IA. Second, the use of the three-level HLM model enabled us to disentangle individual- and classroom-level effects, controlling for other random effects. Specifically, it enabled studying IA symptoms during a critical developmental period for addictions, and revealed that OC as an individual-level risk factor moderated the relation between classroom-level OTE and IA.

Manuscript received 14 July 2014
Revised manuscript accepted 23 June 2015
First published online 17 August 2015

REFERENCES

Asendorpf, J. D., & van Aken, M. A. G. (2003). Validity of Big Five personality judgments in childhood: A 9 year longitudinal study. *European Journal of Personality*, *17*(1), 1–17. doi:10.1002/per.460

Bradley, B. H., Klotz, A. C., Postlethwaite, B. E., & Brown, K. G. (2013). Ready to rumble: How team personality composition and task conflict interact to improve performance. *Journal of Applied Psychology*, *98*, 385–392. doi:10.1037/a0029845

Bronfenbrenner, U., & Morris, P. A. (2006). The bioecological model of human development. In R. M. Lerner (Ed.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (6th ed., pp. 793–828). Hoboken, NJ: Wiley. doi:10.1002/9780470147658.chpsy0114

Cicchetti, D., & Toth, S. L. (2009). The past achievements and future promises of developmental psychopathology: The coming of age of a discipline. *Journal of Child Psychology and Psychiatry*, *50*, 16–25. doi:10.1111/j.1469-7610.2008.01979.x

Coffey, C., Carlin, J. B., Lynskey, M., Li, N., & Patton, G. C. (2003). Adolescent precursors of cannabis dependence: Findings from the Victorian Adolescent Health Cohort Study. *The British Journal of Psychiatry*, *182*, 330–336. doi:10.1192/bjp.182.4.330

Derogatis, L. R., & Savitz, K. L. (1999). The SCL-90-R, brief symptom inventory, and matching clinical rating scales. In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment* (2nd ed., pp. 679–724). Mahwah, NJ: US: Lawrence Erlbaum Associates Publishers.

Dong, G., Lu, Q., Zhou, H., Zhao, X., Miles, J., Dong, G., Lu, Q., Zhou, H., & Zhao, X. (2011). Precursor or sequela: Pathological disorders in people with Internet addiction disorder. *PLoS ONE*, *6*, e14703, doi:10.1371/journal.pone.0014703

Douglas, A. C., Mills, J. E., Niang, M., Stepchenkova, S., Byun, S., Ruffini, C., … Blanton, MarinaM. (2008). Internet addiction: Meta-synthesis of qualitative research for the decade 1996–2006. *Computers in Human Behavior*, *24*, 3027–3044. doi:10.1016/j.chb.2008.05.009

Festl, R., Scharkow, M., & Quandt, T. (2013). Peer influence, Internet use and cyberbullying: A comparison of different context effects among German adolescents. *Journal of Children and Media*, *7*, 446–462. doi:10.1080/17482798.2013.781514

Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics*, *127*, e319–e329. doi:10.1542/peds.2010-1353

Griffiths, M. (2005). The biopsychosocial approach to addiction. *Psyke & Logos*, *26*, 9–26.

Jackson, S. E., Brett, J. F., Sessa, V. I., Cooper, D. M., Julin, J. A., & Peyronnin, K. (1991). Some differences make a difference: Individual dissimilarity and group heterogeneity as correlates of recruitment, promotions, and turnover. *Journal of applied psychology*, *76*, 675–689. doi:10.1037/0021-9010.76.5.675

Jang, K. S., Hwang, S. Y., & Choi, J. Y. (2008). Internet addiction and psychiatric symptoms among Korean adolescents. *Journal of School Health*, *78*, 165–171. doi:10.1111/j.1746-1561.2007.00279.x

Ko, C.-H., Hsiao, S., Liu, G.-C., Yen, J.-Y., Yang, M.-J., & Yen, C.-F. (2010). The characteristics of decision making, potential to take risks, and personality of college students with Internet addiction. *Psychiatry Research*, *175*, 121–125. doi:10.1016/j.psychres.2008.10.004

Ko, C. H., Yen, J. Y., Yen, C. F., Chen, C. S., & Chen, C. C. (2012). The association between Internet addiction and psychiatric disorder: A review of the literature. *European Psychiatry*, *27*(1), 1–8. doi:10.1016/j.eurpsy.2010.04.011

Kuss, D. J., Griffiths, M. D., Karila, L., & Billieux, J. (2014). Internet addiction: A systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design*, *20*, 4026–4052. doi:10.2174/13816128113199990617

Loth, E., Carvalho, F., & Schumann, G. (2011). The contribution of imaging genetics to the development of predictive markers for addictions. *Trends in Cognitive Sciences*, *15*, 436–446. doi:10.1016/j.tics.2011.07.008

Masten, A. S. (2007). Resilience in developing systems: Progress and promise as the fourth wave rises. *Development and Psychopathology*, *19*, 921–930. doi:10.1017/S0954579407000442

Mataix-Cols, D., do Rosario-Campos, M. C., & Leckman, J. F. (2005). A multidimensional model of obsessive–compulsive disorder. *American Journal of Psychiatry*, *162*, 228–238. doi:10.1176/appi.ajp.162.2.228

McCrae, R., & Sutin, A. (2009). Openness to experience. In M. Leary & R. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 257–273). New York, NY: Guilford Press.

Ministry of Education and Religious Affairs. (2010). *Inventory card of secondary education students*. Retrieved from http://www.minedu.gov.gr/epikoinonia-main/gepo-main.html

Motti-Stefanidi, F., Asendorpf, J., & Masten, A. (2012). The adaptation and well-being of adolescent immigrants in Greek schools: A multilevel, longitudinal study of risks and resources. *Development and psychopathology*, *24*, 451–473. doi:10.1017/S0954579412000090

Nadeau, M. J. (2013). *A child distracted: Understanding the relationship between pediatric obsessive compulsive disorder and subjective well being* (Graduate Thesis). University of South Florida.

Papacharissi, Z. (2002). The virtual sphere: The internet as a public sphere. *New Media & Society*, *4*, 9–27. doi:10.1177/14614440222226244

Prot, S., & Gentile, D. A. (2013). Applying risk and resilience models. *Advances in Child Development and Behavior*, *46*, 215–244.

Raudenbush, S. W., Bryk, A. S., & Congdon, R. (2002). *HLM for Windows* (version 6.0.3) [Computer software]. Lincolnwood, IL: Scientific Software International.

Rector, N. A., Hood, K., Richter, M. A., & Michael Bagby, R. (2002). Obsessive–compulsive disorder and the five-factor model of personality: Distinction and overlap with major depressive disorder. *Behaviour Research and Therapy*, *40*, 1205–1219. doi:10.1016/S0005-7967(02)00024-4

Robbins, T. W., & Clark, L. (2015). Behavioral addictions. *Current Opinion in Neurobiology*, *30*, 66–72. doi:10.1016/j.conb.2014.09.005

Selles, R. R., Storch, E. A., & Lewin, A. B. (2014). Variations in symptom prevalence and clinical correlates in younger versus older youth with obsessive–compulsive disorder. *Child Psychiatry & Human Development*, *45*, 666–674. doi:10.1007/s10578-014-0435-9

Shapira, N. A., Goldsmith, T. D., Keck, P. E., Khosla, U. M., & McElroy, S. L. (2000). Psychiatric features of individuals with problematic internet use. *Journal of Affective Disorders*, *57*, 267–272. doi:10.1016/S0165-0327(99)00107-X

Society of Information Observatory. (2010). *Online statistics e-Europe 2005/2010*. Retrieved from http://stats.observatory.gr/pxweb2006/Database/eEurope/1_noikokyria/3_ekpaideysi_fylo_ilikia/3_ekpaideysi_fylo_ilikia.asp

Stavropoulos, V., Alexandraki, K., & Motti-Stefanidi, F. (2013). Recognizing internet addiction: Prevalence and relationship to academic achievement in adolescents enrolled in urban and rural Greek high schools. *Journal of Adolescence*, *36*, 565–576. doi:10.1016/j.adolescence.2013.03.008

Van Deursen, A., & Van Dijk, J. (2014). The digital divide shifts to differences in usage. *New Media & Society*, *16*, 507–526. doi:10.1177/1461444813487959

Vollmer, C., Randler, C., Horzum, M. B., & Ayas, T. (2014). Computer game addiction in adolescents and its relationship to chronotype and personality. *SAGE Open*, *4*(1), 1–9. doi:10.1177/2158244013518054

Widaman, III, K. F. (2006). Missing data: What to do with or without them. *Monographs of the Society for Research in Child Development*, *71*, 42–64.

Young, K. S. (1998). *Caught in the net: How to recognize the signs of internet addiction—And a winning strategy for recovery*. New York, NY: John Wiley & Sons.

APPENDIX

Level 1 equation:

$$Y = \Pi_0 + \Pi_1^* (\text{WAVE}) + \varepsilon.$$

Level 2 equations:

$$\Pi_0 = \beta_{00} + \beta_{01}^* (\text{SCL\_OCD}) + \rho_0.$$

$$\Pi_1 = \beta_{10} + \beta_{11}^* (\text{SCL\_OCD}) + \rho_{01}.$$

Level 3 equations:

$$\beta_{00} = \gamma_{000} + \gamma_{001}^* (\text{FFFK\_OPE}) + u_{00}.$$

$$\beta_{01} = \gamma_{010} + \gamma_{011}^* (\text{FFFK\_OPE}) + u_{01}.$$

$$\beta_{10} = \gamma_{100} + \gamma_{101}^* (\text{FFFK\_OPE}) + u_{10}.$$

$$\beta_{11} = \gamma_{110} + \gamma_{111}^* (\text{FFFK\_OPE}) + u_{11}.$$

Here, ϵ, ρ and u parameters refer to controls of random effects at the three levels.