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The Role of Negative and Positive Urgency in the Relationship Between Craving and Symptoms of Problematic Video Game Use

Francisco J. Rivero[1], Ismael Muela[1], Juan. F. Navas[2], Iván Blanco[2], Cristina Martín-Pérez[3], José A. Rodas[4,5], María F. Jara-Rizzo[6], Damien Brevers[7], & José C. Perales[1]

[1] Department of Experimental Psychology, Mind, Brain and Behavior Research Center (CIMCYC), University of Granada, Granada, Spain
[2] Department of Clinical Psychology, Complutense University of Madrid, Madrid, Spain
[3] Department of Psychology, University of Valladolid, Campus María Zambrano, Segovia, Spain
[4] Escuela de Psicología, Universidad Espíritu Santo, Samborondón, Ecuador
[5] School of Psychology, University College Dublin, Dublin, Ireland
[6] Facultad de Ciencias Psicológicas, Universidad de Guayaquil, Guayaquil, Ecuador
[7] Laboratory for Experimental Psychopathology (LEP), Psychological Sciences Research Institute, UCLouvain, Louvain-la-Neuve, Belgium

Abstract

Craving and emotion-driven impulsivity dimensions (positive and negative urgency) have been suggested as factors involved in the progression of different potentially problematic behaviors. However, their role in severity of video gaming-related problems remains unclear. This study aims to assess the differential capacity of negative and positive urgency to predict craving and the number of internet gaming disorder (IGD) symptoms endorsed (as a proxy to severity of video gaming problems) in majoritarily non-pathological video-gamers. Convenience sampling was used to recruit 232 Spanish and 222 Ecuadorian frequent video game players. Mixed-effects generalized linear (GMLE) and mediation modeling were used to test moderation and mediation hypotheses regarding the association between urgency, craving, and endorsement of IGD symptoms. Results show that (1) craving largely overlaps with endorsement of IGD symptoms; (2) craving for video games is linked to positive urgency, but not to negative urgency, which reinforces the idea that craving, at least in mostly non-pathological gamers, is a positively valenced expectancy state; (3) positive urgency exerts an indirect effect (mediated by craving) on the number of symptoms endorsed; (4) negative urgency exerts a direct effect on the number of symptoms endorsed; and (5) urgency traits do not interact with craving to predict the number of symptoms. These findings are consistent with the proposal that craving is an emotional state, and that dysregulation of positive affect (as measured by positive urgency) influences its emergence and control. In addition, they support the idea that craving is a central feature in the emergence of IGD symptoms.

Keywords: craving; positive urgency; negative urgency; internet gaming disorder; emotional regulation

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Introduction

Craving is characterized by an intense urge or desire to perform a behavior, leading to loss of control over that behavior, despite attempts to refrain from it (Skinner & Aubin, 2010). In contrast with substance use disorders (SUDs), and in spite of the mounting evidence supporting the role of craving in the progression, maintenance, and relapse of disordered gaming and other problematic behavior patterns (Antons et al., 2020; Brand et al., 2019; Cornil et al., 2019; May et al., 2015; Rash et al., 2016), the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013) does not include craving among the diagnostic criteria for internet gaming disorder (IGD; currently listed in Section 3 as a condition warranting more clinical research and experience before it being considered for inclusion as a formal disorder). The 11th version of the International Classification of Diseases (ICD-11; World Health Organization [WHO], 2019) does list IGD as a formal diagnosis (renamed as gaming disorder, to acknowledge the observation that both offline and online gaming can become problematic for some individuals), and mentions impaired control as one of its core features, but does not explicitly mention craving either.

Nonetheless, the mechanisms underlying craving remain a matter of debate. In some cases, craving has been conceptualized as a negative emotional state, whereas in others it has been attributed a positive sign. In the first sense, craving would be similar to withdrawal, namely a negatively valenced state potentially motivating behavior via negative reinforcement (Baker et al., 1986; Drummond et al., 2000), and interfering with the ability to maintain abstinence (Larimer et al., 1999). Craving differs from withdrawal, however, in its continuance in people suffering from addiction that have been abstinent for some time and have overcome the acute phase of the withdrawal syndrome. This persistence is explained by the fact that different cues associated with addictive rewards can progressively acquire the ability to automatically trigger craving, and thus the motivation to relieve it (Baker et al., 2004; Koob & Volkow, 2010; Stewart, 2008).

In the second sense, craving-triggering cues are hypothesized to acquire some of the features of the desired reward and to feed a positively valenced anticipatory state (Larimer et al., 1999; Stewart et al., 1984). This possibility is supported by numerous studies with significant clinical implications (Brandtner et al., 2021; Caselli & Spada, 2015; Mansueto et al., 2019), as well as by some theoretical models, such as the Incentive Sensitization Theory (IST; Robinson & Berridge, 2001), and the Elaborated Intrusion Theory of Desire (EIT; Kavanagh et al., 2005). The IST postulates that the intermittent reward schedules that reinforce addictive activities sensitize the mesolimbic dopaminergic system, which, in turn, increases the incentive value of the cues signaling the availability of reward. By virtue of this conditioned sensitization process, such cues become “motivational magnets” with the power to drive addictive behavior. In the EIT, craving is conceptualized as consisting of reward-related intrusive and elaborate thoughts. The mental imagery linked to the desired target elicits sensations of pleasure, engages executive control mechanisms (i.e., working memory), and makes it difficult to regulate the thoughts and emotions that motivate addictive activities (May et al., 2004).

Positively and negatively valenced aspects of craving are not mutually exclusive and may be present at the same time, in different phases of the same addictive process, or may have more weight in some people than in others, or in some behavioral domains than in others (May et al., 2015). Disentangling their relative roles could help understand the role of positive and negative affect regulation mechanisms in craving control, and the impact of their malfunctioning on craving experiences and ensuing behaviors. With that idea in mind, in this work we will use positive and negative urgency scores as proxies to individual differences in emotion regulation of positive and negative affect and emotions, respectively, and we will explore the associations between them, craving, and severity of video gaming-related problems (with endorsement of IGD symptoms as an estimate of severity).

Craving and Video Gaming-Related Problems

As noted earlier, gaming disorder was included—not without controversy—as an addictive disorder in the ICD-11 (World Health Organization [WHO], 2019). This has motivated efforts to explore whether craving for video games is in some sense similar to craving for drugs (Antons et al., 2020; Brandtner et al., 2021; Saunders et al., 2017). Some of these studies report neural correlates of craving in different brain regions to be similar to those found in substance use disorders (SUDs; Ko et al., 2009; Sun et al., 2012; Zhang et al., 2016). Furthermore, craving and its neural correlates have been observed only in individuals with IGD symptoms and not in recreational gamers (Dong et al., 2017). Some empirical evidence also suggests that the cognitive mechanisms of craving in IGD are similar to

those proposed by the EIT (Kavanagh et al., 2005), and significant correlations between video game craving and IGD symptoms severity have been reported (Brand et al., 2019; Brandtner et al., 2020, 2021; Caselli et al., 2015; Dong & Potenza, 2014; Skorka-Brown et al., 2015). These findings seem to support the main theories of craving mentioned previously, as well as the existence of similarities between IGD and well-established addictive disorders (gambling disorder and SUDs), which would justify the inclusion of IGD in the ICD-11.

Nonetheless, disagreement among experts remains (Billieux et al., 2015; Van Rooij et al., 2018), as the meaning and operationalization of craving seem to vary across instruments and behavioral domains, i.e., very scant research has been dedicated to substantiating the assumption that 'craving for games', 'craving to gamble', and 'craving for drugs' are processually and phenomenologically similar states. In all cases, craving is understood as intense desire but, as discussed in Muela et al. (2022), intense desire could merely reflect the anticipation of some strong reward, whereas a more restricted definition of craving requires that urge to be overwhelming, to be perceived as intrusive, and to jeopardize control attempts. Actually, the scarce research available (e.g., D. L. King et al., 2016) suggests that craving for video games could show some non-trivial differences with craving in *bona fide* addictive disorders.

Positive and Negative Urgency, Emotion Regulation, and Craving

As mentioned earlier, craving is an affect-laden state. Consequently, craving regulation can be understood, at least partially, as an instance of emotion regulation (Giuliani & Berkman, 2015), so that the success or failure of that regulation will facilitate or preclude refraining from the potentially problematic activity. If craving is a negatively valenced (aversive) state, the individual will be motivated to seek relief from it, so the activity will be maintained by negative reinforcement. If craving is a positively valenced (appetitive) anticipatory state, the activity will be maintained by the realization of such expectancy (positive reinforcement). In any of the two cases, hypersensitivity to such states or failure to regulate them will result in more intense cravings and/or an increased incapacity to refrain from the potentially problematic activity.

More precisely, craving itself can result from emotional dysregulation (i.e., failure of emotion regulation mechanisms might contribute to the emergence of intense perceived cravings, and these to potentially addictive behaviors); or, alternatively, emotion dysregulation could make craving—once instantiated—more effective at motivating addictive behavior (i.e., emotion dysregulation as a moderator of the influence of craving on problematic behavior). These two possible roles are compatible with the distinction between incidental and intentional emotion regulation mechanisms in contemporary models of emotion regulation (Etkin et al., 2015; Perales et al., 2020). In any case, the relative and joint contribution of positively and negatively valenced affective components of craving in non-substance-related problematic behaviors remains unexplored.

The UPPS-P model of impulsive behavior (Cyders & Smith, 2008) stems from the Five-Factor Model of personality (FFM; McCrae & Costa, 2003; Whiteside & Lynam, 2001), and was originally intended to unify the measurement of individual differences in impulsivity. Since then, the model has been particularly fruitful in the study of transdiagnostic and neurocognitive mechanisms underlying addictive and other problematic behaviors (Verdejo-García et al., 2021; Rochat et al., 2018). Among its component dimensions, our interest is focused on positive and negative urgency, namely the proneness to rash action under the influence of strong positive and negative affect, respectively. The remaining components of impulsivity in the model are lack of premeditation (lack of capacity to consider the consequences on one's behavior), lack of perseverance (lack of capacity to remain focused on a boring or cognitively taxing task), and sensation seeking (motivation for new and exciting experiences)[1]. Our specific interest on urgencies stems, first, from the available evidence linking emotion-driven impulsivity to the etiology of substance and non-substance-related addictive behaviors (e.g., Coskunpinar et al., 2013; Johnson et al., 2020; Navas, Billieux et al., 2017; 2019; Quintero et al., 2020; Velotti & Rogier, 2021); and second, from its strong theoretical and empirical linkage with emotion-regulation processes (e.g., K. M. King et al., 2018) that, as mentioned earlier, are likely to be crucial for craving sensitivity and control.

According to processual models, urgency results from the combination of compromised emotion regulation (i.e., decreased capacity to modulate the course of positive or negative emotions, resulting in excessive or inappropriate affect), and behavioral hyper-reactivity (a reflexive, or insufficiently inhibited, association between the emotional trigger and the ensuing impulsive behavior; Billieux et al., 2021; Rochat et al., 2018). Some evidence also suggests that urgency traits could be used as proxies to the functioning of incidental emotion regulation mechanisms (Muela et al., 2023; Perales et al., 2020; Quintero et al., 2020), but are probably more modestly related to reflective or model-based emotion regulation strategies (Halcomb et al., 2019).

The Present Study

Here, the relationships between positive and negative urgency, craving, and severity of gaming-related problems (measured using the self-reported endorsement of IGD symptoms) will be explored in a convenience sample of individuals, mostly in the non-pathological range of video gaming-related problems (but broadly distributed in the whole continuum, and with a non-trivial proportion above the customary clinical significance cutoff). According to current theoretical developments (e.g., the I-PACE model; Brand et al., 2019; Brandtner et al., 2021) severity of gaming-related problems exists in a continuum, with IGD symptoms (i.e., gaming-related problems) becoming more prevalent, and cravings more intense and frequent, as problematic gaming worsens. The present study is about the role of craving and urgency in individual differences on that continuum, neither presuming that such problems are clinically significant in the individuals under assessment, nor, obviously, implying that video gaming is essentially a problematic activity. Throughout this article, severity of video gaming-related problems is used as a neutral term to refer to detectable symptoms, regardless of whether their count surpasses the threshold for the individual to be classified at high risk of being diagnosed with IGD.

Positive and negative urgency will be kept as separate predictors. This decision obeys mostly to methodologically practical reasons. Even if common emotion sensitivity and dysregulation processes underpin both urgencies, positively and negatively valenced states, and the behavioral tendencies they motivate, strongly contribute to individual differences (Torrubia et al., 2001), so urgencies can be expressed differently across individuals depending on the influence of such states on motivation and behavior. Hence, in order to try to elucidate the mechanisms underlying craving, and the weight of positively and negatively valenced affective components in it, one can look at the differential capacity of positive and negative urgency to predict craving and severity of video gaming-related problems.

Actually, several studies have pitched negative urgency against positive urgency as predictors of severity of potentially problematic or addictive behaviors (see, for example, Michalczuk et al., 2011; Navas, Contreras-Rodríguez et al., 2017; for a short review see Muela et al., 2023). For instance, Raybould et al. (2022) explored the association between urgency dimensions and gaming-related problems, and found both urgencies to be associated with a higher symptom count, and to be possibly involved in the transition between recreational and disordered gaming. To our knowledge, however, no studies have considered the role of craving in the link between urgencies and video gaming-related problems.

First, an interaction model will be used to test the possibility that the relationship of craving with severity of video gaming-related problems is moderated by positive or negative urgency. Or to be more specific, to test if the impact of craving on video gaming-related problems is larger for high urgency than for low urgency individuals. If that were the case, it would be indicative that stronger cravings are not straightforwardly translated into more severe gaming problems, but people with lower urgency scores do experience cravings yet they control them successfully enough to partly avoid the ensuing problems. Or, what amounts to be the same, once craving is subjectively experienced (and thus accessible to self-report), people with higher urgency scores would find it more difficult to prevent it from triggering dysregulated gaming.

Secondly, a sequential model will be used to test the possibility that craving mediates the links between urgencies and problematic video gaming. If corroborated, such a mediated relationship would suggest that individuals with high urgency scores experience stronger cravings, and consequently experience more problems. Or, in other words, that dysregulation of positive or negative affect makes individuals feel stronger subjective craving states. To our knowledge, only two studies have followed a similar rationale. Quintero et al. (2020) observed that craving mediated the effects of negative urgency on severity of gambling problems, but negative urgency did not directly predict severity (and the potential role of positive urgency was not investigated). Muela et al. (2023), however, found craving to mediate the effect of positive urgency (instead of negative urgency) on gambling problems' severity, and negative urgency exerted a direct effect on severity of gambling-related symptoms, not mediated by craving.

Thus, in accordance with the abovementioned research, we expect craving to be strongly predictive of video gaming-related problems' severity. Based on the emotion regulation model of craving control, we also expect urgencies to correlate with craving scores, although our hypotheses remain open regarding the relative weight of positive and negative urgency in predicting craving. Finally, we also remain neutral with regard to the specific model (moderation or mediation) describing best the pattern of relationships between urgency dimensions, craving, and video gaming-related problems.

Methods

Participants and Procedure

For this study, a convenience sample of video game players living in Spain and Ecuador was recruited. 454 participants (232 from Spain, and 222 from Ecuador) were included in the study. Sample size was limited by availability and time constraints, and no formal a priori power analyses were carried out. The two subsamples were recruited for partially different protocols, and only the common measures of interest for the present purposes will be reported here. The order of measures as administered to participants and other specificities in each sample are described below. For measures not specifically analyzed for the purposes of the current study, references for the versions used are specified below. Observed scores in those measures were not included in working databases to avoid data peeking and potential HARKing, but can be provided by the corresponding author upon reasonable demand.

Apart from the input and output variables of interest (urgencies, craving, and severity of video games-related problems) and available sociodemographics, depression and substance use indices were also kept for control purposes. Both depression and substance use have been reported to co-occur to some degree with problematic video gaming (González-Bueso et al., 2018; Perales et al., 2021), and have been also theoretically and empirically linked with facets of urgency (see, for example, Gunn et al., 2020; Pang et al., 2014). Models were built both with and without depression and substance use indices as control confounders in order to discard the possibility that they could explain theoretically relevant links away.

The characteristics of both samples are described in Table 1. Note, however, that differences between samples are fully considered for all analyses, and joint analyses were checked for robustness separately. Additionally, Table 2 reports partial correlations (Spearman's ρ, conditioned on age and gender) between the variables of interest for the two samples separately. Correlations are mostly comparable, and the correlation coefficients are themselves very strongly correlated across samples (r = .75), i.e., both samples present very similar covariance structures. This similarity in the raw covariance structure between the two samples can be interpreted as evidence that the potential impact of procedural differences between the protocols, if any, is rather small.

Table 1. *Sample Characteristics.*

	Spanish subsample		Ecuadorian subsample	
Gender	62 males	170 females	166 males	56 females
Age	22.484 (7.121)	21.464 (2.854)	23.193 (3.636)	21.821 (2.281)
IGD9 score	2.274 (2.383)	0.794 (1.327)	2.735 (2.435)	2.429 (2.388)
IGD9 > 4	16 (6.90%)		48 (21.62%)	
MultiCAGE drugs	0.500 (1.020)	0.353 (0.802)	0.735 (1.134)	0.411 (0.757)
MultiCAGE alcohol	0.919 (1.164)	0.982 (1.223)	1.018 (1.218)	0.929 (1.319)
BDI	6.565 (6.525)	8.006 (6.743)	8.265 (8.438)	9.714 (8.566)

Note. For quantitative variables (age in years, number of IGD endorsed items, number of MultiCAGE symptoms for illegal drugs and alcohol, and BDI depression score) the mean (standard deviation) is reported. For gender only the frequencies of male and female participants per subsample are reported. The IGD > 9 row displays the frequency and percentage of participants with an IGD score above 4 (cutoff for high risk of IGD) per subsample.

Ecuadorian Subsample

The study was advertised through flyers placed at the seventh author's institution of affiliation. Interested potential participants were interviewed by phone or electronic means to determine their eligibility. The inclusion criteria were to play video games at least six times a year, being between 18 and 65 years old, and reporting no history of brain injury, neurological problems, or psychiatric disorders. Once deemed eligible, a link was sent to their emails, and they were assessed in a single 45-minute online session. All participants were informed about the aims and methods of the study and provided informed consent. They were not compensated for their participation in the study.

The assessment protocol consisted of the common questionnaires detailed below, as well as the following ones (not analyzed for the present purposes): mood (Positive Affect and Negative Affect Scale; Sandín et al., 1999), symptoms of psychopathology (SCL-90; Derogatis, 2002), emotional regulation strategies (ERQ; Cabello et al., 2013), and gaming motives (brief Gaming Motives Questionnaire adapted from bGMI; Barrada et al., 2019). Questionnaires were administered in a fixed order for all participants (1. Sociodemographic survey, 2. Gaming habits survey, 3. BDI, 4. ERQ, 5. UPPS-P, 6. MultiCAGE, 7. IGD9, 8. Craving, 9. brief Gaming Motives Questionnaire). Relevant features and references for the measures considered for analyses are reported below.

Table 2. *Partial Correlations (Spearman's ρ) for Variables of Interest (Conditioned on Age and Gender) for the Ecuadorian and the Spanish Sample. Significant Correlation are Shown in Bold. The Significance Threshold is Corrected for Multiplicity (Bonferroni Corrected p = .05/21).*

Ecuadorian subsample							
Variable		1	2	3	4	5	6
1. IGD	ρ	—					
	p-value	—					
2. Craving	ρ	.436	—				
	p-value	**< .001**	—				
3. Negative urgency	ρ	.221	.110	—			
	p-value	**< .001**	.103	—			
4. Positive urgency	ρ	.216	.158	.599	—		
	p-value	**.001**	.019	**< .001**	—		
5. MC—Alcohol	ρ	.179	−.002	.180	.257	—	
	p-value	.008	.980	.008	**< .001**	—	
6. MC—Illegal drugs	ρ	.278	.027	.136	.128	.480	—
	p-value	**< .001**	.686	.044	.058	**< .001**	—
7. BDI	ρ	.411	.178	.199	.017	.093	.164
	p-value	**< .001**	.008	.003	.798	.171	.015
Spanish subsample							
1. IGD	ρ	—					
	p-value	—					
2. Craving	ρ	.587	—				
	p-value	**< .001**	—				
3. Negative urgency	ρ	.224	.175	—			
	p-value	**< .001**	.008	—			
4. Positive urgency	ρ	.219	.190	.463	—		
	p-value	**< .001**	.004	**< .001**	—		
5. MC—Alcohol	ρ	-.031	.051	.209	.327	—	
	p-value	.640	.440	**.001**	**< .001**	—	
6. MC—Illegal drugs	ρ	.146	.073	.295	.240	.347	—
	p-value	.027	.273	**< .001**	**< .001**	**< .001**	—
7. BDI	ρ	.273	.224	.212	.087	.165	.313
	p-value	**< .001**	**< .001**	**.001**	.190	.012	**< .001**

Spanish Subsample

Participants were recruited, first, using a snowball sampling method starting with recruiters' acquaintances; and second, enrolling undergraduate students from 2 universities located at the city of the third and fourth authors' affiliation. A first inclusion criterion was being 18 years or older. Since this protocol is part of a larger project aimed at comparing psychological processes of gambling and video game use (see Ethics and Acknowledgement sections), a second inclusion criterion was gambling or playing video games at least once in the last 12 months. Completion of the protocol lasted approximately 30 minutes. All individuals who participated in this study did so

voluntarily, were informed about the project aims and characteristics, and gave their informed consent. Those participants who were undergraduate students received course credits for their participation, while the rest of the participants received no compensation. Only participants who play video games and completed the whole protocol were considered for current analyses.

Data were collected using an anonymous survey implemented in Qualtrics (Provo, UT). Questionnaires were administered in a quasi-randomised order. First, they answered questions about sociodemographic data. Subsequently, they answered the questionnaires on gambling, video games and other variables of interest, which were arranged in 3 different blocks. Each block contained the following questionnaires. (1) Gambling block: SOGS (Echeburúa et al., 1994), Gambling habits survey adapted from the third module of the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001) Gambling-related cognitive distortions (GRCS; Del Prete et al., 2017), Brief Gambling Motives Inventory (bGMI; Barrada et al., 2019), and Gambling craving (this scale was borrowed from Quintero et al., 2020). (2) Videogames: IGD9, brief Gaming Motives Questionnaire adapted from bGMI (Barrada et al., 2019), Craving for video games, and Gaming habits survey (following the same logic as in the CPGI). (3) Other variables of interest: UPPSP, Sensitivity to Punishment and Sensitivity to Reward (SPSRQ; Torrubia et al., 2001), Emotional Regulation Questionnaire (ERQ; Cabello et al., 2013), BDI-II, SCL90 (Sandín et al., 1999), and MultiCAGE-CAD. The blocks were administered in a counterbalanced manner, and the questionnaires were presented in a random order within each block. Relevant features and references for the measures considered for analyses are reported in the measures section below. The gambling and video game-related blocks were preceded by a question about their participation in the last 12 months (inclusion criterion). If the participants answered negatively, the block was skipped.

Data and Code Availability

All data and code for the present methods are available at the Open Science Framework (OSF) repository: https://osf.io/5xqyk/.

Ethics

Both subsamples were recruited as part of a larger project (see Acknowledgement section), approved by the Human Research Ethics Committee at the main project's institution (reference number 1830/CEIH/2020). Permission for recruitment and assessment of the Ecuadorian sample was also issued by the corresponding committee at the local institution (reference number RCI-SO-13-064-08.202).

Measures

Sociodemographic Data

An ad-hoc questionnaire was used to collect information on gender, age, years of education, educational level of the father and mother, and approximate income of the family unit. Some of the questions have different formats in the protocols for the two subsamples, as they are adapted to the different cultural backgrounds. For instance, educational categories vary from one country to another, and so do currencies and mean family income. For that reason, among these variables, only age and gender are reported in Table 1.

Impulsivity

The short Spanish version of the *UPPS-P Impulsive Behavior Scale* (Cándido et al., 2012) was used to measure five dimensions of impulsivity: positive urgency (e.g., *I tend to lose control when I am in a great mood*), negative urgency (e.g., *When I am upset I often act without thinking*), lack of premeditation (e.g., *My thinking is usually careful and purposeful*), lack of perseverance (e.g., *Once I get going on something I hate to stop*), and sensation seeking (e.g., *I quite enjoy taking risks*). The scale consists of 20 Likert-type items (4 items per dimension), ranging from 1 (*totally agree*) to 4 (*totally disagree*). Lack of perseverance and lack of premeditation items are positive (higher raw scores indicate more impulsivity), whereas items for the other dimensions are negative (lower raw scores indicate more impulsivity). Negative items were reversed so that higher scores indicated more impulsivity in all dimensions. Question wording and response options were identical for the two subsamples.

Original validation studies have shown UPPS-P to have good psychometrics properties. Only the positive and negative urgency subscales were used for the present study. Observed Cronbach's alpha values were .830 and .672 for negative and positive urgency, respectively, in the Spanish sample; and .787 and .642 in the Ecuadorian sample. Although the adoption of inflexible cutoffs is not recommended, the minimum acceptable reliability is generally established between .6 and .7, so the reliability of the positive urgency scale is questionable. This makes robustness of results for positive urgency across subsamples especially important.

Craving for Video Games

The craving scale used in Quintero et al. (2020) was adapted for video gaming. It consists of three items recording (i) intense urges, *At times, I cannot help feeling an intense desire to play video games*, (ii) stimulus-driven behavior, *Some situations, events or stimuli incite me to play video games, even if I had not planned it*, and (iii) attentional bias, *Video gaming-related situations, events or stimuli immediately grab my attention*. Higher values indicate a greater craving experience. A total craving score was computed as the mean value of the three item scores.

To ensure that the factor weights of the three items are adequate in the two samples, an exploratory (parallel) factor analysis was performed, using promax rotation, as implemented in the Factor module in JASP 0.16.2 (JASP Team, 2022). A single factor underlying the three items was identified as the best solution, with loadings for the Spanish sample of .967, .700 and .724, and for the Ecuadorian sample of .784, .786 and .654, for items 1, 2 and 3 respectively. Reliability analyses showed values of .784 and .833 for Cronbach's alpha in the Ecuadorian and Spanish samples, respectively.

Importantly, due to the differing protocols, the response options for the craving scale were different in the two subsamples. In the Spanish subsample, participants were asked to answer the three questions in a 0–100 scale, whereas participants in the Ecuadorian subsample responded in a 1–5 Likert-type scale. In order to express responses in the same scale, 0–100 responses were translated into a 1–5 scale and rounded to the nearest integer. The total craving score was computed as the mean of the three item scores. Extra measures taken to ensure comparability of responses, and to make the integration of both samples in a global analysis feasible, are described in the statistical analyses section. Additionally, all main analyses were reproduced with the two subsamples separately, with results mostly equal in the two cases. For the sake of brevity, only analyses with the pooled sample are reported here, but segregated analyses are fully disclosed in the section titled *Segregated analyses for the Ecuadorian and Spanish samples* in the *Supplementary analyses.pdf* file available at the OSF link. Differences in results from the two subsamples are also discussed in the second paragraph of the strengths and limitations section of this article.

Severity of Video Gaming-Related Problems

We adapted the *Internet Gaming Disorder Scale* (*IGD9;* Beranuy et al., 2020*),* as a count of criteria for the diagnosis of IGD (as provisionally proposed for DSM-5). Symptoms include preoccupation (e.g., *Do you feel preoccupied with your gaming behavior?*), tolerance (e.g., *Do you feel the need to spend an increasing amount of time gaming in order to achieve satisfaction or pleasure?*), withdrawal (e.g., *Do you feel more irritability, anxiety or even sadness when you try to either reduce or stop your gaming activity?*), unsuccessful attempts to limit gaming (e.g., *Do you systematically fail when trying to control or cease your gaming activity?*), deception or lies about gaming (e.g., *Have you deceived any of your family members, therapists or others because the amount of your gaming activity?*), loss of interest in other activities (e.g., *Have you lost interests in previous hobbies and other entertainment activities as a result of your engagement with the game?*), use despite knowledge of harm (e.g., *Have you continued your gaming activity despite knowing it was causing problems between you and other people?*), use for escape or relief of negative mood (e.g., *Do you play in order to temporarily escape or relieve a negative mood (e.g., helplessness, guilt, anxiety)?*), and harm (e.g., *Have you jeopardized or lost an important relationship, job or an educational or career opportunity because of your gaming activity?*). As it happens with similar scales, the number of items endorsed (ranging between 0 and 9) is customarily interpreted as an estimate of severity of the problems caused by the potentially addictive activity (see, for example, Strong & Kahler, 2007). It presents adequate psychometric properties, with Cronbach's alpha = .785 for both the Spanish and Ecuadorian samples. Question wordings and response options (dichotomous yes/no answers) were identical for the two subsamples.

Depression Severity

The revised version of the *Beck Depression Inventory* (BDI-II; Beck et al., 1996; Spanish version, Sanz et al., 2003) is a 21-item self-report measure of depressive symptoms. Questions refer to the week prior to the evaluation. Each item is scored on a 4-point scale ranging from 0–3 (yielding a maximum of 63) (e.g., for the sadness item: 0 = *I do not feel sad*, 1 = *I feel sad much of the time*, 2 = *I am sad all the time*, and 3 = *I am so sad or unhappy that I can't stand it*).In our study, Cronbach's alpha values were .884 and .899 for the Spanish and Ecuadorian samples, respectively. Question wordings and response options were identical for the two subsamples.

Risk of Drug and Alcohol Abuse

The *MultiCAGE CAD-4* (Pedrero-Pérez et al., 2007) is a quick screening tool designed to detect risky or problematic behavior in several domains: alcohol abuse (e.g., *Have you ever thought you should drink less?*), illegal drug abuse (e.g., *Do you sometimes feel compelled to use drugs even though you have decided not to?*), excessive gambling (e.g., *Have you had psychological, family, financial or work problems because of gambling?*), excessive video gaming (e.g., *Do you spend more time than you think you should, playing with game consoles or computer games*?), excessive internet surfing (e.g., *Do you find it hard to stay away from the internet for days at a time?*), hypersexuality (e.g., *Have your partners complained about your excessive sexual activity?*), eating disorder (e.g., *Are you obsessed with food, dieting and weight control?*), and compulsive money spending/shopping (e.g., *Have you ever had problems with your family members because of overspending and lack of control over money?*). Each subscale consists of four dichotomous (yes/no) items, with subscores for the different domains (count of endorsed items) ranging between 0 and 4. Only drug abuse and alcohol abuse subscales were used in this study, for control purposes. Both subscales showed adequate psychometric properties, with Cronbach's alpha values of .702 and .710 for alcohol and drug abuse, respectively, in the Spanish sample; and .710 and .697 in the Ecuadorian sample. Question wordings and response options were identical for the two subsamples.

Data Analytic Plan

Moderation Analysis

An initial saturated model was built with dichotomous responses to individual IGD items (0/*non-endorsement*; 1/*endorsement*) as output variable. Craving scores, positive urgency, and negative urgency were used as continuous, fixed-effects predictors. The potential moderating effects of positive and negative urgency on the relationship between craving and symptom endorsement were tested by including positive urgency x craving, and negative urgency x craving interactions in the model.

As noted earlier, response options for craving items were different in the two subsamples. So, in addition to translating scores into a common scale, source (Spanish/Ecuadorian), source x craving, source x positive urgency, source x negative urgency, source x craving x positive urgency, and source x craving x negative urgency fixed effects were also added to the model. That implies that any potential contamination of craving effects due to sample source, including differential sensitivities of the craving measure across samples, is explicitly modeled, and thus prevented from affecting theoretically relevant effects. The inclusion of sample source as a main fixed-effects factor in all analyses also controls for the potential extraneous effect of procedural differences between sub-samples. Additionally, in order to ensure the robustness of effects in the moderation models, all analyses were carried out with and without gender, age, illegal drugs, and alcohol subscales of the MultiCAGE questionnaire, and BDI scores as fixed-effects variables.

Model fitting was performed using the *glmer* function in the *lme4* statistical package (Bates et al., 2015) in R programming software (version 4.0.3; The R Core Team, 2020). Responses for IGD items were modeled as binomial variables with a logit link, i.e., the syntax for the saturated model was: glmer (response ~ craving * negurg * source + craving * posurg * source + gender + age + MC_alcohol + MC_drugs + BDI +(1 | id) + (1 | item), family = binomial(link = "logit"))[2]. A hierarchical procedure was subsequently followed to remove interactions not substantially contributing to model fit. Parameter estimates for the saturated and the best-fitting model will be reported. The Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and a likelihood ratio test will be used for model comparison and selection. Effects will be reported for models with and without potential confounders, in order to assess their robustness.

Mediation Analysis

In case moderations are discarded (i.e., if positive urgency x craving and negative urgency x craving interactions do not contribute to model fit) a partial mediation model will be tested. In this model, craving, negative urgency, and positive urgency will be used as direct predictors of the number of IGD items endorsed, and positive and negative urgency as predictors of craving, i.e., craving will be treated as a mediator between urgency and the number of IGD item endorsed. Source, gender, age, BDI, and MultiCAGE alcohol and drugs subscales will be used as background confounders (again, models will be built with and without confounders, except for the case of source, which is included in all models). As in moderation analyses, the inclusion of sample source as a background confounder in mediation analyses is intended to ensure that any theoretically relevant link in the model cannot be explained away by procedural differences between protocols.

The mediation model will be tested using the total number of endorsed IGD items (1–9) as a quantitative output variable, with the mediation analysis function from the JASP SEM module (JASP Team, 2022), with Delta method standard errors, bias-corrected percentile bootstrap confidence intervals, and the Maximum-Likelihood estimator.

We are aware of the fact that moderation was tested using an item-by-item IGD analysis, were mediation was tested using the total IGD score as a quantitative variable, which could have caused sensitivity differences in the output variable across analyses. Although in the main text we stick to the preplanned analysis, we have carried out supplementary analyses to test the robustness of reported analyses relative to an alternative in which the moderation and mediation hypotheses are evaluated in a two-step procedure using the IGD score as a continuous variable. Results from such alternative analyses are available in the section titled *Test of the moderation and mediation hypotheses in a single, two-step procedure* in the *Supplementary analyses.pdf* file available at the OSF link.

Results

Table 3 shows the estimated effects in the saturated moderation model. Among interactions, only the source x craving interaction was significant. The lack of contribution of theoretically relevant interactions to model fit was confirmed by hierarchical tests. In a first step, the removal of the three-way interactions did not hamper model fit. In a second step, two-way interactions were removed one-by-one, with only the removal of the source x craving interaction substantially reducing model fit and thus being retained (see Full control model in Table 4). For the sake of brevity, the whole hierarchical process will not be detailed here, but it is fully reproducible with the R script available at the OSF link.

Among the predictors of theoretical interest, only craving showed a (direct) significant effect on IGD symptoms endorsement in all models (see Tables 3 and 4). Results from models with and without confounders were similar except for negative urgency. In all models, the independent effect of positive urgency was non-significant, whereas the effect of negative urgency was non-significant in the full control model, but it turned significant when BDI and MultiCAGE scores were removed.

As noted earlier, the mediation analysis included positive and negative urgency, as input variables, craving as partial mediator, and total IGD score as output variable. Table 5 shows estimates for direct, indirect, and total effects in the mediation model. As we did with moderation analyses, we fitted three models with all covariates as background confounders (BDI, MultiCAGE scores, gender, age, and source; panel a), with gender, age, and source (panel b), and only with source (panel c). Corroborating results from the moderation analysis, the direct effect of negative urgency depended on the inclusion/exclusion of BDI and MultiCAGE scores. The graphical depiction of the models with unstandardized estimates is displayed in Figure 1–Figure 3.

Table 3. *Effect Sizes (OR), Confidence Intervals (CI), and Significance Level (Z-Value Approximation) for Fixed Effects; and Random Part Estimates (Random Effects) in the Saturated Model of Probability of IGD Item Endorsement.*

Predictors	Odds Ratio	*CI*	*p*
(Intercept)	0.12	0.03–0.40	**.001**
Craving	2.33	1.80–3.03	**< .001**
Negative urgency	1.38	0.99–1.93	.058
Positive urgency	1.15	0.84–1.57	.385
Source	0.70	0.48–1.04	.078
Craving x Negative urgency	0.77	0.56–1.05	.097
Craving x Positive urgency	0.96	0.72–1.27	.752
Craving x Source	2.15	1.45–3.18	**< .001**
Negative urgency x Source	0.74	0.48–1.15	.178
Positive urgency x Source	0.99	0.64–1.55	.981
Craving x Negative urgency x Source	1.27	0.81–2.01	.296
Craving x Positive urgency x Source	0.82	0.51–1.33	.431
Age	01.1	0.96–1.05	.749
Gender	0.78	0.53–1.17	.231
BDI	1.40	1.19–1.66	**< .001**
MC—Drugs use	1.42	1.18–1.72	**< .001**
MC—Alcohol use	0.97	0.84–1.13	.740
Random Effects			
σ^2		3.29	
τ_{00id}		1.57	
τ_{00item}		0.72	
ICC		0.41	
Marginal R^2 / Conditional R^2		.344 / .613	

Table 4. *Effect Sizes (OR), Confidence Intervals (CI), and Significance Level (for Z-Value Approximation Tests) for Fixed Effects; Random Part Estimates (Random Effects), in the Best Fitting Model With all Covariates Left Panel), Only With Age, Gender, and Source as Covariates (Middle Panel), and Only With Source as Covariate (Right Panel).*

	Full control			Age, Gender, and Source control			Source control		
Predictors	Odds Ratio	*CI*	*p*	Odds Ratio	*CI*	*p*	Odds Ratio	*CI*	*p*
(Intercept)	0.11	0.03–0.36	**< .001**	0.17	0.05–0.56	**.004**	0.15	0.08–0.29	**< .001**
Craving	2.26	1.76–2.91	**< .001**	2.40	1.85–3.12	**< .001**	2.45	1.89–3.18	**< .001**
Negative urgency	1.14	0.94–1.40	.185	1.32	1.08–1.62	**.008**	1.31	1.06–1.60	**.011**
Positive urgency	1.19	0.97–1.45	.101	1.19	0.97–1.47	.095	1.19	0.97–1.47	.097
Source	0.68	0.46–1.01	.058	0.64	0.42–0.96	**.030**	0.57	0.39–0.84	**.004**
Source x Craving	2.21	1.51–3.25	**< .001**	2.22	1.49–3.32	**< .001**	2.32	1.56–3.46	**< .001**
Age	1.01	0.97–1.05	.646	1.00	0.96–1.05	.996			
Gender	0.78	0.52–1.16	.216	0.74	0.50–1.11	.150			
BDI	1.40	1.18–1.65	**< .001**						
MC—Illegal drugs use	1.43	1.18–1.72	**< .001**						
MC—Alcohol use	1.00	0.86–1.16	.965						
Random Effects									
σ^2	3.29			3.29			3.29		
τ_{00}	1.61 $_{id}$			1.89 $_{id}$			1.90 $_{id}$		
	0.71 $_{item}$			0.71 $_{item}$			0.70 $_{item}$		
ICC	0.41			0.44			0.44		
Marginal R^2 / Conditional R^2	.333 / .609			.308 / .613			.306 / .613		

Table 5. *Mediation Model Results (With Unstandardized Estimates).*

Full control model						
Direct effects	Estimate	*SE*	*z*	*p*	*CI lower*	*CI upper*
NU → IGD	0.137	0.125	1.092	.275	−0.091	0.369
PU → IGD	0.216	0.160	1.350	.177	−0.067	0.534
Indirect effects						
NU → Craving → IGD	0.010	0.064	0.155	.877	−0.143	0.129
PU → Craving → IGD	0.297	0.085	3.488	**< .001**	0.100	0.482
Total effects						
NU → IGD	0.147	0.141	1.043	.297	−0.150	0.416
PU → IGD	0.513	0.177	2.897	**.004**	0.166	0.898
Source, Gender, and Age control						
Direct effects	Estimate	*SE*	*z*	*p*	*CI lower*	*CI upper*
NU → IGD	0.313	0.129	2.427	**.015**	0.098	0.565
PU → IGD	0.221	0.164	1.348	.178	−0.079	0.537
Indirect effects						
NU → Craving → IGD	0.037	0.068	0.553	.581	−0.096	0.191
PU → Craving → IGD	0.256	0.088	2.909	**.004**	0.075	0.464
Total effects						
NU → IGD	0.350	0.146	2.407	**.016**	0.089	0.610
PU → IGD	0.477	0.183	2.605	**.009**	0.134	0.823
Source control						
Direct effects	Estimate	*SE*	*z*	*p*	*CI lower*	*CI upper*
NU → IGD	0.293	0.129	2.281	**.023**	0.056	0.539
PU → IGD	0.226	0.164	1.379	.168	−0.093	0.527
Indirect effects						
NU → Craving → IGD	0.001	0.073	−0.008	.994	−0.153	0.144
PU → Craving → IGD	0.303	0.095	3.168	**.002**	0.102	0.519
Total effects						
NU → IGD	0.293	0.148	1.979	**.048**	−0.021	0.568
PU → IGD	0.529	0.187	2.834	**.005**	0.177	0.886

Note. Significant effects are displayed in bold. Unstandardized estimates for effects of urgencies on craving (not shown here) are displayed in figures.

Figure 1. *Graphical Depiction of the Mediation Model, With Different Nested Sets of Background Confounders (With Unstandardized Estimates): Full Control Model.*

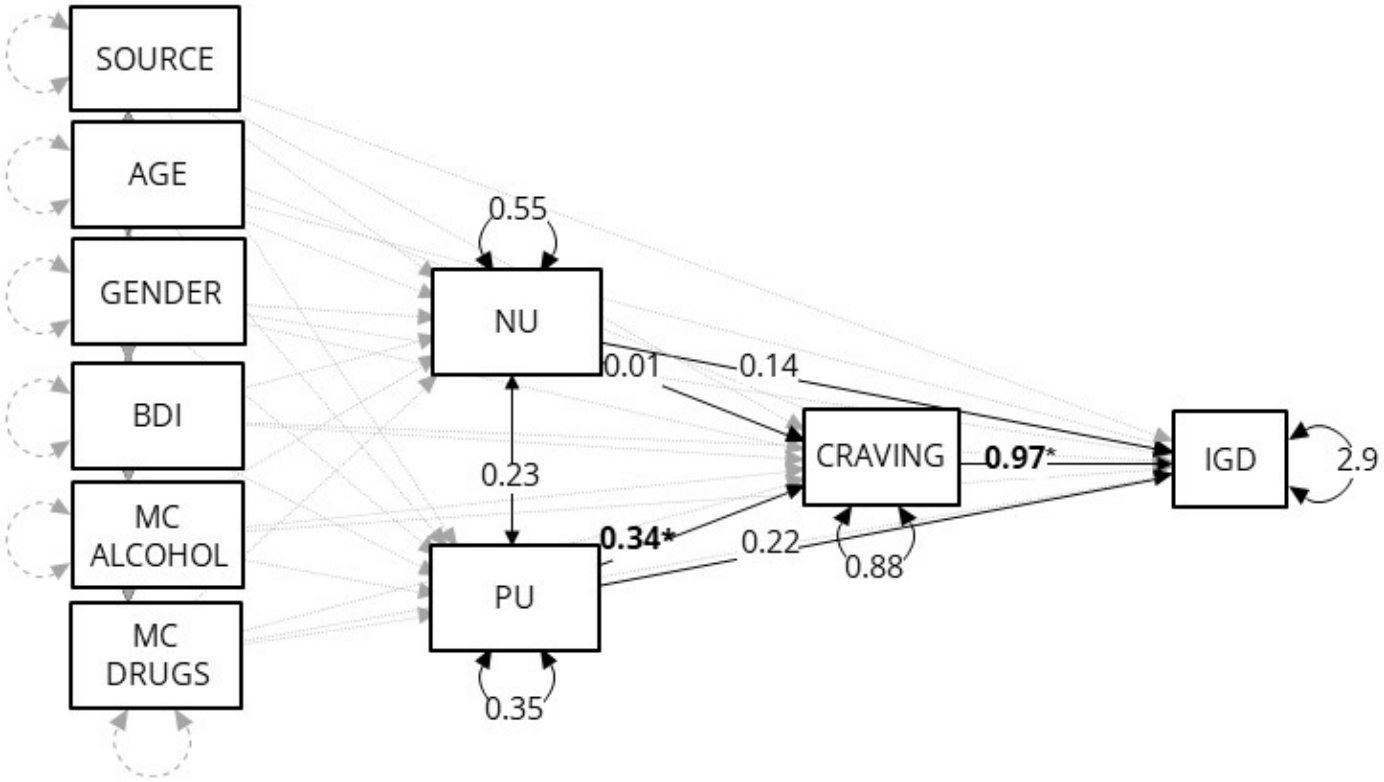


Figure 2. *Graphical Depiction of the Mediation Model, With Different Nested Sets of Background Confounders (With Unstandardized Estimates): Gender, Age, and Source Control.*

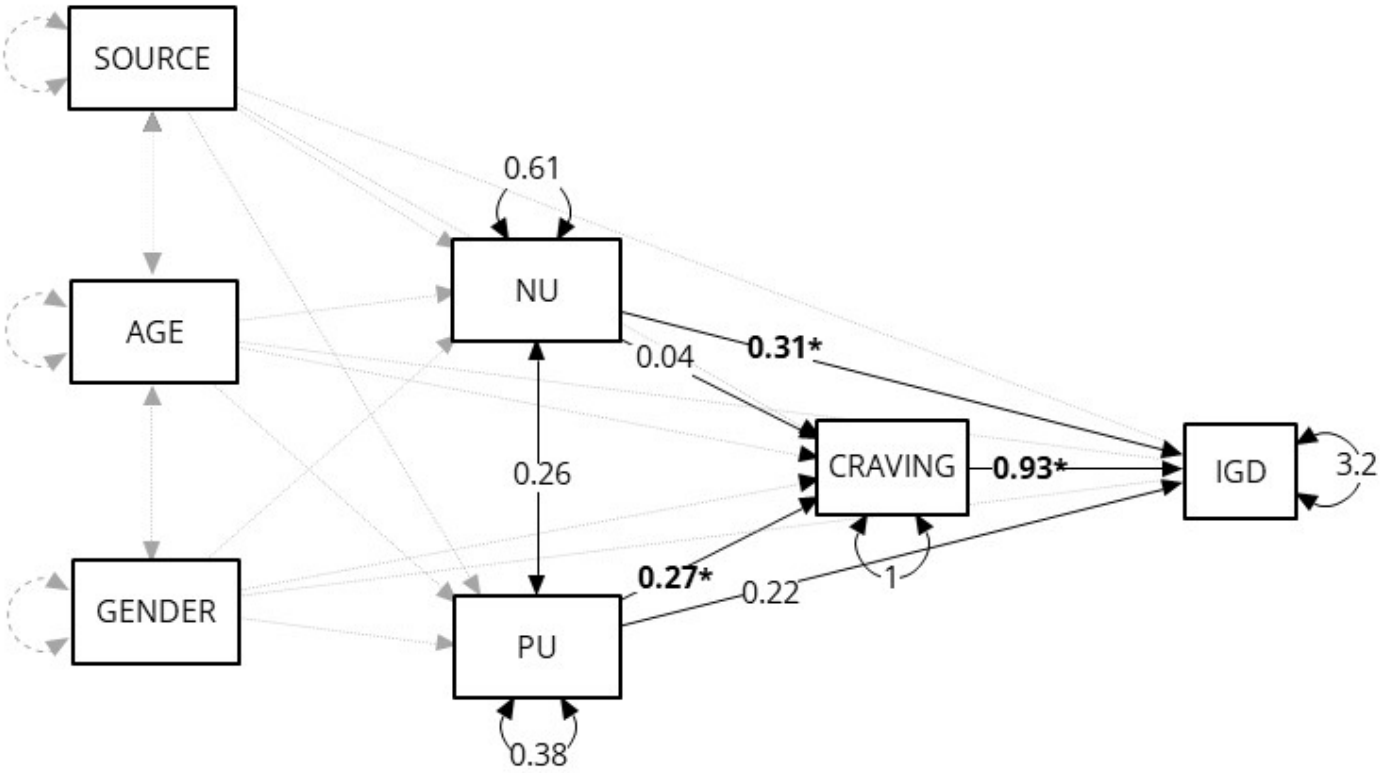
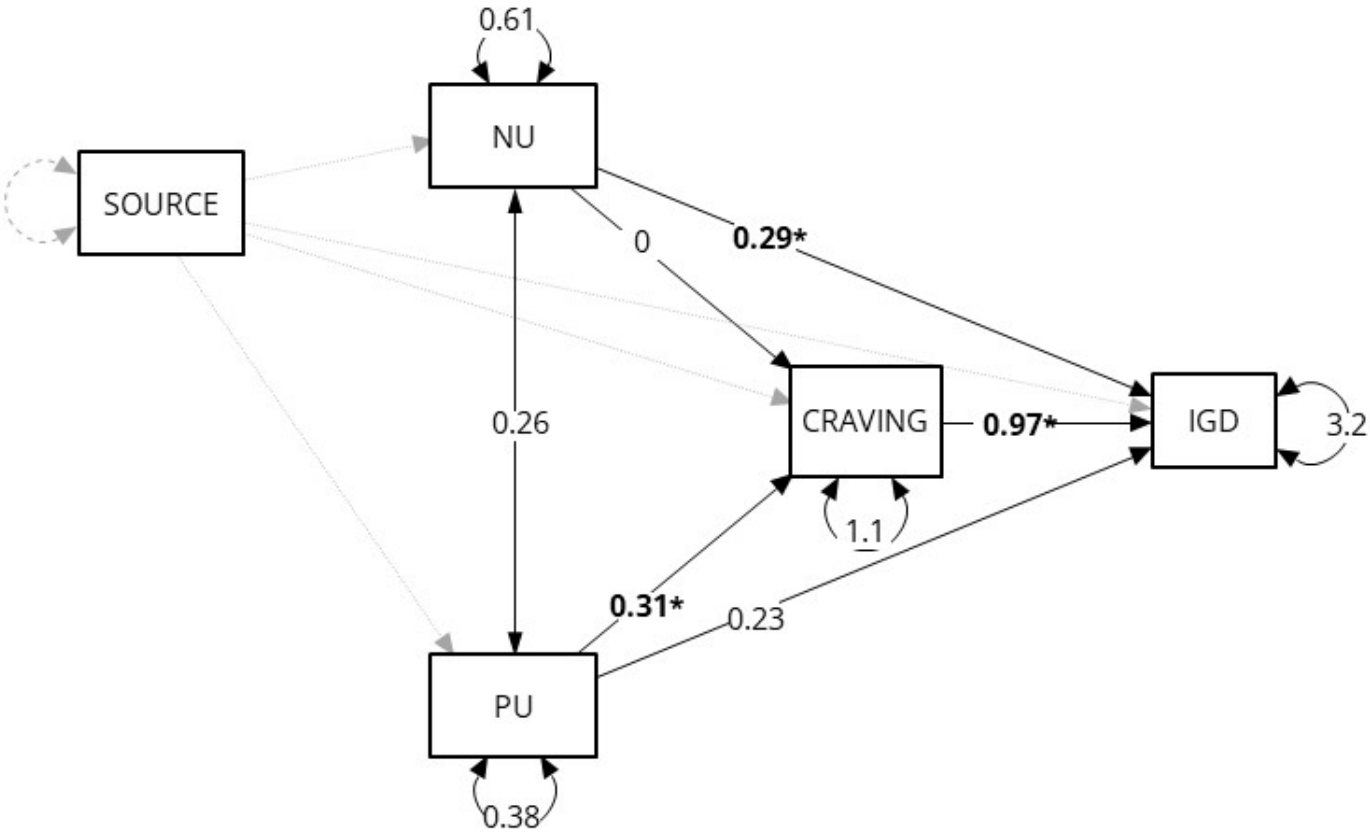


Figure 3. *Graphical Depiction of the Mediation Model, With Different Nested Sets of Background Confounders (With Unstandardized Estimates): Source Control.*



Discussion

The overarching aim of the current study was to investigate the ability of positive and negative urgency to predict craving and endorsement of IGD symptoms (as a proxy to measure severity of gaming-related problems), in a majoritarily non-pathological, convenience sample. Complementarily, we aimed to assess the differential roles of positive and negative urgency, and to evaluate whether the pattern of associations between urgencies, craving, and endorsement of IGD symptoms were better fitted by a moderation model (in which urgencies modulate the influence of cravings on problematic behavior) or a mediation model (in which urgency traits are involved in the emergence of subjective cravings, and these, in turn, increase the severity of video gaming problems).

On the one hand, results show that craving for video games is linked to positive urgency, but not to negative urgency, in such a way that positive urgency exerts an indirect effect on the severity of video gaming-related problems. These results support the conceptualization of urgency as a proxy to emotional dysregulation (Giuliani & Berkman, 2015; Johnson et al., 2020). However, in the present study and sample, the involvement of urgency in craving states seems to be restricted to its positive dimension, whereas the effect of negative urgency on the IGD score is direct (not mediated by craving). On the other hand, the absence of a negative urgency effect on craving and its direct effect on IGD severity support the proposal that negative urgency is a complication factor for behavioral dysregulation and addiction (Navas et al., 2019; Perales et al., 2020), but it is not at the core of its etiology (as far as we accept that the main driver of video gaming problems is craving). This interpretation is also supported by the dependence of the direct NU–IGD link on controlling or not for BDI and potential substance abuse (alcohol and illegal drugs), which suggests that the impact of NU on IGD might be exerted via complication factors or comorbidities with a negative affect or externalization basis.

This pattern could be specific to the video gaming behavioral domain, marking a possible difference with drug and gambling craving. Evidence in this direction is, however, contradictory. For instance, Quintero et al. (2020), using an approach very similar to ours, and also with a convenience sample of mostly non-pathological gamblers, found craving to mediate the effect of negative urgency on gambling-related problems (and no effect of positive urgency). Muela et al. (2023), however, and also with a convenience sample of regular gamblers (with slightly higher severity levels and different distribution of gambling preferences), have recently failed to replicate Quintero et al.'s results

and found a pattern mostly coincident with ours (with craving mediating the effect of positive urgency on gambling-related problems).

Considered together, results thus point out to the existence of other factors, beyond the behavioral domain, that could account for this lack of consistency (especially regarding the relative roles of positive and negative urgency in craving). One possibility, mentioned in the introduction, is a hypothetical progression from a predominant role of positive urgency in early, non-pathological levels of severity, to a predominant role of negative urgency in later, more severe states. This possibility, however, is not totally supported by the available research either (for a brief but overarching review, see Muela et al., 2023). Future research should therefore systematically investigate variations in association patterns between urgencies, craving, and activity-related problems across domains and severity levels using comparable methods.

An important coincidence across studies is the extremely strong effect of craving (measured with only 3, non-overlapping items) on IGD symptoms' endorsement. This finding seems to imply that craving is the main driver of problematic video gaming, and supports the recent proposal that craving is a central feature for the development and recognition of IGD (Antons et al., 2020; Brand et al., 2019; D. L. King et al., 2016; Saunders et al., 2017). Nevertheless, although craving appears to be a central process in the etiology of IGD, more research is needed to clarify whether craving remains an identical construct across different behavioral domains. This is because, despite evidence of parallelisms between different addictive behaviors, there are also differences between them. Indeed, recent reviews (Antons et al., 2020; Castro-Calvo et al., 2021; Muela et al., 2022) highlight the current lack of agreement at operationalizing craving in different behavioral domains and severity levels, as well as the paucity of etiological and longitudinal studies. More research is required to compare the behavioral and neurobiological processes underlying craving in different non-substance addictive behaviors, and to avoid a purely confirmatory research approach.

Finally, statistical analyses seem to contradict the hypothesis that urgency traits increase the sensitivity of gaming-related problems to experienced craving. If that were the case, it would imply that people with lower urgency scores experience cravings, but control them well enough to partly avoid the ensuing problems. Our data are actually more aligned with the alternative hypothesis that high-positive urgency individuals just experience stronger cravings, which is compatible with the idea that successful or unsuccessful regulation operates before the individual becomes fully aware of their craving state. This, however, does not exclude the possibility that other factors beyond urgency could play such a moderation role. Individuals could use more intentional strategies to regulate craving once it is subjectively experienced (and, actually, patients are customarily trained to use them, e.g., Kiluk et al., 2010; Kober et al., 2010).

This interpretation is well accommodated by current models of emotional regulation. For instance, the model proposed by Etkin et al. (2015) differentiates intentional from incidental emotional regulation. The former alludes to active attention to the emotion and the conscious elaboration of strategies to regulate it (e.g., reappraisal). The latter, however, occurs without full awareness, is triggered automatically by contextual cues, and does not require monitoring (e.g., context-dependent extinction). This possibility seems to straightforwardly account for our results, as incidental emotional regulation inability would occur before the individual is fully conscious of the experience of craving. In other words, as proposed by Navas et al. (2019), urgency reflects the malfunctioning of incidental emotion regulation mechanisms. In any case, this is the first study to investigate craving and negative and positive urgency as predictors of IGD symptoms' endorsement and the evidence remains indirect, so further studies to corroborate these ideas are warranted.

Strengths and Limitations

This study is not without limitations worthy of consideration. First, as the two samples were initially recruited as part of different protocols, the response options in the video game craving scale were different for the Ecuadorian and the Spanish sample. This problem was addressed, not only by translating the 0–100 responses into its corresponding 1–5 scale, but also incorporating source (sample) and its interactions with craving and urgency scores into the generalized linear mixed-effects model, and source (sample) as a background confounder into the mediation model. This ensures that the possible contamination of craving effects by source differences, or by differential sensitivity of the craving measure across sources is controlled for.

Still, and in order to discard any possible extraneous effects due to sample differences, the main analyses were reproduced in the two samples separately. Results across samples are qualitatively identical to the global ones,

except for the direct effect of negative urgency on IGD symptoms' endorsement (in both the moderation and mediation analyses) which was significant in the Ecuadorian sample, but not replicated in the Spanish sample. Importantly, craving x urgency interactions did not contribute to model fit in moderation analyses in any of the two samples. Given the similarity of results, and for the sake of brevity, only the global analyses are reported here. Such analyses are however available in the last section of the accompanying R script (for the moderation analyses), and the segregated mediation analyses for the Ecuadorian and Spanish sample (section titled *Segregated analyses for the Ecuadorian and Spanish samples* in the *Supplementary analyses.pdf* file) all of which are available at the OSF link).

A second, related limitation is the relatively low reliability of the positive urgency scale, especially in the Ecuadorian sample. This questionable reliability makes coherence of results for positive urgency across subsamples particularly important. Fortunately, positive urgency was strongly predictive of craving in both subsamples, and results were fully consistent. We are thus confident that the lack of reliability is probably attributable to the fact that the subscale consists of a small number of items, and probably one of them is not reliably reflecting the underlying factor, rather than to heterogeneity.

A third methodological limitation is the lack of a priori power analysis. As noted earlier, sample size was limited by availability and time constraints. Still, the number of factors in the models (especially in the ones without covariates) is relatively low, and the sample size seems to be well above the median sample size for this type of studies (Fritz & MacKinnon, 2007).

A fourth limitation is the cross-sectional nature of data, that imposes limits on causal interpretations. We are aware that the two models considered here are not the only possible causal structures underlying the set of raw associations observed. However, these are the most theoretically plausible ones under a minimal set of assumptions. Please note that positive and negative urgency are traits (impulsivity dimensions), cravings are transient internal states (reported retrospectively), and IGD symptoms are mostly overt behaviors. By logic, traits have causal precedence over transient states, so we have only considered the possibility that urgencies cause or interact with craving, but not that craving states cause urgency traits. Similarly, we regard urgencies and cravings as causes of IGD symptoms, but not the other way round (i.e., we have not considered the opposite directionality, namely that IGD symptoms cause craving or urgency).

Of course, these assumptions are not granted. Still, one of the main aims of the present study does not depend on causal assumptions. The fact that craving is associated with positive urgency but not with negative urgency strongly supports the contribution of positively valenced affect to video gaming craving in our samples. Further research on the generalizability of this result to other samples (especially to clinical samples) is warranted.

Finally, we did not take into consideration the participants' preferred video game categories, so we cannot discard the possibility that the reported set of associations could vary for different subpopulations of video gamers, categorized according to their preferences.

Despite the limitations, this study also presents some strengths to be considered. Firstly, the joint sample was rather large, and the statistical models used and the inclusion of source as a predictor confer robustness to the results and adequate statistical power. Indeed, results from the two samples serve as replications of each other, across different cultural contexts and levels of problematic behavior (which were generally higher in the Ecuadorian sample), which strengthens their robustness and generalizability.

And secondly, these findings are theoretically sound at supporting the emotional nature of craving (Giuliani & Berkman, 2015), and the existence of a type of emotional regulation operating below the threshold of awareness (Etkin et al., 2015). Additionally, results suggest that craving for IGD is mostly appetitive, or generated by positively valenced expectancy, as opposed to the aversive value frequently observed for drug or gambling craving. Finally, they also support the idea that negative urgency is a factor affecting addictive behaviors, it but is not at the core of its etiology (Navas et al., 2019; Perales et al., 2020). Therefore, the results open a new framework for future research to explore the different clinical implications that negative and positive urgency and craving may have on the onset and development of IGD and its possible therapeutic targets.

Footnotes

[1]Simpler factorizations of impulsivity have been proposed. For instance, in a meta-analytic study, Berg et al. (2015) found lack of premeditation to closely correlate with lack of perseverance, and negative urgency to strongly

correlate with positive urgency. Moreover, pairs of correlated dimensions also showed very similar association patterns with several psychopathological conditions, so results were compatible with the existence of three high-order processes reflecting conscientiousness, sensation seeking and emotion-driven impulsivity (see also Birkley & Smith, 2011). Accordingly, the results from a recent network analysis suggest that the two urgency facets reflect a unitary construct (Billieux et al., 2021).

[2]In contrast with more standard analyses, the output variable is not the sum of endorsed symptoms, but the probability of dichotomously endorsing each of them. The inclusion of random intercepts for items assumes that all items are randomly sampled from a population of indices of a common construct. The use of item-by-item responses is technically advantageous, as the availability of several responses per participant makes this analysis more robust that the total-score one, and surpasses the potential violation of the normality assumption for IGD total scores.

Conflict of Interest

The authors have no conflicts of interest to declare.

Authors' Contribution

Francisco J. Rivero: conceptualization, writing—original draft, writing—review & editing. **Ismael Muela:** conceptualization, data curation, writing—review & editing. **Juan F. Navas:** conceptualization, data collection and curation, resources, writing—review & editing. **Iván Blanco:** data collection, writing—review & editing. **Cristina Martín-Pérez:** data collection, writing—review & editing. **Jose A. Rodas:** data collection, writing—review & editing. **María F. Jara-Rizzo:** conceptualization, data collection and curation, resources, writing — review & editing. **Damien Brevers:** writing—review & editing. **José C. Perales:** conceptualization, formal analysis, funding acquisition, methodology, project administration, supervision, visualization, writing—review & editing.

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About Authors

Francisco J. Rivero is a predoctoral researcher at the University of Granada with a grant from the Ministry of Universities (Spain) to carry out his doctoral thesis. He has just completed a master's degree in addictions research and intervention with the highest honours. His research interests focus on the mechanisms of emotional regulation and cognitive biases of behavioural addictions and their possible therapeutic targets. https://orcid.org/0000-0002-4904-4077

Ismael Muela is a PhD candidate at the Mind, Brain and Behaviour Research Centre (CIMCYC) at the University of Granada, Spain. He is also a member of the Learning, Emotion and Decision Research Group based in the Department of Experimental Psychology at the same university. His PhD thesis aims to shed light on the basic mechanisms underlying both incidental and intentional emotional regulation in gambling disorder. https://orcid.org/0000-0002-3331-1679

Juan. F. Navas is assistant professor at the Complutense University of Madrid and member of the Responsible Gambling Advisory Council of the Spanish Ministry of Consumer Affairs. He is also Vice President of the Society for the Advancement of Judgment and Decision Making Studies (SEJyD). His research focuses on the description and modification of affective dysregulation mechanisms in addictions, especially in gambling disorder. https://orcid.org/0000-0002-9521-6642

Ivan Blanco is assistant professor at the Clinical Psychology Department of the Complutense University of Madrid (UCM). Currently, he is co-leading the E-motion Lab research group at UCM and is the Secretary of the Spanish Positive Psychology Association. His research interest focuses on the relation between emotion and cognition. Specifically, he is interested on the study of cognitive biases (i.e., attention, interpretation and memory biases) and emotional regulation processes in emotional disorders such as depression and anxiety. https://orcid.org/0000-0003-3611-5814

Cristina Martín-Pérez is an Assistant Professor of Psychology at the University of Valladolid. Her research interest is focused on affective, personality, and neurobiological factors that underlie addiction and addictive-like behaviors towards food. Her studies combine psychological assessment with novel biological and neuroimaging measurements with the goal of identifying biomarkers that might be targeted in intervention programs. https://orcid.org/0000-0001-7315-3268

Jose A. Rodas is a Professor at Universidad Espíritu Santo in Ecuador and an Adjunct Professor at University College Dublin in Ireland. He is a member of the Brain, Emotion and Behaviour research group and the Attention & Memory Lab. His research interests include structural and functional aspects of executive functions and the relationship between executive functions and emotion regulation. https://orcid.org/0000-0001-8217-0238

María F. Jara-Rizzo is an Assistant Professor at the University of Guayaquil in Ecuador. She is a member of the Society for the Advancement of Judgement and Decision-Making Studies (SEJyD), the American Psychological Association, and head of the Cognition and Behaviour research group. Her research interests focus on the relationship between emotion regulation and behavioural addictions in children and adults. https://orcid.org/0000-0002-8798-7949

Damien Brevers is assistant professor and clinical psychologist at the Psychology Department of UCLouvain (Belgium). He is a senior member of the Laboratory for Experimental Psychopathology (LEP). His research consists in adopting translational and multi-markers approaches (EEG, fMRI, rTMS, psychophysiology) for better understanding neurocognitive processes involved into the initiation and the maintenance of (mal)adaptive habits as applied to physical activity, elite sports, pro-ecological behaviors, as well as addictive disorders. https://orcid.org/0000-0003-4503-0898

José C. Perales is a full professor at the University of Granada, Coordinator of the Master's Degree in Cognitive and Behavioral Neuroscience, and Principal Investigator of the GBrain research team. His research interests focus on the cognitive and learning mechanisms of disordered gambling and other conditions compromising self-control. He is a founding member, former Secretary, and former Vice-president of the Society for the Advancement of Judgment and Decision Making Studies (SEJyD), and a member of the International Society for the Study of Behavioral Addictions (ISSBA). He also serves as Academic or Associate Editor for several international journals on addictive processes. https://orcid.org/0000-0001-5163-8811

✉ **Correspondence to**
Ismael Muela, Department of Experimental Psychology, University of Granada, 18071 Granada, Spain,
imuela@ugr.es

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