The UPPS model of impulsivity in the abuse of Information and Communication Technologies (ICT)

El modelo UPPS de impulsividad en el abuso de las Tecnologías de la Información y la Comunicación (TIC)

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Abstract

The UPPS model of impulsivity has recently been proposed, has been widely applied to substance abuse and is one of those recommended in the context of Research Domain Criteria, RDoC. However, its application to the abuse of information and communication technologies (ICTs) has been very limited. In the present work, a sample of n = 748 (67% females) was recruited through the Internet, and the reduced version of the UPPS-P was administered, in addition to the MULTICAGE-TIC and the Prefrontal Symptoms Inventory (PSI-20). The psychometric properties of UPPS-P were satisfactory in terms of internal consistency ($0.87 > \omega > 0.75$) and structural validity. Impulsivity measured by UPPS-P correlated with all MULTICAGE-TIC scales, although with a very small effect size, and with greater magnitude with prefrontal dysfunction symptoms. The impulsivity dimension most related to ICT abuse was Urgency ($0.3 > r > 0.2$). A structural analysis of all the variables was carried out, with impulsivity appearing as a product of the prefrontal malfunction that predicted, through Positive Urgency, the abuse of ICTs. Impulsivity does not seem to be the central nucleus of ICT abuse, but rather failures in the superior control of behavior, of which impulsivity would be a consequence, but not the most important. This makes it advisable to design cognitive rehabilitation interventions that improve the functioning of superior behavior control mechanisms in the prevention and treatment of ICT abuse.

Keywords: Addictive behavior; impulsive behavior; compulsive behavior; prefrontal cortex; public health; modeling of structural equations; behavioral addictions; abuse of information and communication technologies.

Resumen

El modelo UPPS de impulsividad se ha propuesto recientemente, ha sido ampliamente aplicado al abuso de sustancias y es uno de los recomendados en el contexto de investigación *Research Domain Criteria*, RDoC. Sin embargo, su aplicación al abuso de tecnologías de la información y la comunicación (TIC) ha sido muy limitado. En el presente trabajo se reclutó a través de Internet una muestra de n = 748 (67% mujeres) y se administró la versión reducida de la UPPS-P, además del MULTICAGE-TIC y el Inventario de Síntomas Prefrontales (ISP-20). Las propiedades psicométricas de la UPPS-P resultaron satisfactorias en consistencia interna ($0{,}87 > \omega > 0{,}75$) y validez estructural. La impulsividad medida por la UPPS-P correlacionó con todas las escalas del MULTICAGE-TIC, aunque con un tamaño del efecto muy pequeño, y con mayor magnitud con las de síntomas de mal funcionamiento prefrontal. Las dimensiones de impulsividad más relacionadas con el abuso de las TIC fueron las de Urgencia ($0{,}3 > r > 0{,}2$). Se realizó un análisis estructural de todas las variables apareciendo la impulsividad como un producto del mal funcionamiento prefrontal que predecía, a través de la Urgencia Positiva, el abuso de las TIC. La impulsividad no parece ser el núcleo central del abuso de las TIC, sino los fallos en el control superior de la conducta, de los que la impulsividad sería una consecuencia, pero no la más importante. Ello hace recomendable el diseño de intervenciones de rehabilitación cognitiva que mejoren el funcionamiento de los mecanismos de control superior de la conducta en la prevención y tratamiento del abuso de las TIC.

Palabras clave: Conducta adictiva; conducta impulsiva; corteza prefrontal; modelado de ecuaciones estructurales; adicciones comportamentales; abuso de tecnologías de la información y la comunicación.

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Impulsivity is a widely studied psychological construct and is usually linked to a variety of psychological manifestations. There is, however, no theoretical consensus regarding the true meaning of the construct, which has been defined in very different ways by each theoretical approach (Nigg, 2017). In general, it refers to behaviors carried out without sufficient reflection, focused on immediate goals, without calculating medium- and long-term consequences (Evenden, 1999), although in certain circumstances they may also represent behaviorally adaptive options (Dickman, 1990). This type of behavior is usually linked to multiple psychopathological manifestations, including self-injurious and suicidal behaviors (Lockwood, Daley, Townsend & Sayal, 2017), violent behaviors (Bresin, 2019) and personality disorders (Gagnon, 2017), among many others. Neuropsychological studies have identified the neural substrates of the construct (Bari & Robbins, 2013; Chamberlain & Sahakian, 2007), which must necessarily be considered multidimensional (Rochat, Billieux, Gagnon & Van der Linden, 2018).

One of the areas in which impulsivity has been most studied is in substance dependence since impulsivity is considered a marker of vulnerability for the development of addictive behaviors (Lee, Hoppenbrouwers & Franken, 2019; Verdejo-García, Lawrence & Clark, 2008), something that has been proven in animal studies (Dalley, Everitt & Robbins, 2011). There is also evidence of increased impulsivity associated with addictive behaviors not involving substances (Grant & Chamberlain, 2014; Şimşek, Zincir, Özen & Ceyhan, 2019), although the different studies are very heterogeneous (Carvalho, Sette & Ferrari, 2018). From a neuropsychological perspective, response inhibition is a skill linked to the integrity of the dorsolateral prefrontal cortex, which allows the interruption or non-execution of automated behavior or an acquired habit when the non-interruption or execution of the behavior will be unsuitable and result in an error (Fuster, 1997). Deficits in the response inhibition system and inhibitory control are a central element in addictive behaviors, according to the consensus reached recently by a group of scientists in the framework of the *Research Domain Criteria*, RDoC (Yücel et al., 2019), research project.

This group considers that one of the instruments most suitable for its measurement is the UPPS (Whiteside & Lynam, 2001). The authors of this test noted the general confusion between the various conceptualizations of impulsivity and decided to eschew any specific position on the nature or causes of impulsivity, attempting instead to capture what they believed to be various etiological pathways of impulsive behavior. To do this, they used exploratory factor analysis to assess the various facets of the NEO-PI-R instrument (Costa & McCrae, 1992) related to impulsivity and up to eight impulsivity scales of very different theoretical orientations. With the set of items selected for each of the factors, the authors developed the new questionnaire, called the UPPS *Impulsive Behavior Scale*, in which they identified four traits: *negative urgency* (impulsive behavior arising as a reaction to intense negative affect); [lack of] *premeditation*, which implies the ability to choose an option while taking possible consequences into account; [Lack of] *perseverance* (the ability to stay on task, especially if it is difficult or boring); and *sensation seeking* (the tendency to look for new activities or activities that involve risk). These dimensions made it possible to understand impulsivity through its emotional/affective aspects (in *urgency* and *sensation seeking*) as well as through more cognitive aspects (in *lack of perseverance* and *premeditation*). In the original UPPS review (UPPS-P; Lynam, Smith, Cyders, Fischer & Whiteside, 2007) a fifth dimension was incorporated: *positive urgency*, defined as the propensity to act rashly triggered by intense positive affect. These five impulsivity traits can be measured with the 59-item UPPS-P, from which a shortened version of 20 items was subsequently developed (Billieux et al., 2012).

The traits comprising the UPPS model have been found to be strongly linked to neural substrates, specific to a certain degree for each one and primarily involving fronto-cortical circuits with subcortical structures (Rochat et al., 2018). These findings have been replicated in particular in the study of addictive behaviors linked to various substances (Yücel et al., 2019).

The initial four-scale version has been used increasingly often in the study of substance addiction (Whiteside & Lynam, 2003; Magid & Colder, 2007) as well as in non-substance-related addictive behaviors (Billieux, Rochat, Rebetez & Van der Linden, 2008; Billieux, Van der Linden, M. & Rochat, 2008; Billieux et al., 2011; Rømer Thomsen et al., 2018), among other psychological problems. The revised version, UPPS-P, has also been used in the study of abuse of substances such as alcohol (McCarty, Morris, Hatz & McCarthy, 2017), cannabis (VanderVeen, Hershberger & Cyders, 2016) and tobacco (Kale, Stautz & Cooper, 2018).

Despite this, there are scarcely any studies which apply it to so-called non-substance addictive behaviors. There is currently considerable controversy over whether such behaviors should really be considered addictions, with the prevailing view being that this comparison is not permissible (Billieux, Schimmenti, Khazaal, Maurage & Heeren, 2015; Panova & Carbonell, 2018; Yu & Sussman, 2020). Opposing this view, many authors consider that the circuits involved in so-called behavioral addictions are essentially the same as in substance addiction (Horvath et al., 2020; Yao et al., 2017). What both perspectives share is the consideration that in both cases a prefrontal hypofunction occurs that results in a loss of higher behavior control.

The UPPS has been used in the study of online sexual activity (Savvidou et al., 2017), problematic Internet use (Navas, Torres, Cándido & Perales, 2014) and pathological

gambling (Jara-Rizzo et al., 2019; Wéry, Deleuze, Canale & Billieux, 2018). While pathological gambling is mainly linked to *negative urgency*, online sexual activity is especially related to *positive urgency*, and Internet abuse is not linked to any dimension in particular. These differences could potentially serve to classify behaviors maintained by negative or positive reinforcement.

The UPPS-P has been translated to and validated in Spanish, both in its full version (Verdejo-García, Lozano, Moya, Alcázar & Pérez-García, 2010) and its short form (Cándido, Orduña, Perales, Verdejo-García & Billieux, 2012). The present study aims to investigate some psychometric properties of the short UPPS-P and subsequently analyze the relationships between the impulsive dimensions of the UPPS model, the use/abuse of information and communication technologies (ICT) and symptoms of prefrontal malfunction.

Method

Participants

A sample of n = 764 was obtained. No exclusion criteria were set, particularly with regard to age, since the responses in all age groups were of interest. After an outlier detection analysis, 16 participants with atypical scores (2.1%) were excluded, leaving a final reduced sample of n = 748. Table 1 shows the descriptive statistics of the final sample, 93.6% of whom were born and lived in Spain.

Instruments

Short version (20 items) of the UPPS-P (Lynam, 2013), Spanish version (Cándido et al., 2012). This measures five impulsivity traits (four items each): *negative urgency, lack of premeditation, lack of perseverance, sensation seeking,* and *positive urgency*. Item responses are on a four-point Likert-type scale from 1 (strongly agree) to 4 (strongly disagree). The score is inverted in the two *urgency* scales and in *sensation seeking* so that they can all be scored in the direction of impulsivity, with each having a scoring range from 4 to 16. The internal consistency of the five scales, estimated using Cronbach's α, ranged from 0.61 to 0.81, with the two *urgency* scales below 0.7, which is considered to be the lowest acceptable limit.

Table 1. *Sample descriptives.*

	Men	Women	Total
n	245 (32.8%)	503 (67.2%)	748
Age			
18 - 24	28 (23.7%)	90 (76.3%)	118 (15.8%)
25 - 30	38 (36.2%)	67 (63.8%)	105 (14.0%)
31 - 45	67 (33.5%)	133 (66.5%)	200 (26.7%)
46 - 60	86 (35.2%)	158 (64.8%)	244 (32.6%)
› 60	26 (32.1%)	55 (67.9%)	81 (10.8%)
Education			
Primary or lower	8 (44.4%)	10 (55.6%)	18 (2.4%)
Lower secondary	13 (72.2%)	5 (27.8%)	18 (2.4%)
Higher secondary	52 (47.7%)	57 (52.3%)	109 (14.6%)
University student	18 (24.7%)	55 (75.3%)	73 (9.8%)
University degree	154 (29.1%)	376 (70.5%)	530 (70.9%)

MULTICAGE-TIC, a 20-item questionnaire comprising five scales surveying problems related to the use of the Internet, mobile phones, video games, instant messaging and social networks (Pedrero-Pérez et al., 2018). It is based on MULTICAGE CAD-4, a screening questionnaire for compulsive behavior, with and without substances (Pedrero-Pérez et al., 2007), which has been used in primary care (e.g., Reneses et al., 2015), behavioral addictions (e.g., Megías et al., 2018) and substance addiction (e.g., Navas, Torres, Cándido & Perales, 2014). Subsequently, a mobile phone use/abuse scale was included (Rodríguez-Monje et al., 2019). The MULTICAGE-TIC has four dichotomous response (yes/no) items for each problem behavior asking about the following: item 1, estimated excessive time dedication; item 2, excessive time estimated by significant others; item 3, difficulty in refraining from the behavior; item 4, difficulties in voluntarily interrupting the behavior. The score on each scale is the number of affirmative responses, ranging from 0 to 4 points, 0 corresponding to the absence of the problem and 4 to abuse. The psychometric study showed adequate internal consistency for all its scales ($0.74 < \omega < 0.93$) and evidence of structural validity.

Prefrontal Symptoms Inventory, screening version (PSI-20; Pedrero-Pérez, Ruiz-Sánchez de León, Morales-Alonso, Pedrero-Aguilar & Fernández-Méndez, 2015). This explores symptoms of malfunction in daily life linked to neuropsychological disorders attributable to the prefrontal cortex. This scale has 20 items with Likert-type responses (0: never or almost never; 1: a few times; 2: sometimes yes, sometimes no; 3: many times; 4: always or almost always). The factorial study found a three-factor solution: behavioral control problems, emotional control problems and social behavior problems. Higher scores correspond to more prefrontal malfunction symptoms. Validation in both the general population and people being treated for addictive behaviors reported adequate internal consistency for all subscales ($0.87 < \alpha_s < 0.89$). In our sample, the multivariate consistency of the complete test was $\alpha_s = 0.91$ and that of the scales $0.81 < \alpha_s < 0.90$.

Procedure

Since the target population was regular ICT users, a survey was developed using Google Docs® and anonymous and voluntary participation was sought through instant messaging programs (WhatsApp®), social networks (Facebook®, Instagram®) and email. At the same time, participants were

asked to forward the questionnaire to their contacts, thus a chain sampling technique was used. The online questionnaire was restricted to prevent it being completed more than once on the same device. Since participation was voluntary, subjects were told about the aims of the study, but informed consent was not included as it was implicit in completing the test. Data collection ran from January 2 to February 12, 2019, and a sample of n = 764 was finally obtained. This sample was considered large enough since the ratio between the sample n and the number of items (60 in total) was higher than 10, which is usually considered adequate according to the most demanding criteria.

Data analysis

Firstly, in order to detect and exclude outliers, an analysis was performed using the Mahalanobis distance with a $p < 0.001$ criterion. The univariate descriptions of the items were then obtained and the Mardia (1970) criterion was applied to test whether the data fitted a multivariate normal distribution. Confirmatory factor analysis was carried out, using firstly the maximum likelihood method to favor comparability with previous studies, and then an unweighted least squares analysis as the method best suited to the nature of the data (Morata-Ramírez, Holgado-Tello, Barbero-García & Méndez, 2015). Two possible factorial solutions were compared by applying the goodness-of-fit indices in AMOS 21: absolute (GFI, AGFI, RMR), relative (NFI, RFI) and parsimonious (PGFI, PNFI). Suitable values were those exceeding 0.95 for GFI, AGFI, NFI and RFI, those below 0.05 for RMR and those closest to 1 in PGFI and PNFI. Once the best model was selected, the questionnaire structure was configured, also using AMOS 21. Internal consistency was studied using various estimators, as recommended when the data are not from linear variables or not normally distributed (Revelle & Zinbarg, 2009; Sijtsma, 2009); specifically, standardized Cronbach's alpha (α_s; Enders & Bandalos, 1999) and McDonald's omega (ω) were used. A correlational study was performed using Pearson's r and a linear stepwise regression analysis, confirming the contribution to the model using R^2 and effect size using β. In the multiple correlations, the Bonferroni correction was applied to avoid Type I error. Finally, path analysis was carried out to structurally link all the variables previously studied and by means of the previously used method and fit indices. The SPSS 22 statistical package and the AMOS 21 program were used for all analyses, except for internal consistency estimators, which were obtained through the FACTOR 10.10.01 program. (Lorenzo-Seva & Ferrando, 2006).

Results

Confirmatory factor analysis (CFA)

On applying Mardia's criterion, it was seen that item distribution did not fit multivariate normality ($p < 0.001$). We examined whether the theoretical model fitted the data obtained in the present study. First, a maximum likelihood analysis was carried out, which provided acceptable fit indices in almost all cases (CMIN/DF = 3.28; NFI = 0.905; RFI = 0.887; IFI = 0.932; TLI = 0.919; CFI = 0.932; PNFI = 0.760; RMSEA = 0.055). As most previous studies have used this method, it was calculated here to make results comparable. However, and given the nature of the data (non-continuous Likert scale and absence of multivariate normality in data distribution), an unweighted least-squares analysis was then performed as the most suitable method. The fit indices of a 3-factor (with *urgency* grouped into a single factor, and *lack of perseverance* and *premeditation* into another) and a 5-factor solution were studied. Both solutions showed an adequate fit to the data, although the 5-factor (GFI = 0.985; AGFI = 0.980; PGFI = 0.750; NFI = 0.973; RFI = 0.968; PNFI

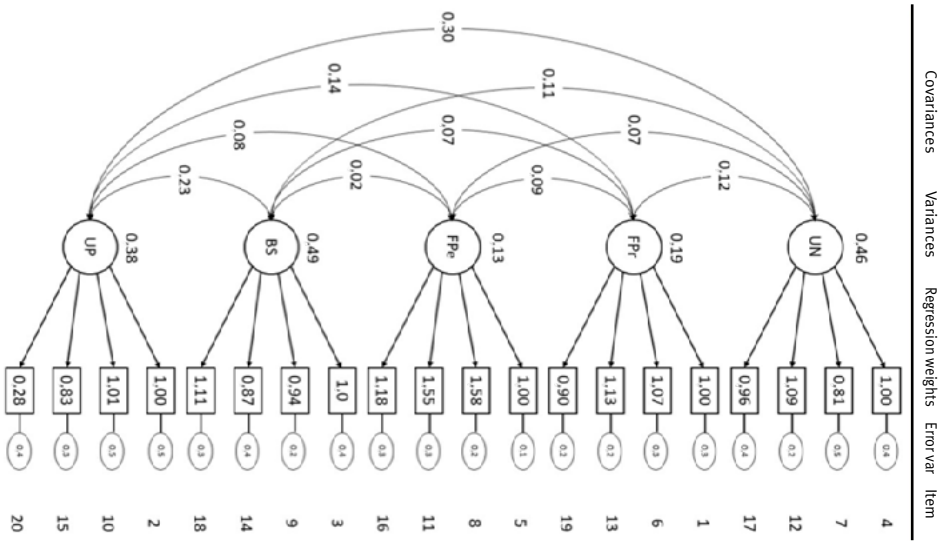

Figure 1. Structure of short UPPS-P.
Nota. NU = Negative Urgency; LPr = Lack of Premeditation; LPe = Lack of Perseverance; SS = Sensation seeking; PU = Positive Urgency.

= 0.820; RMR = 0.028) was slightly higher than the 3-factor solution (GFI = 0.959; AGFI = 0.949; PGFI = 0.763; NFI = 0.930; RFI = 0.920; PNFI = 0.817; RMR = 0.046. The resulting model is shown in Figure 1.

Internal consistency

Table 2 shows the internal consistency estimators of the short UPPS-P scales. It can be seen that, as in the validation study (Cándido et al., 2012), the values for the two *urgency* scales are unacceptable (< 0.70) when Cronbach's α is applied, but when the estimators most appropriate to the nature of the data are applied, internal consistency is acceptable in all cases.

Relationship with ICT abuse

Table 3 shows the correlations obtained between the UPPS-P and MULTICAGE-TIC scales. As can be seen, there are significant correlations in almost all cases, except in the use/abuse of video games. However, the effect size of such differences is very small. Table 4 shows the resulting regression models for each MULTICAGE-TIC scale. In all cases, the proportion of the variance of the use/abuse of each ICT is very low, with the *urgency* scales (positive and negative) contributing most to the models, although again with a very small effect size.

Relationship with prefrontal symptoms

Table 6 shows the correlations obtained between the UPPS-P and PSI-20 scales. In this case, the effect sizes of the correlations obtained between both *urgency* scales and the *lack of perseverance* scale with all the subscales and the total score on the PSI-20 were considerable, and somewhat less so with the others.

Table 2. *Reduced UPPS-P internal consistency estimators.*

	α	αs	ω
Negative urgency	0.67	0.87	0.87
Lack of premeditation	0.82	0.82	0.82
Lack of perseverance	0.78	0.86	0.86
Sensation seeking	0.84	0.89	0.89
Positive urgency	0.67	0.73	0.75

Note. α = Cronbach's alpha; αs= standardised item; ω= McDonald's omega.

Table 3. *Bivariate correlations between the scales of the reduced UPPS-P and the MULTICAGE-TIC.*

	Negative urgency	Lack of premeditation	Lack of perseverance	Sensation seeking	Positive urgency
Internet	0.20*	0.18*	0.14*	0.15*	0.24*
Mobile phones	0.22*	0.19*	0.12*	0.13*	0.26*
Video	0.10	0.10	0.08	0.12*	0.15*
Instant messaging	0.22*	0.12*	0.10	0.10	0.20*
Social networks	0.17*	0.18*	0.11*	0.20*	0.22*

Note. * Significant correlation after Bonferroni correction (p< 0.005).

Table 4. *Regression models of the UPPS-P scales reduced on each of the MULTICAGE-TIC scales.*

	Negative urgency	Lack of premeditation	Lack of perseverance	Sensation seeking	Positive urgency	
	R^2*100 (β)					Total % explained variance
Internet	0.4% (0.09)	0.9% (0.10)			5.5% (0.16)	6.8%
Mobile phones	0.6 % (0.10)	0.9% (0.10)			6.6% (0.17)	8.1%
Video games					2.2% (0.15)	2.2%
Instant messaging	4.7% (0.16)				0.7% (0.11)	5.4%
Social Networks		0.9% (0.11)		1.3% (0.13)	4.8% (0.13)	7.0%

Table 5. *Bivariate correlations between the scales of the UPPS-P and the PSI-20.*

ISP-20	Negative urgency	Lack of premeditation	Lack of perseverance	Sensation seeking	Positive urgency
Social behavior problems	0.31*	0.26*	0.22*	0.25*	0.36*
Emotional control problems	0.46*	0.19*	0.20*	0.13*	0.39*
Executive control problems	0.40*	0.27*	0.47*	0.12*	0.35*
Total	0.50*	0.31*	0.44*	0.18*	0.45*

Note. * Significant correlation after Bonferroni correction (p < 0.025).

General structural model

Figure 2 shows the predictive relationships between all the variables used. To simplify the image, two restrictions were imposed: (a) the five subscales were used, proposed by the authors as the best solution; and (b) regression weights below 0.15 were removed. The model thus obtained achieved adequate fit indices (GFI = 0.997; AGFI = 0.992; NFI = 0.972; RFI = 0.936), although they could have been better in some cases (RMR = 0.479; PGFI = 0.363; PNFI = 0.424). It can be seen how, on the one hand, the greatest predictive capacity corresponds to *prefrontal symptomatology* on the UPPS-P subscales, and, on the other, that *positive urgency* predicts all the MULTICAGE-TIC use/abuse scales, albeit with small effect size. *Negative urgency* only shows poor predictive capacity for instant messaging use/abuse, *lack of premeditation* predicts the use/abuse of mobile phones and social networks, *sensation seeking* only predicts the latter, and *lack of perseverance* is not significantly predicted by any ICT scale.

Discussion

The aim of this study was to examine the application of the UPPS-P questionnaire, in its short 20-item version, in a sample of people using or abusing information and communication technologies. The test showed adequate psychometric properties in its application to the sample obtained in the present study. Confirmatory factor analysis yielded adequate indices of fit to the data of the theoretical five-scale structure. As in the initial validation study of the Spanish version (Cándido et al., 2012), an alternative three-scale structure was tried in which the two *urgency* scales were merged on the one hand, and the *lack of premeditation* and *perseverance* one the other; this also had adequate fit to the data, but was bettered by the five-scale model.

The internal consistency of the five scales was adequate in all cases when multivariate estimators were used. This was not the case when only Cronbach's α was applied in the validation study, something unacceptable at the current level of knowledge (McNeish, 2018) yet common in previous validation studies of the questionnaire (Billieux et al., 2012; Bteich, Berbiche & Khazaal, 2017; D'Orta et al., 2015; Dugré, Giguére, Percie du Sert, Potvin & Dumais, 2019; Fossati et al., 2010; Verdejo et al., 2010).

When the UPPS-P and MULTICAGE-TIC scales were compared, it was observed that almost all correlations were statistically significant, but that effect sizes were very small in all cases: the maximum coefficient of mutual correlation is that between the use/abuse of mobile phones and *positive urgency* ($r^2 = 0.068$), which can be interpreted as each

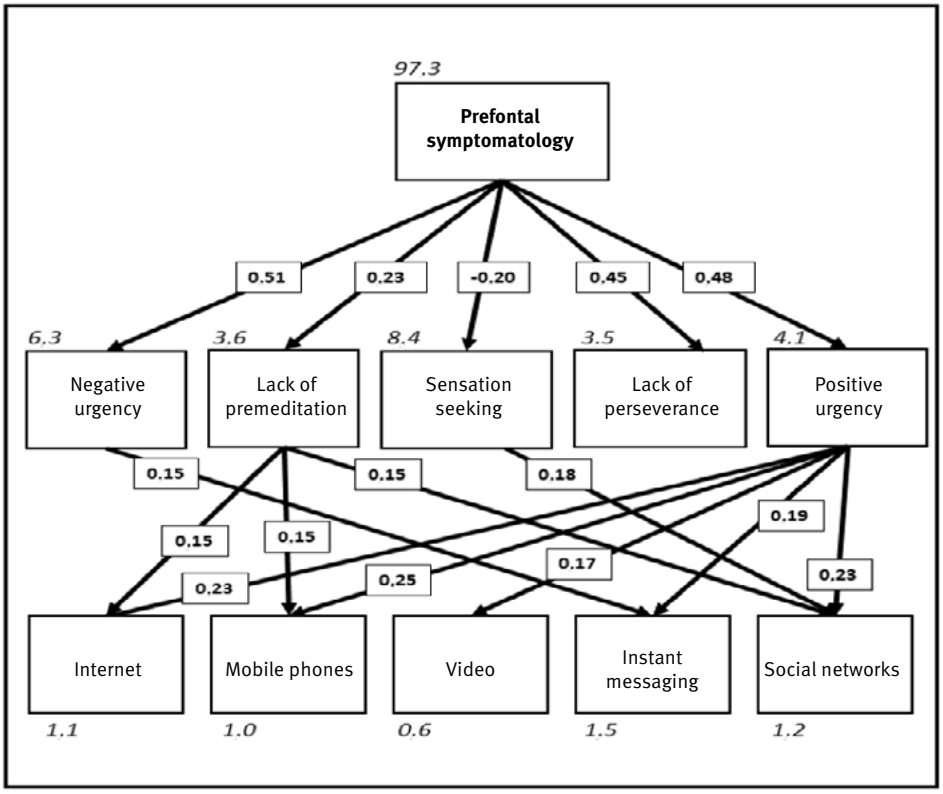

Figure 2. Structural model linking prefrontal symptoms, UPPS-P subscales, and ICT use / abuse scales.
Note. In italics, error variance; boxed and bold, standardized regression weights.
Regression weights below |0.15|.

variable only being capable of predicting 6.8% of the other. These results contrast with those obtained on the same sample when ICT-related compulsivity was explored, some variables reaching up to 40% of mutual determination (Pedrero-Pérez, Morales-Alonso & Ruiz-Sánchez de León, 2021). Based on these data, it may be deduced that ICT abuse is a behavior better governed by the rules of compulsion (avoidance of discomfort, governed by negative reinforcement) rather than by those of impulsivity (search for gratification, governed by positive reinforcement). In reality, *negative urgency* as defined by the UPPS model does not differ from the definition of compulsivity: the authors define *negative urgency* as the tendency to experience strong impulses, often under conditions of negative affect, so that those who score high on *negative urgency* engage in impulsive behaviors in order to alleviate negative effects despite the damaging long-term consequences of these actions (Whiteside & Lynam, 2001).

On eliminating common variance in one regression model, it is observed that the set of impulsivity scales predicts, at most, 8% of the ICT abuse scales, and that only *positive urgency* contributes significantly to the models, although in no case does this reach 7%. The exception is *instant messaging* use/abuse, which would be better predicted by *negative urgency*. In other words, while use of the mobile phone and its applications would be linked to the gratification they provide, *instant messaging* use/abuse would be governed by the reduction of the discomfort caused by the uncertainty of not knowing the content of the messages or as a way of escaping discomfort by producing messages. However, in both cases the contribution of the impulsivity scales is minimal compared to that obtained when considering compulsivity (Pedrero-Pérez et al., 2021).

When the impulsivity scales are correlated with those of prefrontal malfunction symptoms, the relationships with the *urgency* and *lack of perseverance* scales are consistent, and somewhat less so with *lack of premeditation*. The effect is greater when related to problems of *executive functioning*, as might be expected. Just as predictably, the urgency scales also correlate strongly with problems of *emotional control*. In contrast, *sensation seeking* has very small effect size in all its correlations. The latter is probably more of a stable personality trait (Hughson et al., 2019), while the rest of the UPPS-P scales are applied to tendencies of behavioral functioning more dependent on the stimulus context.

The joint structural model links the three levels being examined: symptoms of prefrontal malfunction, impulsivity and ICT use/abuse. What can be observed is the strong capacity of prefrontal malfunction to predict all aspects of impulsive behavior and the central role of *positive urgency* on ICT abuse. *Urgency* in the search for reinforcement reduces reflective capacity and favors involvement in the use of ICT beyond prefrontal control due, as previously mentioned, to the failure of executive control mechanisms, but also to a lack of control of emotional inputs. This model suggests that the best way to improve the use and reduce the abuse of ICTs would be the development of cognitive stimulation and rehabilitation programs that improve the higher behavior control mechanisms, relating both to executive and emotional aspects. Cognitive rehabilitation has already shown its usefulness in the field of addictions with or without substances (Verdejo-García, Alcázar-Córcoles & Albein-Urios, 2019).

The main limitation of the present study is, without doubt, the sampling method. Diffusion through social networks does not allow control of the quality of participation, the motivation and sincerity of the participants, nor, of course, generalization of results. The only way to control the quality of the responses, at least globally, is to obtain a sample large enough so that the specific weight of inappropriate responses in the overall results is reduced. Atypical scores were detected so that random responses or inconsistent completion could be eliminated. The internal consistency and structural validity tests are also guarantees of correct completion. Nevertheless, this method of information gathering has been gaining increasing interest and its use is considered normal in psychosociological research (Geisen & Murphy, 2020). Future studies should find sampling methods which allow generalization of the results.

In conclusion, the UPPS-P in its reduced 20-item version is a consistent and structurally valid test for exploring impulsivity with the multidimensional UPPS model. Given the results, the impulsive components of ICT abuse are not the central nucleus of the problem, unlike when compulsive components have been analyzed. This consideration can guide the design of more effective interventions that should probably be oriented towards improving cortical, executive, and emotional control mechanisms, and the ability to generate valid response alternatives, rather than merely blocking or modifying excessive use behaviors.

Conflict of interests

The authors declare no conflicts of interest.

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