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A Multilevel Longitudinal Study of Experiencing Virtual Presence in Adolescence: The Role of Anxiety and Openness to Experience in the Classroom

Abstract

Presence describes the feeling of reality and immersion that users of virtual/internet environments have. Importantly, it has been suggested that there are individual and contextual differences regarding susceptibility to presence. These aspects of presence have been linked to both beneficial and disadvantageous uses of the internet, such as online therapeutic applications and addictive internet behaviours. In the present study, presence was studied in relation to individual anxiety symptoms and classroom-level openness to experience (OTE) using a normative sample of 648 adolescents aged between 16 and 18 years. Presence was assessed with the Presence II questionnaire, anxiety symptoms with the relevant subscales of the SCL-90-R, and OTE with the Five Factor Questionnaire. A three-level hierarchical linear model was calculated. Results showed that experiencing presence in virtual environments dropped between the ages of 16 and 18 years. Additionally, although anxiety symptoms were associated with higher presence at 16 years, this association decreased with age. Results also demonstrated that adolescents in classrooms higher on OTE reported reduced level of experiencing presence. The practical and theoretical implications of these findings are discussed.

Key Words: Presence, Adolescence, Development, Anxiety, Classroom, Openness to Experience

1. Introduction

Internet use has become a vital part of contemporary life (Millan & Morrison, 2006). The significant advances in the capacities of the medium have promoted online communication and leisure interactivity such as the playing of Massively Multiplayer Online Role Playing Games (Ghanbarzadeh, Ghapanchi, Blumenstein, & Talaei-Khoei, 2014). Furthermore, portals for online communication have been enhanced with high resolution technology that can render three-dimensional virtual worlds, often triggering experiences of presence (Riva, Botella, Légeron, & Optale, 2004).

Presence describes the level to which the user perceives the virtual/internet environment as real (Steuer, 1992; Stavropoulos, Alexandraki & Motti-Stefanidi, 2013) while external reality may be neglected. It is the psychological state of presence that the individual feels present in one "place" while physically being in another (Steuer, 1992), partially due to the virtual nature of the internet experience being unnoticed and/or ignored (Lee & Nass, 2001). Importantly, the experience of presence has been linked to both beneficial and disadvantageous uses of the internet, such as online therapeutic applications (Ghanbarzadeh et al., 2014) and addictive internet behaviours (Stavropoulos et al, 2013). Therefore, understanding which factors contribute to presence is a critical issue in relation to optimising online health applications, as well as treating internet addiction.

In the present study, a broad definition of presence and an integrative conceptual approach is adopted. Some theorists have specified separable aspects of presence according to the applications used - such as "Immersive Virtual Presence" (Riva et al, 2004) and "Social Robotic Presence" (Coradeschi et al., 2011). Drawing on Witmer and Singer's (1998) approach, presence is conceived as being immersed in the experience of

"the computer-generated environment" as opposed to the current physical location (Witmer & Singer, 1998, p. 225). Moreover, the experience of presence may vary in degree according to the way attention is divided between the real and the mental world. This construct has been applied across various technological and internet applications. It has also been adopted by other Greek and international studies, and has been operationalised in a formal assessment tool (Spagnolli, Bracken & Orso, 2014; Stavropoulos et al., 2013).

1.1.Conceptual framework

In the present study, presence is investigated using a novel integrative, multilevel approach that blends principles from the fields of human-computer interaction (HCI) science and developmental psychology. More specifically, within the bio-ecological model of development (Bronfebrenner & Morris, 2006), the concepts of presence from the HCI literature are embedded (Slater & Usoh, 1994; Lombard et al., 2000) alongside the behavioural elements of excessive internet use (Douglas et al., 2008). The components of this hybrid approach are considered complementary.

Internet engagement (time and absorbance) and excessive internet use have been explained as the result of the interplay between "push and pull factors" (Douglas, 2008). The individual's inner needs (e.g., introversion, escapism) and learning history (e.g., internet familiarity) are factors that push them to engage in the internet activity, while attractive features of the medium (e.g., online flow, which describes the level of absorbance of the user by their internet activity) are factors that pull the user in and moderate the level of their internet engagement (Stavropoulos et al., 2013). Douglas'

model presents similarities with the division of "internal" (within the user) (e.g., the perceptual position of the user "egocentric" and "exocentric") and "external" determinants (e.g., visual field of view, auditory externalisation) of presence as defined by Slater, Usoh and Steed (1994). Internal factors relate to the different responses of different users to the same form of technology, while external factors relate to parameters of the virtual environment. Similarly, Lombard and colleagues (2000) suggest that the degree of presence experience is defined by the interplay between three types of factors: (i) characteristics of the medium (e.g.,, image size and quality, visual and aural dimensionality, camera techniques and interactivity); (ii) characteristics of the content (e.g.,, realism, tasks); and (iii) characteristics of the user (e.g.,, knowledge, prior experience, willingness to suspend disbelief.). The common denominator between these three theoretical conceptualizations is the differentiation of user and medium/content-associated parameters, the interplay of which results in the level of internet engagement and presence experience respectively.

From a developmental perspective, the bio-ecological model of human development reinforces the significance of the interplay between internal and external factors as the basis of development, suggesting that all behaviour emerges from the dynamic interaction of individual and contextual factors over time. Therefore, the hybrid conceptual approach outlined here views the experience of presence as arising via the interplay of push and pull factors (related to characteristics of the individual as well as characteristics of their real and internet context) over time. The present study mainly focuses on the role of push factors related to the user's ambient environment and the characteristics of the individual. Changes in the experience of presence across age and the

possible moderating role of individual and contextual effects were of particular interest. Consequently, three levels of analysis were applied: the effect of age, the individual, and the proximal context. Such multilevel models have recently been recommended for examining the effects of media on behaviour (Prot & Gentile, 2014).

1.2. Adolescence and presence

Developmental differences in the experience of presence have been reported variously in the literature, mainly from cross-sectional studies. In one early study, adult users (aged 35 and 45 years) were less likely to experience presence than children and adolescents aged 10 to 20 years (Bangay & Preston, 1998). Similarly, Van Schaik and colleagues reported a negative correlation between spatial presence and age, in a sample that ranged roughly from 16 to 50 years (14% < 16 years, 43% = 17–30 years, 24% =30–45 years, and 19% ≥45 years) (Van Schaik, Turnbull, Wersch & Drummond, 2004). On the other hand, at least one experimental study with a sample ranging from 18 to 62 years of age demonstrated that older individuals reported higher presence (Schuemie et al., 2005). In another study, Thorson, Goldiez and Le (2009) found no relationship between age and presence experience. These disparities are most likely explained as being due to variations in the age groups compared, reliance on cross-sectional data, and poor sampling. To address these methodological limitations, a longitudinal design was utilized, with a specific focus on the late adolescent period, and representative sampling from a large number of mainstream schools.

The focus on the late adolescent period was based on several compelling factors related to peak internet use. First, the years between 16 and 18 years just precede the

period of maximum internet use both in Greece (Society of Information Observatory, 2011) and internationally (Pew Internet, 2010). Second, late adolescence has been shown to be a period of high risk for internet addiction, to which presence experience has been closely associated (Stavropoulos et al, 2013). Third, interest in internet-delivered intervention has grown substantially, particularly in lieu of the range and severity of symptoms among adolescent clients including obsessive-compulsive behaviours, insomnia, and victimization (De Bruin et al., 2014; Jacobs et al., 2014; Lenhard et al., 2014). Understanding the nature of presence during the late adolescent period is vital when developing effective forms of online interventions, and anticipating both therapeutic responses (Spagnolli, Bracken, & Orso, 2014) and vulnerability to excessive internet use (Stavropoulos et al., 2013).

1.3. The effect of anxiety

Research has also suggested relationships between characteristics of the user and susceptibility to presence (Alsina-Jurnet & Gutiérrez-Maldonado, 2010). Presence experience is thought to be a byproduct of the interaction between the way that the user processes information and the stimulation provided by the medium and/or application (Alsina-Jurnet & Gutiérrez-Maldonado, 2010). At the individual level, presence is affected by personality dispositions and traits (Sacau et al., 2008) that "push" the user to the virtual world. Despite this, recent studies have focused mainly on "pull" factors (i.e., characteristics of the virtual context and activity) (Alsina-Jurnet & Gutiérrez-Maldonado, 2010; Sacau et al., 2008). The present study fills the gap by including an examination of the association of individual level anxiety (offline) as a presence "push" factor.

Inclusion of anxiety in the multi-level conceptualization of presence was prompted by a number of empirical findings and observations. First, a positive correlation has been reported between anxiety and presence in virtual therapy studies (Alsina-Jurnet, Gutiérrez-Maldonado, & Rangel-Gómez, 2011). Second, both anxiety and presence are associated with escapism (Hartmann, Klimmt, & Vorderer, 2010; Kardefelt-Winther, 2014). Third, media are often used as a coping mechanism to deal with unpleasant situations or emotions (McDonald, 2009). Finally, no longitudinal data exist that test the causal effect of anxiety on presence. It has been persuasively argued that individuals with excessive online engagement do so as a way of coping with their offline anxiety (Kardefelt-Winther, 2014) and has been termed, *compensatory internet use*. Support for this hypothesis includes data showing that work-related stress increases internet use (Whang, Lee & Chang 2003) and also that internet user reduces arousal in children and adolescents (Leung, 2007). Moreover, there is converging data that many individuals use the internet as a way to mentally escape from adverse situations in their everyday life (Young, 2009; Henning & Vorderer, 2001; Zillmann, 2000). Therefore, individual anxiety could function as a push factor for higher susceptibility to presence experience.

Similarly, virtual reality (VR) therapy studies have indicated a synergistic relationship between anxiety (during the virtual therapy sessions) and presence in online treatment applications (Alsina-Jurnet et al., 2011). Higher levels of presence have been reported among clients with phobias and other anxiety disorders who are engaged in VR treatment (Robillard, Bouchard, Fournier & Renaud, 2003; Gorini & Riva, 2008). It is possible that the emotion (i.e., stress) triggered though a virtual application could increase the attentional resources orientated to the virtual context, giving rise to higher

presence (Alsina-Jurnet et al., 2011). Taken together, there is a compelling argument that individual level anxiety acts as a push (predisposing), precipitating, and maintaining factor of presence experience. This hypothesis has yet to be investigated longitudinally in a normative and representative sample of internet users.

1.4. The effect of classroom openness to experience

Since presence depends on how attention is shared between the real and the virtual world, the proximal offline context of the individual is a significant factor (Witmer & Singer, 1998). Indeed, this argument has been highlighted repeatedly in the psychological literature (Lee & Nass, 2005; Nack, 2003; Witmer & Singer, 1998). Most persuasively, Nack (2003) suggests that presence depends on the capacity of the individual to contextualize events, and described the context of experience as "the interrelated social and cultural conditions in which something exists or occurs" (p.57), all of which affect the individual's experience. Here, it is argued that a proximal context, which is socially attractive and stimulates positive feelings, could bias the selective attention of the user, reducing their susceptibility to presence (Witmer & Singer, 1998). More specifically, proximal context may reduce the user's willingness to focus on virtual stimuli, while increasing elements that may be distracting in the real world (Witmer & Singer, 1998). It follows that a context that evokes positive feelings could reduce the need to escape in the virtual world (Kardefelt-Winther, 2014; Henning & Vorderer, 2001; Zillmann, 2000; Spagnolli et al., 2014).

To assess the role of contextual factors, the classroom was included as a multi-level predictor of presence. The classroom context is highly significant in the

development of adolescents in general, and for Greek adolescents in particular (Kokkinos & Hatzinikolaou, 2011; Leadbeater, Hoglund, & Woods, 2003). The classroom context contributes to adolescents' social development (Leadbeater, Hoglund, & Woods, 2003) and has a moderating effect on psychological wellbeing (Kuperminc, Leadbeater, & Blatt, 2001). Greek adolescents remain in the same classroom groups throughout their school years, surrounded by the same group of classmates who function as an important ongoing social context. It is argued that the promotion of offline classroom participation reduces an individual's experience of presence.

Finally, openness to experience (OTE) may promote socialization and classroom participation (McCrae & Sutin, 2009). Individuals who are more open tend to seek feedback and to have positive perceptions of relationships (Wanberg & Kammeyer-Mueller, 2000) that helps advance the level of engagement in the classroom (Wanberg & Kammeyer-Mueller, 2000). This is borne out by recent data showing the positive role of OTE for relationships within groups as a whole (Bradley, Klotz, Postlethwaite & Brown, 2013). To assess the effect of OTE in groups, individual data is aggregated over all members of the group (Bradley et al, 2013), with high aggregate scores being related to better group communication and engagement (Bradley et al, 2013). In turn, it is feasible that a classroom high on OTE may better capture students' attention and reduces their tendency to experience presence. These theoretical conceptualizations are in accordance with recent findings that have demonstrated the protective effect of a higher level of classroom OTE on adolescents' internet addition symptoms (Stavropoulos, Gentile & Motti, 2015). To date, no study has examined the association of presence with contextual characteristics such as the average level of classroom OTE.

1.4. The present study

The present study comprised a longitudinal examination of changes in the degree of presence experience in a normative sample of adolescents enrolled in Greek high schools. More specifically, the study focuses on differences in presence experience over time, both between and within groups of students, enlisting a three-level hierarchical linear modeling (HLM) approach for analyzing nested data (Motti, Masten & Asendorpf, 2012). This design enables investigation of intra-individual change along with group differences, taking into consideration the role of classroom context. More specifically, anxiety symptoms as an individual push (control) factor were examined, while classroom OTE was included as a potential contextual (distraction from presence) factor. Furthermore, the modeling was also designed to evaluate interactions with age-related changes in presence. Accordingly, the following research hypotheses were defined:

> H_1: It is hypothesized that presence scores will decrease between the ages of 16 and 18 years. This is in accordance with previous cross-sectional findings that demonstrated a negative relationship between presence and age over the 10- to 20-year age period (Bangay & Preston, 1998) due to decreased excitement in response to the virtual context.
>
> H_2: It is hypothesized that due to their tendency to escape to the virtual world to avoid the reasons of their anxiety in reality, more anxious adolescents will report higher presence scores (Hartmann, Klimmt, & Vorderer, 2010; Kardefelt-Winther, 2014).
>
> H_3: Given the demonstrated effects (i) of classroom OTE on reducing internet addiction symptoms in adolescence (Stavropoulos, Douglas & Motti 2015),

(ii) the positive role of OTE in relationships between groups (McCrae & Sutin, 2009), and (iii) the dependence of the level of presence experience on the allocation of attentional resources between the real and the virtual context (Witmer & Singer, 1998), it is hypothesized that higher classroom OTE will be associated with decreased scores of presence.

2. Methods

2.1. Participants

This paper-pencil research[1] received approval by (i) the Ministry of Education, (ii), the Teachers' Council of each school, and (iii) parents' consent. The sample was collected in the Athens metro area and selected regional area in the Northern Peloponnese (Korinthia) using the randomized stratified selection based on the latest inventory card of the Ministry of Education (2010). Consecutively, the ratios of high schools and students were identified (i) between the extended capital metro area and the selected regional population, and (ii) between academic and vocational track high schools within these areas. Based on these quotas, school units and participants were randomly selected via a lottery. The sample comprised 648 students attending 34 classes in 13 public academic and vocational track high schools[2]. Additionally, chi-squared analysis confirmed that the distribution of the valid sample did not differ from that of the original population regarding the area of residence and the type of school of the participants (X^2=12813.68, df=3, p>.05) (see Table 1).

-Table 1. *Sample & Population Proportions* -

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% using predominantly blogs and social networking sites, 16.4% instant messengers, 14.6% information seeking engines, 13.6% chatrooms, 13.4% online games, 13.4% you-tube and videos, 2.4% pornographic sites, and 5% other applications. Parents' 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).

The cohort was assessed twice in a period of 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&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). Retention between the two waves was 56% ($N_{\text{Wave 2}}$=363) due to changes of school, school, and research drop-outs. The frequency of assessments for each individual varied (1–2, M = 1.57). Although attrition was unsystematic, to evaluate the attrition effects, and in consensus with applied methodologies (Motti, Asendorpf & Masten, 2012), attrition was used as an independent

variable (dummy coded 1= Attrition, 0= not attrition) at Level 2 of the HLM analyses to assess whether it effects presence score and its associations with the other independent variables. Results confirmed that attrition did not have significant effects (see Table 2).

-Table 2. *Assessment of the attrition effects in HLM analyses*-

2.2. Measures

Presence II

To assess presence[3], the Presence II questionnaire (Witmer & Singer, 1998) was used after bidirectional translation from bilingual translators. The Presence Questionnaire II is a self-reported instrument comprising 32 questions and uses a seven-point scale format that is based on the semantic differential principle (Dyer, Matthews, Stulac, Wright, Yudowitch, 1976). Participants were required to answer how much they had experienced each of the items described (e.g., "How completely were all of your senses engaged?", "How much did your experiences in the virtual environment seem consistent with your real-world experiences?", "How natural did your interactions with the environment seem?") while using their most preferred internet application during the last six months on a scale ranging from: 0= Not Compelling to 6= Very Compelling. The responses from the 32 answers were summed up resulting in a range between 0 to 192, with lower scores indicating lower degrees of presence and higher scores reflecting higher presence. The internal rate of reliability of the questionnaire was high with a Cronbach alpha=0.89.

A PCA analysis with direct oblimin rotation type was applied. Kaiser-Meyer-Olkin value was 0.90 and Bartlett's Test of Sphericity was 10,154.07 with a $p<0.001$.

The analysis supported the of presence six components with eigenvalues greater than 1, explaining 24.66%, 16.12%, 6.20%, 4.27%, 4.02% and 3.51% of the variance respectively. This solution explained a total of 58.78% of the total variance similar to other studies (Witmer & Singer, 1998).

Symptom check list 90 revised (scl-90-r): Anxiety subscale

To assess anxiety symptoms, the Anxiety subscale of the SCL-90 –R questionnaire (Derogatis & Savitz, 1994) was used comprising 10 items addressing anxiety-associated behaviors. It should be noted that the instrument has been widely used internationally to assess anxiety in adolescents and adults, and offers the advantage of findings' comparability with other international studies (Cuijpers et al., 2014). Items refer to issues regarding tension and trembling, feelings of terror and panic, as well as somatic correlates of anxiety. Participants were required to respond on a 5-point Likert scale (0= "not at all", 1= "a little", 2= "moderate", 3= "very much", 4= "all the time") how much they had experienced each of the symptoms during the last six months (e.g., "Worrying too much about things?", "Trembling?", "Nervousness?", "Feeling fearful"). The mean of the items compiling the subscale was calculated ranging from 0-4, where 0 indicated minimum and 4 maximum disturbance. The internal Cronbach's alphas (of the SCL-90 clinical subscales) in the present study were: OC = .79; somatization = .85; interpersonal sensitivity = .82; hostility = .85; phobic anxiety = .82; depression = .83; paranoia =.73, and psychoticism = .75. Internal reliability of the anxiety subscale in particular was acceptable (.72) with a Cronbach's α similar to that of previous studies (Olsen, Mortensen & Bech, 2004).

Five-Factor-Questionnaire for Children: Openness to experience (OTE) subscale

To assess OTE as a classroom characteristic, individual scores within the same classroom were aggregated to produce the classroom mean. This method has been applied for contextualizing the effect of personality traits on groups to evaluate group processes (Barrick et al, 1998; Bradley et al, 2013). The FFFK OTE subscale was used (Asendorpf & Van Aken, 2003). The questionnaire comprises five subscales: extraversion, emotional stability, conscientiousness, agreeableness, and OTE. Each subscale included eight bipolar adjectives (i.e. "I have no interests - I have many interests", "I have vivid - creative imagination - I like doing simple and ordinary things", "I am open with others - I am closed with others") 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 to a range from 1 to 5, indicating the minimum and the maximum presence of each trait. The Cronbach's alphas were: Extraversion = .64; emotional stability = .55; agreeableness = .63; conscientiousness = .67, and OTE = .73.

2.3. Procedure

The first time point measurements were collected in the school year 2009-2010 and the second time point measurements were collected in the school year 2011-2012. The process of data collection was identical between the two time points. A specially trained research team of 13 undergraduate and postgraduate students of the Department of Psychology of the University of Athens collected the data in the participants' classrooms during the first two or last two school hours (45 minutes each) of a school day, according to the permission provided by the Ministry of

Education. The adolescents were motivated to participate in the study by the fact that they would not have to attend subjects taught during the time of the study and they would not be considered as absent from lessons. It should also be noted that according to 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.

2.4. Statistical analyses

The structure of the data which were nested at two levels, measurements across time points referring to the same participant (Level 1 nesting) and measurements of various participants embedded in the same classroom (Level 2 nesting), dictated the use of multilevel analysis (Motti, Asendorpf & Masten, 2012). The use of multilevel analysis enabled the research team to: (i) assess the effects of different levels (age-related changes, individual, classroom) on presence scores, and (ii) control for random effects which may compromised the findings through the calculation of robust standard errors (Motti et al., 2012). Therefore, hierarchical linear modeling (HLM) 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). Conducting covariance based structural equation modeling (CBSEM) was not selected as: a) it requires at least three or four indicators (the current study includes two time points) for every latent variable (growth) (Baumgartner & Homburg, 1996) and; b) it assumes multi-normal distribution of the observed variables to ensure meaningful results, which is rarely the case in empirical research (Micceri, 1989). Similarly, latent growth modeling (LGM) was not chosen as it assumes that level-1 predictors with random effects have the

same distribution across all participants in each subpopulation, while HLM allows different distributions (Raudenbush & Bryk, 2002). Finally, HLM was preferred over partial least square analysis (PLS), as it estimates the effects of variables on the outcome variable at one level (i.e. individual), while at the same time taking into account the effect of variables on the outcome variable at another level (i.e. classroom) (Raudenbush & Bryk, 2002).

Subsequently, the HLM 6.0.8 software was used (Raudenbush & Bryk, 2002). Model testing proceeded in successive phases, such that each of the examined conditions was first studied separately, before being included in the full model (Hox, 2010; Raudenbush & Bryk, 2002): 1) Unconstraint (null) model; 2) Random ancova model (level 1 predictor); 3) Means as outcomes model (level 2 predictor); 4) Random coefficient (regression slope) model (levels 1& 2 predictors); 5) Means as outcomes model (level 3 predictor); 6) Random coefficient (regression slope) model (levels 1 & 3 predictors) and; 7) Full Model-Random intercepts and slopes (levels 1, 2 & 3 predictors). In this context, presence scores (level 1 outcome variable) were predicted for each individual at Level 1 by wave in the study. Wave was centered at Wave 1 such that the individual intercepts referred to the initial level of presence (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 anxiety symptoms at Time 1. Finally, the classroom characteristic of OTE (Time 1 grand centered) was added to test both its main effects and its cross-level interaction (slope) with wave at Level 1. 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.

3. Results

3.1. Descriptive statistics and correlations

Presence scores' distribution (Cronbach α=0.89) varied across the two measurements (Presence Wave 1 mean=129.39, *SD*=25.66; Presence Wave 2 mean= 123.96, *SD*= 26.51). Prior to the HLM analyses, the means, standard deviations, and inter-correlations between all the HLM variables were estimated (see Table 3). Anxiety at the age of 16 years (Wave 1) significantly positively correlated with anxiety at the age of 18 years (Wave 2), indicating that adolescents higher in anxiety at the age of 16 years were likely to be higher in anxiety at the age of 18 years (r = .44, p<.01). Moreover, anxiety at the age of 16 years significantly positively correlated with presence scores at the same age (r = .13, p< .01), demonstrating that more anxious adolescents presented higher presence scores at the age of 16 years. Furthermore, the average classroom level of OTE at the age of 16 years was significantly negatively correlated with presence scores at the same age (r = -.11, p<.01) and similarly the average classroom level of OTE at the age of 18 years was significantly negatively correlated with presence scores at Wave 2 (r = -.10, p<.01). These indicated that adolescents situated in classrooms with a higher average level of OTE were less likely to report higher presence scores at both time points. Finally, presence scores at Wave 1 significantly positively correlated with presence scores at Wave 2 (r = .23, p<.01), indicating that adolescents who were at more susceptible for presence at the age of 16 years were similarly more susceptible for presence at the age of 18 years.

-Table 3. *Means, standard deviations and correlations of the HLM variables-*

3.2. Imputation of missing values at level 2

To treat missing values at Level 2/ individual (in HLM missing values do not present a problem at Level 1/time related change, and did not occur at Level 3/classrooms in the data), multiple imputation using the maximum likelihood method was applied. This approach was followed for three reasons: (i) missing values with respect to the studied variables were unsystematic in the data; (ii) to avoid list-wise deletion which would reduce the sample; and c) to follow relevant previous literature recommendations (Motti et al., 2012). Therefore, multiple imputation using all available Level 2 variables was performed. All multilevel analyses were run using the multiple imputation option of HLM 6.0.8. Consequently, all multilevel analyses were run five times, and the results of the five runs were averaged.

3.3. The unconstraint (null) model

To evaluate the extent to which the three levels of analysis (age-related change, individuals, and classrooms) were associated with the overall variation in presence scores, the variance components of each level from the unconditional-null model were calculated (presence was inserted as the dependent variable at level 1 with no independent variables used at levels 2 and 3). The final estimation of variance components confirmed the need of applying HLM ($X^2_{\text{Level 2}} = 804.28$, $df = 596$, $p < .001$, $X^2_{\text{Level 3}} = 89.76$, $df =, 33$ $p < .001$). As an additional step, the intra class correlation (ICC) was calculated to determine which percentage of the variance in presence is attributable to classroom membership (level 3), which percentage is

attributable to between individual differences (level 2), and which is attributable to over-time differences within individuals (level 1). Results suggested that 76.6% (522.02) of the variance in presence is at the first level (over-time differences within individuals), 17.7% (120.98) at level 2 (the individual level) and 5.7% (35.33) at level 3 (between classrooms). Results confirm that the level of presence experienced varies according to differences within individuals over time, differences between individuals, and differences between classrooms. Because variance existed at all three levels of the data structure, predictor variables were separately added at each level to address the research hypotheses before testing the full model.

-*Figure 1.* Proposed Model-

3.4. Random ancova model (level 1 predictor)

Next, and to address *hypothesis 1* (differences within individuals over time), the relationship between time (the level 1 predictor, centered at time point 1) and presence was tested. The coefficients for the intercept and the slope of the regression line (of time on presence) were allowed to vary randomly between individuals and between classrooms, but were not predicted by individual (level 2) and classroom level variables (level 3). The results (accounting for robust standard errors) supported *hypothesis 1*, indicating that presence scores significantly dropped between 16 and 18 years, b = -4.59, p =.022. The within individuals (level 1) variance of presence scores explained by the effect of time was 4.3%.

3.5. Means as outcomes model (level 2 predictor)

To address *hypothesis 2*, the relationship between anxiety (level 2 predictor) and presence was tested. Anxiety (grand centered-when the level 2 predictor variable is grand centered, the level 2 intercept is equal to the grand mean of the outcome variable) was applied as the independent variable at level 2. No additional independent variables were used at levels 1 and 3. Error terms were included at levels 2 and 3 to account for both between individuals, and between classrooms random effects respectively. The standardized (i.e. with robust standard errors) results supported *hypothesis 2*, indicating that presence scores significantly increased among individuals higher on anxiety, b = 1.65, p =.017. The between individuals' variance of presence scores explained by the effect of anxiety was 7.3%.

3.6. Random coefficient (regression slope) model (levels 1 & 2 predictors)

To longitudinally address *hypothesis 2*, the over-time relationship between anxiety (level 2 predictor) and presence was tested. Therefore, time (centered at time point 1) was used as the independent variable at level 1, and anxiety (grand centered) was inserted as the independent variable at level 2, to predict the slope of the effect of time on presence at level 1. No additional independent variables were used at level 3. Error terms were included at levels 2 and 3 to account for random variations between individuals and between classrooms. The standardized (i.e. with robust standard errors) final estimation of fixed effects revealed that anxiety significantly interacted with time. Anxiety's effect on presence appeared to reduce between 16 and 18 years, b = -1.85, p =.035. This indicated that the relationship between anxiety and susceptibility to presence was buffered by maturation effects. Figure 2 illustrates the increase of presence scores for more anxious adolescents at the age of 16 years and the weakening of this relationship at

the age of 18 years. The cross-level interaction of time at level 1 and presence at level 2 explained 3% of the variance of presence scores.

-*Figure 2*. Presence, Anxiety and Time-

3.7. Means as outcomes model testing (level 3 predictor)

To address *hypothesis 3*, the relationship between the average level of classroom OTE (level 3 predictor) and presence was tested. Therefore, classroom OTE (grand centered- such that the level 3 intercept is equal to the grand mean of the outcome variable) was inserted as the independent variable at level 3. No additional independent variables were used at levels 1 and 2. Error terms were included at levels 2 and 3. The standardized (i.e. with robust standard errors) final estimation of fixed effects validated *hypothesis 3*, indicating that presence scores significantly decreased among students attending classrooms with a higher average level of OTE, b = -8.83, p =.025. The variance of presence scores between classrooms explained by the effect of classroom OTE was 22%.

3.8. Random coefficient (regression slope) model (levels 1 & 3 predictors)

To longitudinally address *hypothesis 3*, the over-time relationship between classroom OTE (level 3 predictor) and presence was assessed. Time was used as the independent variable at level 1. Classroom OTE (grand centered) was inserted as the independent variable at level 3 to predict the slope of the effect of time on presence at level 1. No additional independent variables were used at level 2. Error terms were included at levels 2 and 3. The standardized (i.e. with robust standard errors) final

estimation of fixed effects indicated that the effect of the average level of classroom OTE on IGD scores did not vary between 16 and 18 years, b = -1.54, p =.804.

3.9. The full model

Finally, the intercepts and slopes, as outcomes models including all three level predictors, were simultaneously tested. Common method variance was estimated at 6% for this empirical data[4]. Results were in agreement (i.e. significant associations identified) with the separately tested models. Table 4 summarizes the full model findings regarding the individual and classroom factors examined along with their interactions (and is divided into four quadrants). The upper left quadrant presents the cross-sectional findings without controlling for random effects. The lower left quadrant presents the over-time change results without controlling for random effects. The upper right quadrant presents the cross-sectional findings after controlling for random effects at Levels 2 (individual) and 3 (Classroom). The lower right quadrant presents the over-time change results after controlling for random effects at Levels 2 (individual) and 3 (Classroom). As expected, controlling for random effects differentiated the results, and therefore, only the right side of Table 4 (columns 6-10) should be considered. The full model explained 6% of the Level 1, 10% of the Level 2 and 29% of the Level 3 variance in presence scores. Considering the overall (three levels) presence variance, the full model explained 11.28%. The model comparison test (based on the deviance statistics provided), indicated that the addition of random errors at level 3 did not significantly contribute to the explanation of presence variance (X^2= 7.248, df = 9, p>.05).

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-Table 4. *HLM full model analyses predicting adolescents' Presence Scores*-

4. Discussion

The present study examined changes to the experience of presence between 16 and 18 years in a normative and representative sample of adolescents. An integrative framework that focused on examining individual differences in the context of age-related and ecological effects was operationalized via a three-level hierarchical linear model. Findings demonstrated that receptiveness to presence declined between 16 and 18 years. Furthermore, adolescents higher in anxiety symptoms were significantly more susceptible to presence at the age of 16 years and less receptive over time. Finally, students in classrooms of higher average level of OTE were less likely to report presence both at the age of 16 years and over time.

4.1. Changes in adolescence

The effect of age on presence has been highlighted repeatedly (Lombard et al., 2000; Stanney, & Salvendy, 1998), although with somewhat contradictory results. After longitudinally assessing a normative and representative sample of adolescents, the present study found that presence scores significantly decreased between 16 and 18 years. Comparisons with other (cross-sectional) studies depends upon the age range sampled, with studies of older populations showing mixed results, and those involving adolescents tending to a negative relationship between presence and age. However, two previous cross-sectional studies involving adults have suggested that the experience of presence either increases with age over the late-adolescent to older adult period (Schuemie et al., 2005) or remains stable in young adults (Thorson et al., 2009). These differences could be attributed to the different methodologies applied (cross-sectional vs. longitudinal)

and/or the different age ranges of interest. Indeed, Thorson, Goldiez and Le (2009) suggested that the absence of change in presence in their sample (499 undergraduate students) might be attributable to the narrow age range explored, and they recommended further research with more heterogeneous populations. Similarly, Schuemie and colleagues did not interpret the positive correlation between presence and age, but rather controlled for age in a subsequent analysis (Schuemie et al., 2005).

With respect to adolescents, the results of the present study tend to coalesce in showing a negative relationship between presence and age (Bangay & Preston, 1998; Van Schaik et al., 2004). According to Bangay and Preston (1998), decreased excitement in response to the virtual context explains the change with age that was observed over the 10-20 year period. By comparison, lower computer confidence and more usability problems among older adults explained much of the variation over the 16-50 year period (Van Schaik et al., 2004). In a comprehensive literature review, reductions in presence over adulthood were attributed to a decline in information processing speed and attentional allocation that occur with aging (Sacau, Laarni & Hartmann, 2008). The same arguments do not apply for adolescence where both cognitive and computer use skills increase (Blakemore & Choudhury, 2006; Society of Information Observatory, 2011). Rather, transitions in socio-emotional development may provide an alternative hypothesis for adolescents. During this period romantic relationships unfold rapidly after 15 years (Collins et al, 2009), a transition associated with cognitive and emotional maturation, identity formation, and a higher degree of autonomy (Collins et al, 2009). Preoccupation with peer and romantic relationships may moderate the experience of presence over adolescence through inviting attention to the real world.

4.2. The effect of anxiety

Anxiety may also operate to heighten presence in adolescents, although this association tends to weaken over time. Other studies have also suggested that individual dispositions and traits (e.g., neuroticism) may increase susceptibility to presence (Alsina-Jurnet & Gutiérrez-Maldonado, 2010; Sacau et al., 2008) by "pushing" the user into the virtual world. In another line of work, virtual therapy research has indicated that higher anxiety has a synergistic relationship with higher presence experience (Alsina-Jurnet et al., 2011; Robillard et al., 2003). Anxiety provoked in virtual therapies may increase the allocation of attentional resources to features in the virtual environment, resulting in higher level of presence (Alsina-Jurnet et al., 2011). More specifically, presence has been shown to be associated with the level of anxiety induced in virtual exposure therapies, and is correlated with treatment efficacy (Gorini & Riva, 2008).

In the present study, anxiety was assessed as an individual characteristic that could push the user into the virtual world, rather than an outcome triggered by the virtual context. The pattern of results may be better explained by compensatory internet use (Kardefelt-Winther, 2014) and escape from reality tendencies (Young, 2009). Here, individuals may overly engage with the online context as a way to cope with or escape from their offline problems/feelings such as anxiety (Young, 2009). Put another way, being tele-present may allow the individual to be "absent" from anxiety in real life. Indeed, being susceptible to presence can heighten this effect (Spagnolli et al., 2014),

allowing individuals to avoid life situations that they find difficult and to alleviate noxious experiences (Henning & Vorderer, 2001; Zillmann, 2000).

However, over the course of adolescence, this relationship between anxiety and presence dissipates. This could indicate that over time more anxious adolescents gradually learn to rely less on virtual escaping behaviors (Kardefelt-Winther, 2014; Young, 2009), and more on alternate stress coping skills (Aldwin, Sutton, Chiara, & Spiro, 1996). Developmental studies have also suggested changes in the ways adolescents address anxiety and shifts toward more adaptive coping responses (Compas et al., 2001; Cairns et al., 1989). Increasing metacognitive skills (e.g., thought and feeling reflection) during adolescence may provide the individual with greater ability to differentially address their sources of stress (Compas et al., 2001; Cairns et al., 1989). These could enhance problem-solving skills and thus decrease avoidant (e.g., escaping online) behaviors that likely induce higher receptiveness to presence.

4.3. The effect of classroom openness to experience

Results demonstrated that adolescents in classrooms with a higher average level of OTE presented lower presence scores. This supports: (i) the role of offline contextual factors (Lee & Nass, 2005; Nack, 2003; Witmer & Singer, 1998), and (ii) the role of classroom as an important factor for the development of adolescents (Hamre & Pianta, 2005; Kuperminc, Leadbeater, & Blatt, 2001; Leadbeater, Hoglund, & Woods, 2003) and Greek adolescents in particular (Kokkinos & Hatzinikolaou, 2011). At the classroom level, higher OTE engenders lower presence scores, a relationship that may reflect the selective allocation of attention to salient social stimuli. OTE – encompassing creativity,

flexibility, curiosity, and novelty-seeking – has been associated with higher socialization (McCrae & Sutin, 2009; Wanberg & Kammeyer-Mueller, 2000). High OTE may foster greater engagement with the classroom environment, reducing their susceptibility to presence.

Along similar lines, OTE as a group characteristic has been shown to strengthen group communication and engagement (Bradley, Klotz, Postlethwaite & Brown, 2013). In turn, this may reduce any tendency to attend to virtual stimuli and be psychologically involved with the virtual world (Biocca, Harms, & Burgoon, 2003; Witmer & Singer, 1998). In addition, high OTE at the classroom level is likely to provide a source of positive emotions, reducing the need for online escapism (and presence) which function to compensate aversive feelings (Bradley et al., 2013; Kardefelt-Winther, 2014; Henning & Vorderer, 2001; Zillmann, 2000; Spagnolli et al., 2014), and perhaps online sensation-seeking (Lee & Nass, 2005).

4.4. Limitations and further research

In addition to the study's strengths, its limitations need to be highlighted. First, the use of self-report assessments might reduce the validity and the reliability of the findings. More specifically, scholars have questioned the over-reliance on questionnaires when assessing presence (as a cognitive and emotional state) (Slater, 2004) suggesting the integration of more actuarial methods. Similarly, measurements of anxiety and classroom OTE, although assessed with widely used and reliable instruments and methods, did not entail any biological or socio-metric scores respectively. Second, the specific age and cultural background of the sample imposes the need of cautious

generalization of the findings. Nevertheless, the presence II questionnaire used in this study was used to assess what might be considered as a trait construct, susceptibility to presence while using the internet, and not a concurrent cognitive and emotional state in relation to the specific use of a particular online application. In that context, although different parameters of online engagement (e.g., time spent online per day or week, internet application/activity preferred) were assessed, they were not considered for the conducted analysis. Instead, their possible influence was controlled via addressing for random effects at the three levels of the data. This is an important point that was not included in the aims of this study (which primarily emphasized individual and contextual factors associated to the experience of presence in adolescence) and needs to be addressed by future research. Furthermore, future research could specifically co-examine both the quality and the extent of online and offline interactions among students of the same class. Given that tendencies to use specific applications often constitute social phenomena and trends among users in general (and adolescent users in particular), it might be assumed that groups within the classes would be sharing specific applications such as games or chat programs and that could significantly impact susceptibility to experiencing presence. It is expected that research into such factors could result in more insightful findings regarding possible mixed reality conditions.

In addition, recent studies classify presence into several components, which can be crudely categorized as early (perception) and late (believability) neural processes (Riva 2006), not examined in this study. Future research should emphasize age-related changes in each of these specific aspects, as well as their interaction with other individual and proximal context factors, including anxiety and classroom OTE. Further exploration

of the interactions between individual characteristics and elements of real and virtual context should be attempted using supplementary research methodologies (e.g., task-activity based, between-groups (age) quasi-experimental studies, combining questionnaires and actuarial measurement methods). The dynamic interplay of such factors appears to be important to better understand presence during adolescence.

The present study sheds light on questions that have not been previously investigated. Paradoxically, the same innovative nature of the findings weakens in many cases their proposed interpretations, due to lack of previous empirical evidence. This could invite future studies to expand the knowledge on the field in terms of both breadth and depth.

4.5. Conclusion and Implications

Research into presence has made important advancements in the last two decades, with new knowledge of its contributing factors and its implications for virtual therapy (Sacau et al., 2008; Ghanbarzadeh et al., 2014). However, research has tended to focus more on factors associated with the virtual world than those of the user and their immediate context (Alsina-Jurnet & Gutiérrez-Maldonado, 2010; Sacau et al., 2008). The present study addressed this point by adopting a conceptualization that integrated constructs from the presence literature with those of developmental and ecological psychology. This approach is in line with recent recommendations for embracing longitudinal and multilevel methodologies in media studies (Prot & Gentile, 2014). The present study is perhaps the first to investigate the interplay of age-related, individual, and classroom factors on the tendency to experience of presence during adolescence –

achieved using a three-level, hierarchical linear model that controlled random effects. The longitudinal data showed a reduction in experiencing presence between 16 and 18 years. Furthermore, the weakening association between anxiety and presence over time may reflect the unfolding of coping strategies that adolescents can enlist to better manage anxiety states, rather than relying on escape to the virtual world. Finally, at the classroom level, higher OTE may operate to attenuate the experience of presence.

All these findings have specific implications for the design of virtual therapies. Tailor made approaches in designing and implementing e-health applications and protocols should be adopted based on age-related, individual, and contextual parameters. This approach is in consensus with the "differential susceptibility to media effects model" that has been gaining support internationally (Valkenburg & Peter, 2013). In particular, e-health applications involving presence should be age-specific and increase their presence-related features (e.g., sensorial stimuli, interactivity) when referring to older adolescents. Following this line of thought, and although presence based virtual treatments appear to be more suitable for more anxious adolescents at the age of 16 years, they need to be progressively integrated with more offline components, due to the weakening relationship between anxiety and presence demonstrated. Finally, the element of the proximal context of the adolescent needs to be carefully taken into consideration. Accordingly, adolescents situated in less open to experience classrooms may be more susceptible to presence-based virtual therapies.

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Note 1: The present data have been used in three more published studies that address different theoretical questions (Stavropoulos, Kuss, Griffiths & Motti-Stefanidi, 2015; Stavropoulos, Gentile & Motti-Stefanidi 2015; Stavropoulos, Kuss, Griffiths, Wilson & Motti-Stefanidi, 2015). Instruments used in the data include the: (i) Internet Addiction Test IAT (Young, 1998a); (ii) Presence II questionnaire (Witmer & Singer, 1998); (iii) Online Flow Questionnaire (Chen, Wigand & Nilan, 1999); (iv) Symptom Check List 90 (Derogatis & Savitz, 1999); (v) Rosenberg Self-Esteem Scale (Rosenberg, 1965); (vi) Five Factor Questionnaire for Children (Fünf-Faktoren-Fragebogen für Kinder) (Asendorpf & Van Aken, 2003); (vii) Generalized Self-Efficacy Scale (Schwarzer, 1993); (viii) Family Adherence and Cohesion Evaluation Scale (Olson, 2000); (ix) Socio-metric Questionnaire (Coie, Dodge & Coppotelli, 1982); (x) Greek version of the Experience of Close Relationships Revised (Tsagarakis, M., Kafetsios, K., & Stalikas, A., 2007); (xi) demographic and internet use questions and; (xii) school grades of the participants were retrieved from their school records.

Note 2: The data abides with the sample size requirements suggesting: a) a minimum ratio of $10_{clusters}$ / $5_{participants}$ to test for fixed effects and cross-level interactions in models with one explanatory variable at each of the levels, and; b) a minimum requirement of 30 clusters for testing standard errors of fixed effects (Maas & Hox, 2004, 2005).

Note 3: The Presence II questionnaire focused on summative evaluation of a specific experience in previous studies (Witmer & Singer, 1998). In the present study students were asked to address the Presence

II items having in mind the most characteristic (average) use/experience of their most preferred internet application within the period of the last six months.

Note 4: To address the issue of common method variance, the method of using a single common latent factor (CLF) was used with all of the measures involved in the model as indicators. Their parameters/regression weights were constrained to be the same (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The square of the regression weight of the latent factor (.24 in the current model) on the observed variables indicates the amount of variance accountable to common method variance, which with the present variables was 6% (.057). The analysis was then repeated without the CLF (Meade, Watson & Kroustalis. 2007). The standardized regression coefficients weights (SRCW) with and without the CLF were compared (SRCW $_{\text{without CLF}}$ - SRCW $_{\text{with CLF}}$). The differences were lower than .20 indicating that the effect of common method bias was insignificant.

Appendix

Summary of Models' Equations

Unconstraint (Null) Model:
$$PRESENCE_{ijk} = \gamma_{000} + \rho_{0jk} + u_{00k} + \varepsilon_{ijk}$$

Random Ancova Model (level 1):
$$PRESENCE_{ijk} = \pi_{0jk} + \pi_{1jk}*(time_{ijk}) + \varepsilon_{ijk}$$

Means as Outcomes Model (Level 2 predictor):
$$PRESENCE_{ijk} = \gamma_{000} + \gamma_{010}*ANX_{jk} + \rho_{0jk} + u_{00k} + u_{01k}*ANX_{jk} + \varepsilon_{ijk}$$

Random Regression Slope (Coefficient) Model (Levels 1 & 2 interaction):
$$PRESENCE_{ijk} = \gamma_{000} + \gamma_{100}*time_{ijk} + \gamma_{110}*time_{ijk}*ANX_{jk} + \rho_{0jk} + \rho_{1jk}*time_{ijk} + u_{00k} + u_{10k}*time_{ijk} + u_{11k}*time_{ijk}*ANX_{jk} + \varepsilon_{ijk}$$

Means as Outcomes Model (Level 3 predictor):
$$PRESENCE_{ijk} = \gamma_{000} + \gamma_{001}*Classroom\ OTEk + \rho_{0jk} + u_{00k} + \varepsilon_{ijk}$$

Random Regression Slope (Coefficient) Model (Levels 1 & 3 interaction):
$$PRESENCE_{ijk} = \gamma_{000} + \gamma_{100}*time_{ijk} + \gamma_{101}*time_{ijk}*Classroom\ OTEk + \rho_{0jk} + 1_{jk}*time_{ijk} + u_{00k} + u_{10k}*time_{ijk} + e_{ijk}$$

Full Model: Random Intercepts and Slopes Level 1, 2 & 3 predictors and cross-level interactions:
$$PRESENCE_{ijk} = \gamma_{000} + \gamma_{001}*Classroom\ OTE_k + \gamma_{010}*ANX_{jk} + \gamma_{100}*time_{ijk} + \gamma_{101}*time_{ijk}*Classroom\ OTE_k + \gamma_{110}*time_{ijk}*ANX_{jk} + \rho_{0jk} + \rho_{1jk}*time_{ijk} + u_{00k} + u_{01k}*ANX_{jk} + u_{10k}*time_{ijk} + u_{11k}*time_{ijk}*ANX_{jk} + \varepsilon_{ijk}$$

Note: (ε, ρ and u parameters refer to the controls of random effects at the three levels respectively)