

Problematic technology use, leisure time activities and executive functions in adolescents¹

Uso problemático de las tecnologías, actividades de ocio y funciones ejecutivas en adolescentes

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Abstract

Introduction: The main objective of this study was to analyze the relationship between problematic use of information and communication technologies (PUT), executive functions (inhibitory control, planning and goal achievement) and leisure activities of adolescents (positive leisure and unstructured leisure), according to gender, age and academic performance. **Methodology:** This research involved 3,831 school-going adolescents aged 13 to 18 from four countries (Chile, Spain, Mexico and Peru). The instrument used was the self-report questionnaire of the YOURLIFE project. A multiple linear regression analysis was performed in order to obtain a predictive model. **Results:** The analyses showed that PUT was more frequent in the older group. The predictive model indicated that lower inhibitory control, as well as unstructured leisure activities, were associated with PUT. In addition, positive leisure activities (family activities and recreational reading) were found to be protective factors for PUT. **Discussion:** The article highlights the need for developmental programs for adolescents that promote positive leisure activities, educational and psychological intervention, and parental involvement in education for responsible and efficient use of information and communication technologies.

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Keywords: adolescents-ICT-executive functions- leisure activities-inhibitory control

Resumen

Introducción: El objetivo principal de este estudio ha sido analizar la relación entre el uso problemático de las tecnologías de la información y comunicación (UPT), las funciones ejecutivas (control inhibitorio, planificación y logro de metas) y las actividades de ocio de los/as adolescentes (ocio positivo y ocio no estructurado), en función del género, la edad y el rendimiento académico. **Metodología:** En esta investigación han participado 3.831 adolescentes escolarizados de 13 a 18 años de 4 países (Chile, España, México y Perú). El instrumento utilizado ha sido el cuestionario de autoinforme del proyecto YOURLIFE. Se ha realizado un análisis de regresión lineal múltiple con el fin de obtener un modelo predictivo. **Resultados:** Los análisis han mostrado que el UPT era más frecuente en el grupo de más edad. El modelo predictivo, ha indicado que un menor control inhibitorio, así como las actividades de ocio no estructurado, se asociaban con el UPT. A su vez, las actividades de ocio positivo (actividades familiares y lectura recreativa) se han presentado como factores protectores de la UPT. **Discusión:** En el artículo se destaca la necesidad de desarrollar programas para adolescentes que promuevan actividades de ocio positivo, la intervención educativa y psicológica, y la implicación de los padres y madres en la educación para el uso responsable y eficiente de las tecnologías de información y comunicación.

Palabras clave: adolescentes-TIC-funciones ejecutivas-actividades de ocio-control inhibitorio

Introduction

Information and Communication Technologies (ICT) play an important role in the lives of young people (Arab & Díaz, 2015), contributing to create an environment of relationships, exchanges and entertainment (Fernández-Montalvo, Peñalva, & Irazábal, 2015). However, despite the numerous benefits of ICT (De la Hoz, 2018), its rapid and constant growth has also brought risks for young people, leading to the problematic use of ICT (PUT), when time spent online affects the proper development of everyday life (Gairín Sallán, & Mercader, 2018).

According to the meta-analysis carried out by Cheng and Li (2014), the prevalence of PUT across the 31 countries providing data ranges from

2.6% to 10.9%. Among young Spanish people, PUT prevalence stands at 17% (Machimbarrena et al., 2018), with 10.8% in Belgium (López-Fernández, 2018), 11% in the Netherlands (Jelenchick, Hawk, & Moreno, 2016), while in Asian countries it is as high as 30.9%, as reflected in a study in Korea (Cha & Seo, 2018). Regarding gender differences in problematic Internet use, some studies indicate that this is higher in boys (Laconi, Tricard, & Chabrol, 2015; Munno et al., 2017), while others show problems are more prevalent among girls (Carbonell et al., 2018; Gómez et al., 2017; López-Fernández, 2018; Yudes-Gómez et al., 2018). It is possible that the differences between boys and girls in PUT are small or that it depends on cultural contexts. In older adolescents (17-18 years), PUT is more frequent than in younger adolescent age groups (Gómez et al., 2017). However, as Laconi et al. (2018) indicate, it would be necessary to examine the differences in sex and age of the PUT in more depth.

In an empirical study, López-Fernández (2018) concluded that the causes of excessive use of online activities may be individual (e.g., avoiding boredom and escaping reality), social (e.g., sharing a hobby with others who have similar interests in online technologies and activities) and contextual (e.g., having a great deal of free time, a perceived “poor” or “hostile” external context, such as difficult or unsatisfactory relationships). Among the individual factors associated with PUT are clinical symptoms such as avoidance of face-to-face social interaction (Lee & Stapinski, 2012), problems at school (Secades-Villa et al., 2014), depressive symptoms and family conflicts (De Leo & Wulfert, 2013), as well as changes in self-esteem (Pantic, 2014). Some mental disorders, such as attention deficit hyperactivity disorder (ADHD) or obsessive-compulsive disorder (OCD) (Andreassen et al., 2016), as well as lack of physical activity (Rosen et al., 2014), may also be involved.

Leisure activities of young people

Free time is a personal space in which adolescents find motivation for their meaningful choices and personal well-being (Fawcett, 2007; Padhy et al., 2015). The present article classifies leisure activities into positive and unstructured leisure activities. Positive leisure includes taking part in more or less structured activities that provide adolescents with

opportunities to acquire and perform a series of physical, intellectual or social skills, belong to a socially recognized and valued group, establish support networks among peers and adults, as well as to experiment and to deal with challenges (Eccles, Barber, Stone, & Hunt, 2003; Fawcett, 2007). Through these activities, adolescents have the opportunity to improve their social skills and learn to control themselves, promoting positive adjustment and providing a protective context against participation in risky behaviours (Kristjansson et al., 2010). Likewise, because they have a challenging component and require concentration, positive leisure activities also promote the acquisition of skills (Kleiber et al., 2014). Activities such as playing sports, creating expressive art or attending a cultural club, have a protective effect against disruptive behaviour in adolescents, such as substance abuse, truancy and delinquency (Adachi-Mejia et al., 2014; Driessens, 2015) and through them they acquire a more positive image of themselves and reduce emotional stress (Harrison & Narayan, 2003).

Unstructured leisure activities lack formal rules or adult supervision to a greater or lesser extent. In fact, “hanging out” with friends is classed as the preferred leisure time activity by adolescents (Fawcett, 2007; Panelli, Nairn, Atwool, & McCormack, 2002). However, criminal behaviours are more likely to occur during unstructured leisure time (Caldwell & Smith, 2006), as is substance use (Lee & Vandell, 2015). Therefore, it would be expected that taking part in positive leisure activities is a protective factor against PUT, while practising unstructured leisure activities is a risk factor. Unstructured leisure could be a risk factor for poor academic performance (Bartko & Eccles, 2003), in the same way that PUT could negatively affect school work given that problematic Internet use has been associated with poor academic achievement (Díaz-López, Maquilón-Sánchez, & Mirete-Ruiz, 2020; Muñoz-Miralles et al., 2014).

Executive functions

Executive functions (EF) are essential mental capacities for effective, creative and socially accepted behaviour, and they are separate from the basic cognitive capacities such as memory, attention and language (Tirapu-Ustarroz, Muñoz-Céspedes, & Pelegrín-Valero, 2002). They constitute a set of cognitive skills controlling and regulating behaviours,

emotions and cognitions necessary to achieve goals, solve problems and perform actions which are non-routine or not well-learned (Sánchez-Carpintero & Narbona, 2004). Inhibitory control, or impulse control, is one of the essential components of EF (Diamond, 2013) that involves being able to control attention, behaviour, thoughts and/or emotions to counteract a strong internal predisposition or external enticement in order to do what is most appropriate or necessary instead (Arán-Filippetti & Richaud, 2012). Planning is an executive function that involves goal setting and the ability to organize and sequence the intermediate steps, anticipating consequences and building the mental map necessary for achieving the objective or reaching the goal (Díaz et al., 2012). Inhibitory control and planning are different functions that act in an interrelated way with the other EFs, enabling self-regulated, flexible and adaptive behaviour (Diamond, 2013). The incomplete development of EFs has been associated with the presence of risk behaviours in the adolescent stage (Prencipe et al., 2011). Given that intensive mobile use has been linked to impulsive behaviours (Marco-Puche & Chóliz, 2012), lack of concentration, deficit in emotional control and uninhibited social behaviour (Pedrero-Pérez et al., 2018), it would be interesting to see if PUT is related to a low level of EF.

Objectives and hypothesis

Taking into account that studies examining gender and age differences in relation to PUT in adolescents are scarce and the results are not very consistent, one aim of the study was to analyze PUT, positive leisure, unstructured leisure, executive functions (inhibitory control, planning and achievement of goals) and academic performance, depending on gender, age (13-15 vs. 16-18 years) and country of residence. Relevant differences in PUT are not expected between boys and girls because the results of previous studies have been inconsistent. Furthermore, in older adolescence (16-18 years), PUT will be more frequent than in the younger age group (13-15 years), in line with the results of previous studies (Gómez et al, 2017; Santana-Vega et al., 2019).

The main objective of the study was to explore the predictive capacity of leisure activities, EFs and academic performance in relation to PUT in adolescents while controlling for sex and age. The absence of previous

studies on the predictive capacity of leisure activities or executive functions in relation to PUT makes this study novel both at empirical and conceptual levels.

Three hypotheses were posited in relation to this objective:

- a) PUT is expected to be associated with a higher level of unstructured leisure activities because unstructured leisure is a risk factor for alcohol use (Prieto-Damm, et al., 2019), substance use (Lee & Vandell, 2015) or crime (Caldwell & Smith, 2006),
- b) The level of executive functions will inversely predict PUT, taking into account that intensive mobile use has been linked to impulsive behaviours (Marco-Puche & Chóliz, 2012), as well as lack of concentration, deficits in emotional control and uninhibited social behaviour (Pedrero-Pérez et al., 2018).
- c) Academic performance will be related to lower PUT levels, based on the results of previous studies (Díaz-López, Maquilón-Sánchez, & Mirete-Ruiz, 2020; Muñoz-Miralles et al., 2014).

Method

This research forms part of an international study (YOURLIFE Project) on the perception and beliefs that young people have about relationships, love and sexuality. This is an international survey, but it is not a typical cross-sectional study since new schools can continuously join at any time. This is a cohort study with a shorter follow-up than usual (for more information see Carlos et al., 2016; de Irala et al., 2009; Osorio et al., 2012; Osorio et al., 2015).

Sample

Sample selection was performed using the convenience sampling method, suitable for such an ongoing, dynamic and multipurpose international study. Schools from all over the world were invited to take part by an email providing the link to the website designed to provide detailed information to the participants (<http://www.proyectoyourlife.com/>). At the time of the present study, the sample consisted of 3,831

in-school adolescents between the ages of 13 and 18 years at the time of recruitment, of which 51% were girls, from four countries (Chile = 305, Spain = 988, Mexico = 715, Peru = 1,823). This was an explanatory study with a correlational cross-sectional type design. Socio-economic levels may be high because the percentage of parents (at least one of the two) with university studies was high (Chile 91%, Mexico 88%, Spain 64% and Peru 58%).

Instrument and variables

The assessment instrument used was the YOURLIFE project self-report questionnaire (Carlos et al., 2016), with three different age-related versions (13, 15 and 17 years). This instrument was previously validated and used in several national and international surveys conducted among adolescents of the World Health Organization (Health Behavior in School-Based Children, HBSC; Questionnaire, 2010; Illustrative Questionnaire for Interview-surveys with Young People, Cleland, 2001). The questionnaire was first written in Spanish and later adapted to English. The variables analyzed in the present study are as follows (see Annex):

Socio-demographic variables. Information was collected on the socio-demographic data of the participants, among them sex, age, country of residence and parents' educational level.

Problematic technology use. This was assessed on the basis of five questions that include time spent using mobile devices, interacting with peers through social networks, writing e-mails, chats or tweets, having more virtual than in-person friends, and eating with your mobile phone in front of you. The response format was a Likert-type scale from 0 (Strongly disagree) to 4 (Strongly agree). The internal consistency of this scale ($\alpha = .70$) was acceptable.

Positive leisure activities. The frequency of positive leisure activities (reading, volunteer activities, artistic and sports activities or family activities) during the last year was measured. The response format of the reading variable had 6 options (Less than 1 hour a week; 1-2 hours; 2-3 hours; 3-4 hours; 4-10 hours; More than 10 hours), while the other questions had 5 response options (Never; Less than 1 day a month; 1-3 days a month; 1-2 days a week; and 3 or more days a week).

Unstructured leisure activities. The frequency of unstructured leisure activities (in public spaces, leisure centres, youth venues or discos) during the last year is measured based on four questions, with the same response format as for positive leisure activities.

Executive functions. Executive functions (inhibitory control, planning and achievement of goals) were measured on the basis of responses to three statements (I do things without thinking about them; I plan the things I do; I usually finish what I start) with 5 options (Never; Almost never; Sometimes; Almost always; Always).

Academic performance. The school achievement variable was assessed by academic results in the past year, with three response options (I failed some subjects; I passed all subjects; I obtained good grades).

Procedure

Schools agreeing to participate in the project received a protocol with instructions on the survey process, and on the specified date, each school administered the questionnaire in person during school time. The general design of the study was approved by the Ethics Committee of the University of Navarra and each new centre was asked to follow the project's specific ethical guidelines. The respective ethics committee of each participating country had access to the questionnaire prior to application.

The purpose of the study was explained verbally to the students in all schools involved in the study, and written information detailing the objectives of the project as well as the rights of the participants, was also provided. Two days later, the framework questionnaire was administered to request permission from the parents for this research (Ruiz-Canela et al., 2013) given that no specific legislation in this regard existed in some participating countries. The instrument used was a self-administered anonymous questionnaire. The young participants in the study did not receive any incentive for their participation, but each school was sent a report with the overall results of their centre, and the implementation of specific educational programs was encouraged to prevent the problems detected in the study. Detailed data collection procedure can be found in a previous publication (Carlos et al., 2016).

Data analysis

The prevalence rate of PUT was calculated on the basis of participants scoring 4 (Totally agree) in any of the five questionnaire items. Subsequently, analyses of the differences in the means of PUT, academic performance, EF and leisure activities, were performed by sex (Table 1), and age group (13-15 and 16-18 years) (Table 2). To this end, Student's *t* test was applied, and effect size was calculated with Cohen's *d* test (1992). For the interpretation of effect size, the following criteria were taken into account: values below 0.20 represent a small effect size, near 0.50 to a medium effect size, and above 0.80 to a large effect size. To explore the differences between the countries, single-factor ANOVAs were carried out, showing η^2 as effect size ($\eta^2 \leq 0.01$ small, $\eta^2 \leq 0.06$ = medium, $\eta^2 \leq 0.13$ = large, Cohen, 1988). The Tukey test was also applied when the country factor was significant. Next, the correlation matrix between PUT and the rest of the study variables was calculated (Table 3). Finally, stepwise multiple linear regression was performed to find the best predictive PUT model, including the rest of the study variables as predictor variables (Table 4), with socio-demographic variables such as sex and age serving as control variables.

Results

PUT prevalence was 21.1% (boys 20.08%; girls 21.5%), $\chi^2 = .28$, $p = .594$. Table 1 shows the mean differences of the study variables based on sex. While there were no significant differences in mean PUT between boys and girls, such differences were found in most of the other variables studied. It should be noted, for example, that boys did significantly more sports ($d = 0.62$) and spent more leisure time at discos ($d = 0.21$), whereas girls spent more time on recreational reading ($d = -0.47$) and artistic activities ($d = -0.20$).

TABLE I. Comparisons of means of the study variables by sex (with standard deviations in parentheses)

Variables	Minimum/ Maximum	Girls (n = 1,948)	Boys (n = 1,846)	t	d
PUT ^a	0-4	1.47(0.81)	1.42(0.76)	-1.82	-0.06
School performance	0-2	1.24(0.71)	1.19(0.76)	-2.32*	-0.07
<i>Executive functions</i>					
Inhibitory control	0-4	2.32(0.98)	2.41(.98)	2.61**	0.09
Planning	0-4	2.54(1.06)	2.54(1.06)	0.978	0.00
Goal achievement	0-4	2.76(0.94)	2.85(0.91)	2.96**	0.10
<i>Positive leisure</i>					
Reading	0-6	1.85(1.53)	1.34(1.37)	-14.46**	-0.47
Sport	0-4	2.43(1.31)	3.18(1.11)	18.21**	0.62
Artistic activities	0-4	1.57(1.40)	1.28(1.35)	-5.95*	-0.20
Family activities	0-4	1.75(1.22)	1.90(1.17)	3.61**	0.12
Volunteering	0-4	0.72(0.97)	0.82(1.06)	2.79**	0.10
<i>Unstructured leisure</i>					
Leisure public spaces	0-4	2.52(1.17)	2.62(1.14)	2.54 *	0.09
Leisure centres	0-4	1.77(1.15)	1.72(1.13)	-1.49	-0.04
Youth venues ^b	0-4	1.52(1.26)	1.71(1.24)	4.37***	0.15
Discos	0-4	0.61(1.04)	0.84(1.15)	5.97**	0.21

a: Problematic use of technology

b: Youth clubs and/or friends' houses; *** p < .001; **; p < .01; *; p < .05.

Table 2 shows the mean differences of the study variables, based on two age groups (13-15 years and 16-18 years). Older adolescents spent more leisure time in discos ($d = -0.53$), at youth venues ($d = -0.32$), had higher PUT ($d = -0.32$) and did more volunteer activities ($d = -0.25$), although the effect size is moderate to low.

TABLE II. Comparisons of means of the study variables by age group (with standard deviation in parentheses)

Variables	13-15 years (n = 2,604)	16-18 years (n = 1,227)	t	d
PUT	1.37(0.78)	1.62(0.77)	-8.41***	-0.32
Academic performance	1.24(0.74)	1.17(0.73)	2.38*	0.09
<i>Executive functions</i>				
Inhibitory control	2.40(.99)	2.28(.95)	3.23**	0.12
Planning	2.51(1.07)	2.61(1.02)	-2.42**	-0.10
Goal achievement	2.79(0.92)	2.83(0.92)	-0.89	-0.04
<i>Positive leisure</i>				
Reading	1.51(1.52)	1.39(1.48)	2.41*	0.08
Sport	2.81(1.26)	2.77(1.29)	0.83	0.03
Artistic activities	1.42(1.49)	1.28(1.29)	4.39***	0.15
Family activities	1.88(1.21)	1.70(1.17)	3.98***	0.15
Volunteering	0.69(0.98)	0.95(1.08)	-6.71***	-0.25
<i>Unstructured leisure</i>				
Public spaces	2.60(1.17)	2.51(1.12)	2.25*	0.08
Leisure centres	1.76(1.16)	1.70(1.01)	1.30	0.05
Youth venues ^a	1.49(1.26)	1.89(1.22)	-8.89**	-0.32
Discos	0.54(1.16)	1.16(1.19)	-14.61**	-0.53

a: Youth clubs and/or friends' houses; *** $p < .001$; ** $p < .01$; * $p < .05$.

With regard to the country of origin of the participants, all differences were significant except for goal achievement. The most notable differences were in sports activities ($\eta^2 = .08$), leisure in discos ($\eta^2 = .08$) and in public spaces ($\eta^2 = .06$). Adolescents in Chile and Mexico did more sports than those in Spain or Peru, and also spent more leisure time in discos than their counterparts in the latter two countries ($p < .05$). Meanwhile, the level of leisure activities in public spaces was significantly higher in Spain than in the other countries ($p < .05$).

With reference to the correlation matrix in Table 3, the most notable results were found in the relationship between PUT and unstructured leisure activities [youth venues $r = .27$, $p < .001$; discos $r = .26$, $p < .001$; leisure centres $r = .25$, $p < .001$], as well as executive functions (inhibitory control $r = -.26$, $p < .001$; planning $r = -.15$, $p < .001$; goal achievement r

= -.18, $p < .001$). Goal achievement is mostly related to family activities ($r = .17, p < .001$), and sports ($r = .14, p < .001$), while inhibitory control is inversely associated with activities in youth venues ($r = -.15, p < .001$), leisure centres ($r = -.12, p < .001$) and discos ($r = -.12, p < .001$). School performance is linked to positive leisure activities [recreational reading $r = .11, p < .001$; sports $r = .09, p < .001$; artistic activities $r = .09, p < .001$; family activities $r = .09, p < .001$]. Additionally, an inverse relationship was found between academic performance and PUT ($r = -.09, p < .001$). Complementary analyses found that this relationship changed depending on age group [13-15 years $r = -.10, p < .001$; 16-18 years $r = .04, p = .14$].

TABLE III. Correlation matrix between the problematic use of technologies and the study variables (academic performance, executive functions and leisure activities)

Variables	Minimum/ Maximum	1	2	3	4	5	6	7	8	9	10	11	12	13
1. PUT	0-4	—												
2. Academic performance	0-2	-.09**	—											
<i>Executive functions</i>														
3. Inhibitory control	0-4	-.26**	.08**	—										
4. Planning	0-4	-.15**	.13**	.07**	—									
5. Goal achievement	0-4	-.18**	.18**	.09**	.41**	—								
<i>Positive leisure</i>														
6. Reading	0-6	-.13**	.11**	.05*	.06**	.08**	—							
7. Sport	0-4	-.02	.09**	.01	.09**	.14**	-.04	—						
8. Artistic activities	0-4	-.02	.09**	.01	.09**	.05**	.22**	.07**	—					
9. Family activities	0-4	-.11**	.09**	.06**	.14**	.17**	.04*	.28**	.16**	—				
10. Volunteering	0-4	.03*	.05*	.01	.07**	.07**	.04**	.16**	.22**	.16**	—			
<i>Unstructured leisure</i>														
11. Public spaces	0-4	.10**	.03	-.09**	.02**	.05**	.01	.26**	.08**	.14**	.11**	—		
12. Leisure centres	0-4	.25**	.00	-.12**	.01	0	-.02	.21**	.08**	.20**	.12**	.30**	—	
13. Youth venues ^a	0-4	.27**	-.05*	-.15*	-.03*	-.02	-.07**	.16**	.01	.11**	.18**	.25**	.37**	—
14. Nightclubs	0-4	.26**	-.07**	-.12**	-.03	-.01	-.11**	.12**	-.02	.04**	.20**	.16**	.28**	.41**

a: Youth clubs and/or friends' houses; **, $p < .01$; *, $p < .05$.

In the multiple linear regression analysis, a combination of ten variables predicted PUT, $F(10, 2748) = 79.75, p < .001, R^2 = .22$, with sex

and age as control variables (Table 4). The model explains 22% of the variance in PUT, and inhibitory control is the predictor contributing most to the inverse prediction ($\beta = -.18, p < .001$) alongside leisure centres ($\beta = .18, p < .001$).

TABLE IV. Predictive model of problematic use of technologies

	Unstandardized coefficients B	Standardized coefficients B	t
Inhibitory control	-.18	-.18	-10.47**
Leisure centres	.17	.18	9.45**
Youth venues ^a	.14	.12	6.32**
Family activities	-.07	-.11	-6.36**
Goal achievement	-.09	-.10	-5.39**
Age	-.04	.10	5.67**
Reading	-.09	-.09	-4.90**
Nightclubs	.07	.09	4.74**
Planning	-.06	-.08	-4.25**
Being female	.10	.06	3.52**

a: Youth clubs and/or friends' houses; **: $p < .001$.

Discussion

The present study aimed to analyze the association between PUT in adolescents, school performance, EF and leisure activities. The prevalence rate of PUT was 21%, without significant differences between boys and girls, in line with the results of previous studies (López-Fernández, 2018; Munno et al., 2017). According to a meta-analysis examining the widespread use of the Internet worldwide (Su et al., 2019), men have a relatively higher tendency to Internet addiction than women, with a small effect size ($g = 0.145$). Another meta-analysis investigating the specific use of the Internet found that men were predominantly addicted to games and women to social networks (Su et al., 2020). Other studies have concluded that adolescent girls suffer more negative emotional

consequences from mobile phone use than boys (Alfaro et al., 2015; Santana-Vega, Gómez-Muñoz, & Feliciano, 2019). The type of technology used and the emotional consequences in adolescents depending on sex are aspects not addressed in this research and should be analyzed in future studies.

Regarding the differences between boys and girls in terms of leisure activities, it should be noted that boys did significantly more sports and spent more leisure time in discos, while girls spent more time on recreational reading and artistic activities. These results are consistent with those obtained by other studies (e.g., Kleiner et al., 2004). As expected, the present study found PUT to be more widespread in the older group (16-18 years), in line with various other studies (e.g., Santana-Vega, Gómez-Muñoz, & Feliciano, 2019).

The main contribution of this study is the presentation of a predictive model for specific leisure activities and executive functions in relation to PUT in a sample of in-school adolescents from four Spanish-speaking countries. As predicted, unstructured leisure activities were associated with PUT. In the predictive model for PUT, three unstructured leisure activities (in youth venues, leisure centres or discos) emerge as risk factors. In general, unsupervised leisure time in young people has been seen as a problematic environment that promotes deviant behaviours, including substance use (Kristjánsson et al., 2010), while reducing unsupervised leisure time and increasing participation in sports can have a positive impact on reducing substance use (Lee & Vandell, 2015). In addition, two positive leisure activities, family activities and recreational reading, appeared in the predictive model as protective factors against PUT. Along similar lines, Muñoz-Miralles et al. (2016) found an association between PUT and poor family relationships.

A further contribution of this study is to show that lower inhibitory control is also associated with PUT, thereby confirming our hypothesis, in line with the results of similar studies (Marco-Puche. & Chóliz, 2012; Pedrero-Pérez et al., 2018). The association between lower inhibitory control and PUT may be related to a predisposing psychological thrill-seeking factor (Echeburúa & Requesens, 2012). Thrill seeking and impulsivity are related to high levels of multitasking mobile phone use due to lack of concentration and reduced ability to control distractions (Sanbonmatsu et al., 2013).

As expected, executive functions inversely predicted PUT, with inhibitory control being the most relevant. As Echeburúa and De Corral (2010) have shown, technology abuse causes a person to lose their capacity to control; however, a characteristic of this type of addiction is that the screens of the digital devices take on a central role in the teenagers' lives in escaping from real life and improving their mood. For all these reasons, parents and education professionals should help adolescents to develop their ability to communicate in person, promoting hobbies such as recreational reading, family activities and sports. Indeed, there is empirical evidence of the relationship between participation in structured prosocial activities of adolescents and their positive functioning, while the most negative functioning is related to being involved in few constructive leisure activities (eg.. Bartko & Eccles, 2003).

School achievement was inversely related to levels of PUT, although it did not reach the level of significant protective predictor. In the 13-15-year group, the relationship between PUT and academic performance was inverse ($r = -.10$), while no relationship was found in the 16-18-year group. Muñoz-Miralles et al. (2014) have shown that in the first three years of ESO (compulsory secondary education in Spain), low school performance was related to high use of the computer (more than 3 hours a day), with a linear increase in school failure rates observed as the hours of use increased.

One limitation of this study is associated with its cross-sectional design, making it impossible to establish causality between the variables studied, for which longitudinal studies would be necessary. Nevertheless, the relevance of this study lies in the originality of the topic discussed, the predictive power of EF and leisure activities regarding PUT, as well as the large sample size. However, although the results show that unstructured leisure activities and low levels of executive function are risk factors for PUT, the mediational effect of EF between positive leisure and PUT should be analyzed through structural equation models. The differences found in terms of leisure activities in the countries studied may be attributed to differences in the educational level of parents and not necessarily to cultural differences.

In conclusion, unstructured leisure activities and low executive function are relevant risk factors for PUT. Time spent on leisure activities has a great impact on the development of young people, allowing them to establish social networks outside the family of origin. The basic

objectives of development programs for adolescents should aim to reduce unstructured or supervised leisure time to prevent problem behaviours such as PUT, as well as the promotion of positive leisure activities (Lerner, 2004), and comprehensive interventions promoting the responsible use of ICT among young people. Coping strategies should also be mentioned since Internet addiction correlates negatively with the use of problem-focused strategies and positively with coping strategies focused on emotions, abstinence and self-blame (Schneider, King, & Delfabbro, 2017; Zhou, 2009) or avoidance and denial of coping strategies (Senormanci et al., 2014). Therefore, strategies aiming to change circumstances or generate solutions for PUT will be more effective.

From an educational perspective, Educational and Psychopedagogical Guidance Teams (EOEP, Equipos de Orientación Educativa y Psicopedagógica) can help develop prevention activities to train students in the proper use of technological devices through different curricular activities (Santana, 2015). It is also essential that parents become aware of the impact of the abusive use of ICT and social networks on their children, and acquire skills to educate them in responsible use, reaching agreements about how and when ICT may be used from an early age. The use of communication technologies can be an interesting means to promote communication and improve parent-child relationships, allowing information and positive messages to be shared between them.

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Appendix

Questionnaire administered

Socio-demographic data

Sex: Boy Girl

Age: years

University graduate, mother: Yes No

University graduate, father: Yes No

Problematic use of technology

Please indicate the extent to which you agree with the following situations	Strongly disagree	Disagree	Neutral	Agree	Completely Agree	Prefer not to answer
I spend my time distractedly, looking at my smartphone, tablet or computer, even when I could be doing more productive things.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I spend more time interacting with 'virtual friends' than I do with the people who are physically around me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I spend my time reading or answering e-mails, chats, tweets ... at all hours, even interrupting other activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I often feel uncomfortable when I forget my cell phone or other electronic device.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
While I eat, I usually have my mobile in front of me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Executive functions

Please indicate how often the following situations apply to your life	Never	Almost never	Sometimes	Almost always	Always	Prefer not to answer
I do things without thinking (Inhibitory control)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I plan the things that I do (Planning)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I usually finish what I start (Goal achievement)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Positive leisure activities

In the last 12 months, how often have you done the following activities?	Never	Less than 1 day per month	1-3 days per month	1-2 days per week	3 or more days per week	Prefer not to answer
Do sports, go hiking, etc. (Sport)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Volunteering (collaborate with an NGO, charity association, etc.) (Volunteering)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do or attend artistic and educational activities (music, painting, theatre, courses, talks, Sunday school, etc.) (Artistic activities)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Read books (Reading)	Less than 1 hour <input type="checkbox"/>	1-2 hours <input type="checkbox"/>	2-3 hours <input type="checkbox"/>	3-4 hours <input type="checkbox"/>	4-10 hours <input type="checkbox"/>	More than 10 hours <input type="checkbox"/>

Unstructured leisure activities

In the last 12 months, how often have you done the following activities?	Never	Less than 1 day per month	1-3 days per month	1-2 days per week	3 or more days per week	Prefer not to answer
Hanging out on the street, in a park, on the beach or in other public places (Public spaces)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spending time in shopping centres, gaming rooms, pool halls, football stadium (Leisure spaces)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meeting in a place for friends only, with no adults present (Youth venues)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Going to discos (Discos)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

School performance

In the last school year	I failed some subjects <input type="checkbox"/>	I passed all subjects <input type="checkbox"/>	I got good grades <input type="checkbox"/>
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