



# Strength of Pornography Craving Experience (PCE-S): Psychometric properties of a new measure based on the elaborated intrusion theory of desire

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## ABSTRACT

**Introduction:** Pornography use is a common sexual activity with potentially addictive use in some people. Even though craving is being recognized as an important characteristic of addictive behaviors, there is a lack of a specific validated instrument measuring the pornography craving experience.

The present study aimed at adapting and validating an instrument measuring the users' strength of pornography craving experience (PCE-S) based on the Elaborated Intrusion theory of desire.

**Methods:** Items from the "strength" form of the Craving Experience Questionnaire (CEQ) were adapted to pornography use and used to create the PCE-S. The PCE-S was then administered online to 1584 English-speaking cyberporn users aged 18–75 years old (M = 33.18; SD = 10.84]; 63.1 % male, 35.2 % female, and 1.7 % non-binary). All participants completed an assessment of compulsive cyberporn use (CIUS adapted for cyberporn). Confirmatory factorial analysis (CFA) was used to examine the construct structure validity; Cronbach alpha coefficient, corrected item-total correlation, regression, and discriminant analysis were used to assess the instrument's psychometric properties.

**Results:** After using the modification indices to improve the initial model, a relatively good fit for the three-factor model was confirmed. Concurrent validity with the compulsive cyberporn use (CCU) measure was demonstrated. The PCE-S discriminated between participants with high CCU and those with low CCU scores.

**Conclusions:** A specific pornography craving experience instrument scale, based on the Elaborated Intrusion theory of desire seems to capture key constructs of the theory and correlate with measures of compulsive cyberporn use.

## 1. Introduction

Cyberporn, or online pornography, is growing rapidly. It's the most common cybersexual activity (Fisher & Barak, 2001; Ross, Månsson, & Daneback, 2012). Cyberporn can become addictive, making it a risky

Internet activity (Brand, 2020; De Alarcón, De la Iglesia, Casado, & Montejo, 2019; Koós, Orosz, Demetrovics, & Bóthe, 2022; Müller et al., 2022). About 1.2 % of women and 4.4 % of males in a representative sample of the Australian population (Rissel et al., 2016) reported being addicted to porn content.

**Abbreviations:** PCE-S, Pornography Craving Experience – Strength form.; ACE, Alcohol Craving Experience questionnaire.; ACE-S, Alcohol Craving Experience questionnaire - Strength form; UPPS-P, Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency (UPPS-P) Impulsive Behavior Scale; CIUS, Compulsive Internet Use Scale.; KMO, Kaiser-Meyer-Olkin.; EFA, exploratory factorial analysis.; CFA, confirmatory factorial analysis; GFI, goodness-of-fit index.; NFI, normed fit index.; RFI, relative fit index.; IFI, incremental fit index.; TLI, Tucker-Lewis index.; CFI, comparative fit index.; RMSEA, root mean square error of approximation.; SRMR, standardized root mean square residual.

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Early investigations described problematic online sexual activity with an exaggerated use duration despite its negative effects (Cooper, Scherer, Boies, & Gordon, 1999). Carroll et al. (2008) studied porn consumption frequency and duration. Men use cyberporn more often and spend more time on it every week (Wetterneck, Burgess, Short, Smith, & Cervantes, 2012). Impulsivity weakly correlates with problematic pornography use in men and women, according to Bóthe et al. (2019).

Craving is associated with compulsive porn consumption (Weinstein, Zolek, Babkin, Cohen, & Lejoyeux, 2015). Craving is a strong desire that is known to be a key feature of addictions (May et al., 2014). It is a DSM-5 (Association, 2013) criterion for substance use disorder diagnosis (Cornil et al., 2019; Mallorquí-Bagué, Mestre-Bach, & Testa, 2023). It is also important in behavioral addictions (Tiffany & Wray, 2012). Weinstein et al. (2015) found that men had greater “self-reported craving” for porn than women. In their study, they employed Young (2001)’s “20 questions about cybersex addiction including pornography.” The Pornography Craving Questionnaire (PCQ) of Kraus and Rosenberg (2014) was used to measure craving. However, this PCQ evaluates a big heterogeneous notion that includes “perceived control in using pornography, changes in mood, psychophysiological activity, and intention for using pornography” (Weinstein et al., 2015, p. 2). Additionally, the scale was assessed only among US male students. This scale assessing craving intensity and other non-craving dimensions (i.e. perceived control and mood change) lacks specificity towards the theory-driven cognitive mechanisms involved in craving (for instance, lack of imagery dimension).

The Elaborated Intrusion (EI) theory (Kavanagh et al., 2005) underlies the Alcohol Craving Experience Questionnaire (ACE) (Statham, Connor, Kavanagh, Feeney, & Young, 2011) and the Craving Experience Questionnaire (CEQ) (May et al., 2014). This theory describes craving as “a cognitive-affective phenomenon that involves an initial, apparently spontaneous intrusive thought (triggered by cues from the environment, mind and body), followed by controlled processes of elaboration, which tend to include construction of multi-sensory imagery” (May, Andrade, Panabokke, & Kavanagh, 2010, May et al., 2014). According to the EI theory, users create mental representations of the needed substance that are instantaneously fulfilling but aggravate their perception of deficit. This vicious loop of desire, imagery, and planning to satisfy it involves a larger elaboration of imagery that interacts with “high-level cognitive processes (such as working memory)”. Thus, concurrent cognitive tasks are inefficient and emotional responses are high (May, Andrade, Panabokke, & Kavanagh, 2004).

The CEQ is a desire “generic measure” for varied consumption targets and periods (May et al., 2014). It was based on the ACE and uses its two forms: strength (ACE-S) for how strong the cravings are and frequency (ACE-F) for how often they happen. The CEQ assesses the ACE’s three dimensions: Imagery, Intensity, and Intrusion, for strength and frequency. The ACE’s Imagery dimension measured sensory imagery vividness (e.g., How vividly did you imagine a drink?). The Intensity dimension measures craving intensity (e.g., how strongly did you want a drink?). The Intrusion dimension measured how intrusive drinking thoughts were (e.g., How hard were you trying not to think about alcohol?). Studies that have adapted the CEQ to gambling have found modest links between the three components of its strength form and positive and negative urgency (Cornil et al., 2019).

Since the literature lacks specific, brief, and theory-based instruments to assess the pornographic craving experience, this study adapted and validated an instrument to measure users’ craving strength for pornography. The Pornography Craving Experience – Strength form (PCE-S) was created using items from the Strength form of the Craving Experience Questionnaire (CEQ) (May et al., 2014). We also studied the correlations between the three dimensions of the developed PCE-S and psychosocial characteristics including impulsivity (positive and negative urgency), compulsive cyberporn use, and cyberporn use patterns.

## 2. Materials and methods

### 2.1. Participants

1584 people completed the online survey. Participants ranged in age from 18 to 75 ( $M = 33.18$ ;  $SD = 10.84$ ). 63.1 % were male, 35.2 % female, and 1.7 % non-binary. 77.6 % of the participants were heterosexual, 6.3 % were homosexual, 13.7 % were bisexual, and 2.4 % chose “other” to describe their sexual orientation. 32.1 % of the study participants were single, 42.7 % were in a relationship but not married, 24.6 % were married, and 0.5 % were widows. Appendix 1 lists the participants’ residences.

### 2.2. Recruitment and sampling procedures

The study used an anonymous SphinxOnline survey. We recruited adults over 18 who had watched pornography in the last six months. They were recruited through Prolific (<https://www.prolific.ac/>), an academic research crowdsourcing platform that produces high-quality data (Palan & Schitter, 2018; Peer, Rothschild, Gordon, Evernden, & Damer, 2022).

### 2.3. Ethics

The Research Ethics Committee of Tours-Poitiers in France (no. 2020-04-05) assented to the study protocol. All participants confirmed their online informed consent.

### 2.4. Measures

#### 2.4.1. Socio-demographic characteristics

These characteristics consisted of age, sex, sexual orientation, and marital status.

#### 2.4.2. Cyberporn use patterns

These included the one year estimated cyberporn use duration (CUD) per week (range: 0 h–40 h), and the frequency of cyberporn use (FCU) over the past year (continuous variable).

#### 2.4.3. Strength of pornography craving experience

We developed the Pornography Craving Experience – Strength form (PCE-S) to assess the strength of the craving experience related to porn use. The development of this tool was based on the CEQ, from which we took the items related to the Strength form. We adapted these items to pornography use. We revised the adaptation of these items with the authors (FBB, JM, YK, and RC) until an unanimous consensus was reached. The items were well understood by a pilot sample of 10 participants. The PCE-S included 10 items evaluating 3 dimensions (Table 1). The Imagery dimension is related to the vividness of the sensory pornographic imagery (4 items). The Intensity dimension assesses the urge to use pornography (3 items). The Intrusion dimension is about the intrusiveness of thoughts related to pornographic stimuli (3 items). Associated with each item there is a visual analog scale with anchor points of zero (not at all) and 10 (extremely). Following are the instructions and an example item: “Think about the time in the last month you most wanted to watch porn. At that time...how much did you want it?”.

#### 2.4.4. Compulsive cyberporn use

The 8-item short form of the Compulsive Internet Use Scale (CIUS) was applied to assess compulsive cyberporn use (CCU) (Gmel, Khazaal, Studer, Baggio, & Marmet, 2019; Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009). A 5-point response scale was used to measure each participant’s CCU score. Higher scores indicate higher CCU. The CIUS has been adjusted for cybersex in previous studies (Ben Brahim, Rothen, Bianchi-Demicheli, Courtois, & Khazaal, 2019; Varfi et al., 2019). In this

**Table 1**  
Descriptive statistics from the PCE-S 10 items and the 3 factors.

Factors/Items	Range	Mean	SD	Skewness	Kurtosis
<b>Factor 1: Imagery</b>					
Item 4: At that time, how vividly did you picture doing it?	0–10	5.39	3.11	-0.326	-1.005
Item 5: At that time, how vividly did you hear yourself doing it?	0–10	3.39	3.09	0.481	-0.971
Item 6: At that time, how vividly did you imagine your emotional feelings while doing it?	0–10	4.15	3.18	0.151	-1.213
Item 7: At that time, how vividly did you imagine the physical feelings of doing it?	0–10	5.83	3.05	-0.498	-0.796
<b>Factor 2: Intensity</b>					
Item 1: At that time, how much did you want it?	0–10	6.16	2.50	-0.562	-0.112
Item 2: At that time, how much did you need it?	0–10	4.41	2.88	0.093	-0.912
Item 3: At that time, how strong was the urge to have it?	0–10	5.71	2.75	-0.363	-0.648
<b>Factor 3: Intrusion</b>					
Item 8: At that time, how hard were you trying not to think about it?	0–10	2.66	2.84	0.925	-0.117
Item 9: At that time, how intrusive were the thoughts?	0–10	3.54	3.08	0.442	-0.974
Item 10: At that time, how hard was it to think about anything else?	0–10	3.58	3.13	0.448	-0.993

SD = standard deviation.

study, we adapted this measure to cyberporn. We specified that the word “Internet” refers to pornographic websites.

**2.4.5. Impulsivity: Positive and negative urgency**

Short Impulsive Behavior Scale (UPPS-P) (Billieux et al., 2012; Lynam, 2013) was used. Only 8 of this scale’s 20 items were used in this study to assess positive and negative urgency (4-point response scale), the two dimensions most commonly associated with addictive issues (Coskunpinar, Dir, & Cyders, 2013; Devos, Clark, Bowden-Jones, Grall-Bronnec, Challet-Bouju, Khazaal, & Billieux, 2020; Kim et al., 2022; Wéry, Deleuze, Canale, & Billieux, 2018). Thus, each subject had two urgent impulsivity scores: positive and negative. Higher scores indicated impulsivity.

**2.5. Data analysis**

First, we conducted descriptive analysis (mean [M] and standard deviation [SD]) and normality distribution test (Skewness and Kurtosis) for each item of the PCE-S – Table 1 shows the main results.

Second, we conducted tests to check the appropriateness of the data for factorial analysis (Kaiser-Meyer-Olkin [KMO] and Bartlett’s test of sphericity), reliability tests (Cronbach alpha coefficient and Corrected item-total correlation), exploratory factorial analysis (EFA) to examine the variance associated with each of the three modeled factors – Table 2 shows the main results. Using Varimax rotation, EFA returned orthogonal factors (Kim & Mueller, 1978). Eigenvalues > or = 1 and the scree-test as proposed by Kaiser (1970) and Cattell (1966) determined the number of extracted factors. Third, we conducted confirmatory factorial analysis (CFA) to test the validity of the PCE-S factorial structure theoretical model (Imagery = 4 items, Intensity = 3 items, Intrusion = 3 items). The CFA includes (a) the main analysis, (b) model improvement

**Table 2**  
Reliability Statistics and Item-total Correlation.

Factors (subscale) / Items	Sub-scale Corrected Item-Total Correlation	Sub-scale Variance if Item Deleted	Sub-scale Cronbach’s Alpha if Item Deleted
<b>Factor 1: Imagery (4.69 [SD = 2.70/], Eigenvalue = 5.64, Variance = 56.44 %, <math>\alpha = 0.89</math>)</b>			
Item 4: At that time, how vividly did you picture doing it?	0.78	66.98	0.84
Item 5: At that time, how vividly did you hear yourself doing it?	0.71	69.86	0.87
Item 6: At that time, how vividly did you imagine your emotional feelings while doing it?	0.76	66.86	0.85
Item 7: At that time, how vividly did you imagine the physical feelings of doing it?	0.77	68.43	0.85
<b>Factor 2: Intensity (Mean = 5.43 [SD = 2.47], Eigenvalue = 1.30, Variance = 13.01 %, <math>\alpha = 0.90</math>)</b>			
Item 1: At that time, how much did you want it?	0.80	27.68	0.85
Item 2: At that time, how much did you need it?	0.74	25.25	0.90
Item 3: At that time, how strong was the urge to have it?	0.85	24.21	0.79
<b>Factor 3: Intrusion (Mean = 3.26 [SD = 2.65], Eigenvalue = 1, Variance = 9.74 %, <math>\alpha = 0.85</math>)</b>			
Item 8: At that time, how hard were you trying not to think about it?	0.63	34.10	0.86
Item 9: At that time, how intrusive were the thoughts?	0.81	27.52	0.70
Item 10: At that time, how hard was it to think about anything else?	0.72	29.06	0.79

SD = standard deviation;  $\alpha$  = Cronbach’s alpha.

Cronbach’s alpha: If the scale is an exploratory one, a good reliability is set at  $\alpha > 0.7$ . If the scale is an established one, a good reliability is set at  $\alpha > 0.80$ .

Corrected Item-Total Correlation: A good corrected item-total correlation is set at  $r(\text{correlation coefficient}) > 0.30$ .

Scale Variance if Item Deleted and Cronbach’s Alpha if Item Deleted corresponding values indicate the scale dimension (factor) variance and Cronbach’s alpha if the relevant item is deleted. These metrics suggest that no item should be deleted.

techniques based on the examination of the modification indices yielded by the main analysis, and (c) a test of the model invariant across groups (male vs. female) – Fig. 1 shows the main results.

Fourth, we conducted discriminant analyses to test whether scores on the PCE-S subscales discriminated between (a) the participants with low CCU scores and (b) the participants with high CCU scores – Fig. 2 shows the main results.

Fifth, we conducted correlations analysis between the three PCE-S subscales (factors) and the other study variables: CCU, FCU, CUD, UPPS-P negative urgency, and UPPS-P positive urgency – Table 3 shows the main results.

Sixth, using only data from the male and female participants, we conducted a linear regression analysis to predict the value of CCU (mean centered) from Sex and the three PCE-S subscales (Imagery, Intensity, and Intrusions) – Table 4 shows the main results.

SPSS (version 29.0) and AMOS (26.0) were used for statistical

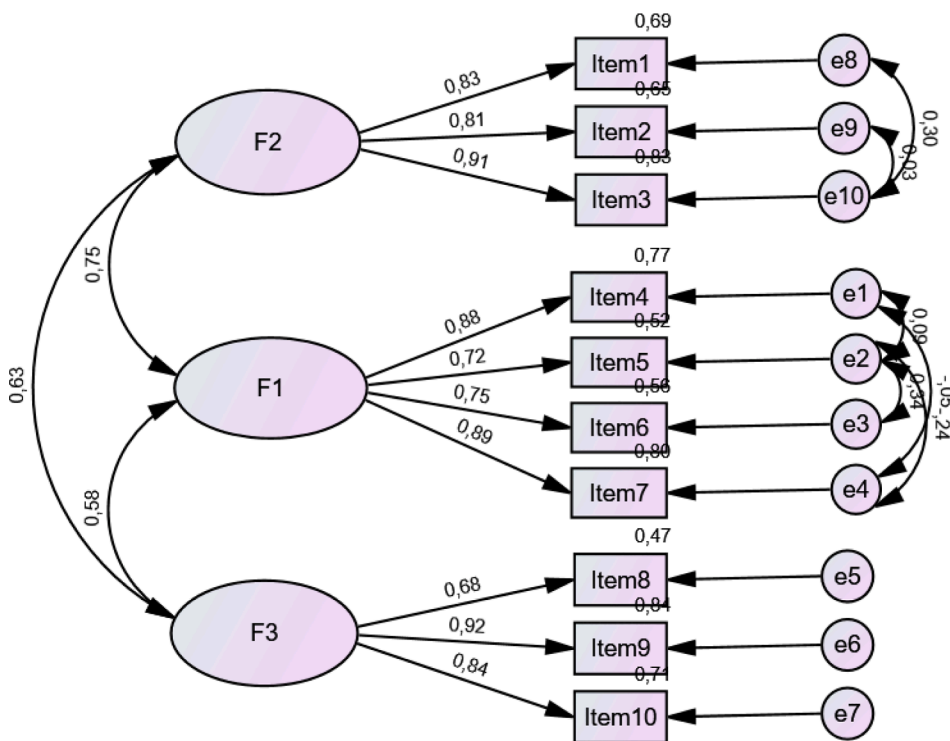


Fig. 1. The CFA path diagram of the first improved model (10 items) with the standardized estimates. Confirmation factor analysis of the questionnaire. The ellipses represent the factors and the rectangles represent the different items. The residual variances are shown in the small circles. The ellipses represent the factors (F1 = Imagery, F2 = Intensity, F3 = Intrusion). The values on the arrow linking the three factors to the corresponding items are the factors loadings (standardized estimates). The values on top of each rectangle are the square of the standardized factor loadings; they give the proportion of the explained variance ( $R^2$ ) in each item, which indicates how much of the variance in the item is explained by the unobserved construct. If a standardized factor loading value is greater the 0.70 or explains at least half (0.50 = 50 %) of the variance in the item, then the corresponding item is important in explaining the unobserved construct it belongs to. The small rounds are the error terms (measurement errors for each item), and the values on the arrow linking the error terms are the covariances established to improve the model fitting metrics.

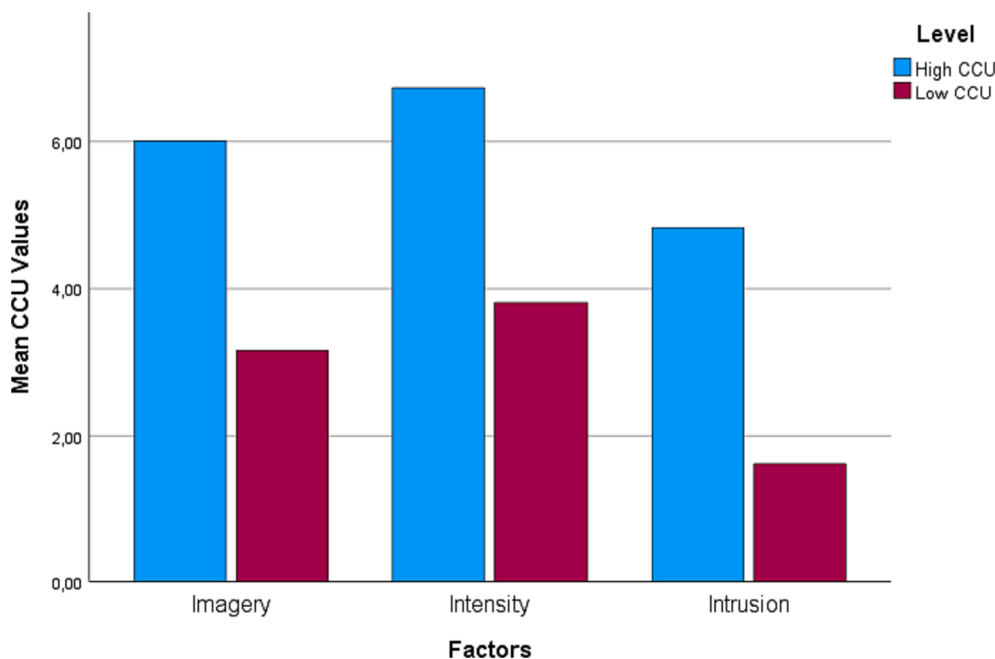


Fig. 2. Mean scores for participants with lower risk of CCU and higher risk on Imagery, Intensity and Intrusion for Pornography Craving Experience–Strength (PCE-S). This figure shows the discrimination between participants with high CCU and participants with low CCU based on the mean scores of each of the three PCE-S constructs. NB: color should be used for this figure in print.

analysis. R replicated all analyses. The Open Science Framework hosts R data, code, and Markdown files: <https://osf.io/mt6re/>.

### 3. Results

#### 3.1. Descriptive statistics, normality tests, and adequacy of data for factorial analysis

Table 1 presents the main descriptive statistics and normality distribution tests regarding the 10 items of the PCE-S.

Tests of univariate normality indicated that all items were normal,



**Table 3**

Zero-order correlation between Pornography Craving Experience-Strength (PCE-S) and Compulsive Cyberporn score (CCU), Frequency of Cyberporn Use (FCU), and Cyberporn Use Duration (CUD), UPPS-P negative urgency, UPPS-P positive urgency, and UPPS-P urgency score.

PCE-S subscales	PCE-S subscales								
	Imagery	Intensity	Intrusion	CCU	FCU	CUD	UPPS-P negative urgency	UPPS-P positive urgency	UPPS-P urgency
Imagery	–	0.65**	0.52**	0.39**	0.32**	0.19**	0.09**	0.14**	0.13**
Intensity	0.65**	–	0.52**	0.44**	0.46**	0.27**	0.10**	0.16**	0.15**
Intrusion	0.52**	0.52**	–	0.44**	0.27**	0.19**	0.16**	0.19**	0.20**

UPPS-P = Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency.

UPPS-P urgency = Negative + Positive urgency combined score.

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table 4**

Predicting CCU score from Sex and PCE-S scales.

	Estimate	Std. Error	t	p
(Intercept)	1.52	0.07	21.996	<0.001
Sex	–0.04	0.1	–0.36	0.719
Imagery	0.04	0.01	3.48	0.001
Intensity	0.09	0.01	6.27	<0.001
Intrusion	0.1	0.01	8.499	<0.001
Sex:Imagery	–0.01	0.02	–0.453	0.65
Sex:Intensity	–0.03	0.02	–1.106	0.269
Sex:Intrusion	–0.01	0.02	–0.38	0.704

except item 8 which was slightly right skewed (skewness = 0.925) and item 6 which was platykurtic (kurtosis = –1.213). When the skewness is between –0.5 and 0.5, the distribution is fairly symmetric. If the value is greater than + 1, the distribution is right skewed. If the value is less than –1, the distribution is left skewed. If the Kurtosis value is greater than +1, the distribution is leptokurtic; if the value is less than –1, the distribution is platykurtic.

The data suitability test was as follow: KMO = 0.876 (a value >0.8 can be considered good); Bartlett’s test of sphericity  $\chi^2(45) = 11183.65$ ,  $p = <0.001$ . These values confirm that the data is suitable for factorial analysis (see Cerny & Kaiser, 1977).

**3.2. Internal reliability, means and variances explained by each PCE-S subscale**

Table 2 displays the main results of the reliability tests and variances analysis for each of the three PCE-S subscales.

Cronbach’s alpha coefficient showed all PCE-S subscales had acceptable internal reliability: Imagery ( $\alpha = 0.89$ ), Intensity ( $\alpha = 0.90$ ) and Intrusion ( $\alpha = 0.85$ ). The corrected item-total correlations for each item are all >0.60. Cronbach’s alpha: if the scale is an exploratory one, a good reliability is set at  $\alpha > 0.7$ ; if the scale is an established one, a good reliability is set at  $\alpha > 0.80$  (Bland & Altman, 1997; Zijlmans et al., 2018). Corrected item-total correlation: a good, corrected item-total correlation is set at  $r$  (correlation coefficient) > 0.30 (Bland & Altman, 1997; Zijlmans et al., 2018).

EFA was mostly used to determine factor variances. The EFA factor loading is on Table B, Appendix 1.

**3.3. Confirmatory factorial analysis (CFA)**

The theoretical internal structure of the PCE-S (resulting from the adaptation of the CEQ) was tested by applying CFA using AMOS statistical software. Fig. 1 shows the path diagram of the improved model with the standardized estimates.

The initial model (see path diagram in Appendix 2, Figure A) metrics were as follow: chi-square [ $\chi^2$ ] = 602.65, degree of freedom [df] = 32,  $p < 0.001$ ;  $\chi^2/df = 18.83$ ; goodness-of-fit index [GFI] = 0.93; normed fit index [NFI] = 0.94; relative fit index [RFI] = 0.92; incremental fit index [IFI] = 0.95; Tucker-Lewis index [TLI] = 0.93,

comparative fit index [CFI] = 0.95; root mean square error of approximation [RMSEA] = 0.106; standardized root mean square residual [SRMR] = 0.044. The standardized regression weights (factor loadings) were between 0.68 and 0.92, being statistically significant ( $p < 0.001$ ). All these ratings are acceptable, except for chi-square (for which the p-value should be not significant), the  $\chi^2/df$  values (which should be under 5), and the RMSEA value (which would be  $\leq 0.080$ ) (Collier, 2020; Kline, 2005). For an acceptable model, the SRMR should be  $\leq 0.080$  (which is the case here); the other indicators should be  $> 0.90$  (acceptable model) and  $> 0.95$  (good model) (Collier, 2020; Kline, 2005).

After examining the modification indices, we improved the model by establishing covariances between the standardized errors. The improved model (see path diagram in Fig. 1) metrics were as follow:  $\chi^2 = 358.76$ ,  $df = 26$ ,  $p < 0.001$ ;  $\chi^2/df = 13.79$ ; GFI = 0.96; NFI = 0.97; RFI = 0.95; IFI = 0.97; TLI = 0.95; CFI = 0.97; RMSEA = 0.090; SRMR = 0.039.

After examining the standardized residual covariance (SRC) matrix of the improved model, we decided to try to improve the model again by eliminating item 8 (from the Intrusion factor), the only one that had an SRC value >2 (as recommended by Collier, 2020). The improved 9-item model (see path diagram in Appendix 2, Figure B) metrics were as follow:  $\chi^2 = 200.16$ ,  $df = 18$ ,  $p < 0.001$ ;  $\chi^2/df = 11.12$ ; GFI = 0.97; NFI = 0.98; RFI = 0.96; IFI = 0.98; TLI = 0.96; CFI = 0.98; RMSEA = 0.080; SRMR = 0.039.

**3.4. Sex (Male vs. Female) invariance tests**

To find out whether the factor structure of the scale is invariant to sex, a multi-group analysis was carried out from the first improved model (with all 10 items).

The configural invariance test showed an acceptable fit for the unconstrained model:  $\chi^2 = 387.04$ ,  $df = 52$ ,  $p < 0.001$ ;  $\chi^2/df = 7.44$ ; GFI = 0.95; NFI = 0.96; RFI = 0.94; IFI = 0.97; TLI = 0.95; CFI = 0.97; RMSEA = 0.091; SRMR = 0.039. The metric invariance test indicated that the meaning of the three modeled constructs (factors) did not change across groups ( $\chi^2$  change = 11.36,  $df = 7$ ,  $p = 0.124$ ).

**3.5. Concurrent validity**

Summing items on each factor gave PCE-S factor scores. PCE-S factor scores, CCU scores, FCU, and CUD were zero-order correlated. Table 3 reveals that all PCE-S factors are significantly correlated with the CCU score, the FCU, the CUD, the UPPS-P negative urgency, and the positive urgency.

**3.6. Discriminant validity**

Discriminant analyses tested whether scores on the PCE-S subscales discriminated between (a) the participants with low CCU scores (first quartile, CPU scores  $\leq 1.63$ ;  $n = 403$  [males = 168, females = 224, non-binarys = 11]). and (b) the participants with high CCU scores (fourth quartile, CCU scores  $\geq 3.13$ ;  $n = 348$  [male = 246, female = 96, non-

binary = 6]).

The descriptive statistics for the CCU score was as follow: scale = 1–5 points; range = 0–4; mean = 2.44 (SD = 0.93); median = 2.37. The Percentiles were: 25 % = 1.63, 50 % = 2.38; 75 % = 3.13.

Fig. 2 summarizes graphically the results of this analysis. One significant discriminant function explained the overall relationship between the grouping and response variables. Factors distinguished between participants with low CCU scores and participants with high CCU scores. This function explained 61 % of between-group variance,  $\chi^2 = 351.14$ ,  $df = 3$ ,  $p < 0.001$ . Participants with low CCU scores were classified more successfully (83.1 % of cases) than participants with high CCU scores (77.0 % of cases). All three PCE-S factors were discriminated significantly between participants with low CCU scores and participants with high CCU scores: Intrusion ( $F[1, 749] = 331.54$ ,  $p < 0.001$ ) was the most powerful discriminator, followed by Intensity ( $F[1, 749] = 302.97$ ,  $p < 0.001$ ) and Imagery ( $F[1, 749] = 231.60$ ,  $p < 0.001$ ). The structure coefficient matrices showed that the three factors were highly correlated with the discriminant functions ( $r = 0.72$ ;  $r = 0.16$  [imagery];  $r = 0.82$ ;  $r = 0.46$  [intensity];  $r = 0.86$ ;  $r = 0.89$  [intrusion]).

### 3.7. Sex, CCU, and PCE-S

When participants were split into quartiles, there was a statistically significant difference between the number of males and females present in each group,  $\chi^2[3] = 73.3$ ,  $p < 0.001$ . Fig. 3 summarizes graphically the results of this analysis. Figure C (in Appendix 2) presents the mean PCE-S score for participants within each quartile of the CCU. As can be seen in this Fig. 3, the number of females is greater than the number of males in the first quartile; conversely, in the fourth quartile, the number of females is lower than the number of males.

We predicted CCU (mean-centered) from Sex and the three PCE-S subscales using only male and female data. Table 4 displays the standardized regression coefficients and statistical significance for each predictor (Sex, the three PCE-S subscales).

Sex was not a statistically significant predictor. In the contrary, the PCE-S subscales were significant predictors. Overall, these variables and

the regression predicted 27.8 % of the variance in CCU.

## 4. Discussion

After improvement, the PCE-S theoretical construct structure (3 factors, 10 items) fits most significant CFA indices. The  $X^2/df$  and RMSEA values passed the goodness criterion of  $< 5$  and  $\leq 0.080$  (Collier, 2020; Kline, 2005). The 9-item model showed a good RMSEA, but the remaining indices did not improve ( $X^2/df = 11.12$ ). The CFA validated the theoretical construct of the PCE-S in its 10-item version, as the original scale ACE (Statham et al., 2011) had  $X^2$  p-value and RMSEA metrics above the goodness requirement ( $p < 0.001$  and 0.108, respectively;  $X^2/df$  not published). The reason all indices except  $X^2$  and  $X^2/df$  indicate a good fit needs further examination. This PCE-S structure with its three factors related to Imagery, Intensity, and Intrusion has also allowed covering important elements constituting the craving (Kavanagh et al., 2013).

The reliability, concurrent, and discriminant validity statistics showed that the PCE-S has good psychometric properties. Particularly, the three constructs related to Imagery, Intensity, and Intrusion are positively and significantly correlated with three measures of the participant’s cyberporn use: frequency, duration, and compulsive use (FCU, CUD, CCU). This PCE-S three constructs also successfully discriminated participants with high CCU from those with low CCU. Moreover, PCE-S scores predicted the variance of the CCU. The literature advanced that addiction craving is characterized by sensory imagery (May et al., 2004). Some authors have previously suggested the prediction of alcohol use by the Imagery items using the ACE Imagery items (Connor et al., 2014). More specifically and concerning behavioral addictions, a recent systematic review reported links between craving and the gambling use (Mallorquí-Bagué et al., 2023). Furthermore, craving seemed to predict the severity of the gambling disorder as well as its episodes. The present study reports the close links between craving and addictive cyberporn use. These associations are only very little studied in the literature or studied with measures less specific to the craving and to the cyberporn such as the PCQ. The present results with the development of the PCE-S,

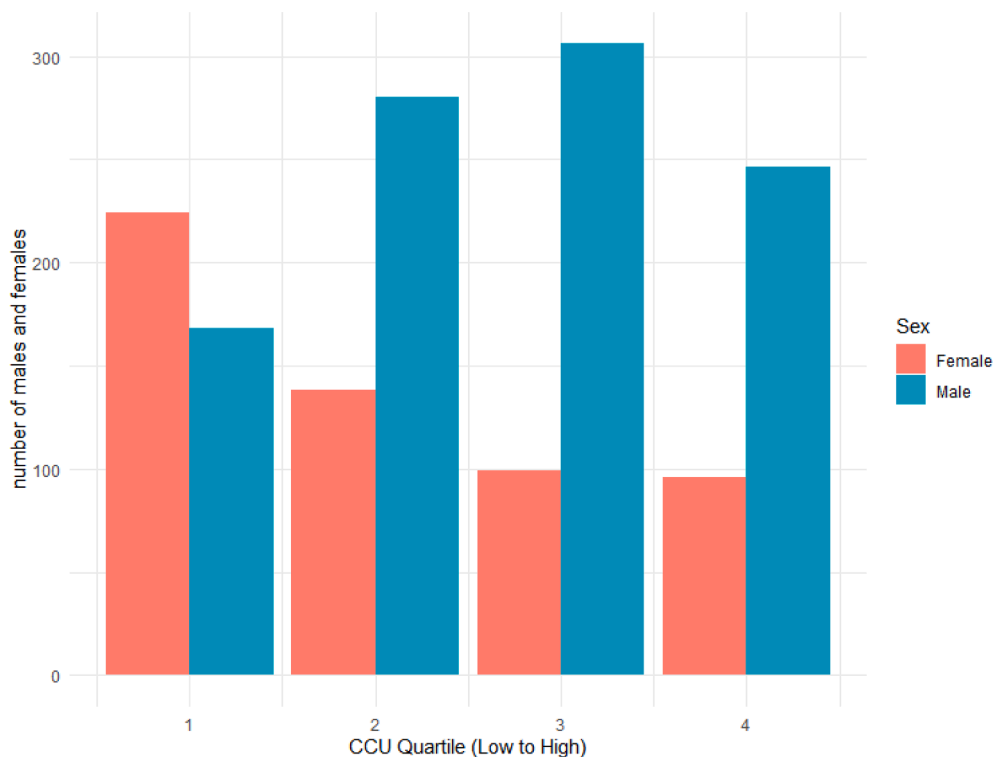


Fig. 3. Number of participants in each CCU quartile by sex. NB: color should be used for this figure in print.

allow for better assessment of the craving role in addictive cyberporn based on the Elaborated Intrusion theory of desire. They highlight the association between craving (with its three constructs of Imagery, Intensity, and Intrusion) and addictive cyberporn.

Pornography craving scores were positively and significantly linked with negative and positive urgency in the study. Negative urgency is the tendency to respond rashly in reaction to an intense negative affect. Positive urgency is the tendency to respond rashly when reacting to intense positive affect (Cyders & Smith, 2008). Urgency and tobacco cravings were positively correlated in previous studies (Billieux, Van der Linden, & Ceschi, 2007). Negative urgency increased gambling craving (Mallorquí-Bagué et al., 2023). Impulsivity and pornography are controversially linked in the literature. In their review of the literature, Bóthe et al. (2019) found a weak to moderate link between impulsivity and pornography's frequency of use and motives. The present study suggests another understanding approach by linking pornography craving to negative and positive urgency impulsivity. These correlations and the dynamic interactions between craving and addictive porn use need additional investigation.

The present study benefits from a large cohort of participants used to cyberporn assessed with the pornography-specific PCE-S. Therefore, it proposes items adapted to porn use. This brief, theory-based measure can be used clinically and for research. The PCE-S may help explain how craving patterns, context, and porn use connect. The PCE-S may aid in targeting interventions and assessing potential treatments. It allows, in the research settings, for a more precise assessment of craving dimensions, including the intrusion and imagery elaboration dimensions added by this theory (Brandtner, Antons, Cornil, & Brand, 2021), in addictive cyberporn. The results may facilitate integrating such dimensions in clinical settings, in the development, assessment, or strategies aiming to increase craving dimensions awareness. Also, in training for craving-competitive visuo-spatial activities (May, Kavanagh, & Andrade, 2015) such as Tetris game as suggested by some reports (Skorka-Brown, Andrade, Whalley, & May, 2015). Furthermore, factors influencing the automatic and motivational experience of craving, its recurrence and maintenance such as specific cues, desire thinking processes (a perseverative, conscious, and intentional process) (Marino et al., 2023), and possibly positive and negative metacognitions (Allen, Kannis-Dymand, & Katsikitis, 2017) about craving should be investigated in research and clinical settings. In the present study, we asked participants about their last month's craving experiences to capture their current craving experience. To better capture dynamic connections between diverse phenomena and addictive porn use patterns, future studies may re-assess craving using the PCR-S at different times.

## 5. Limitation

This study was cross-sectional. Thus, it was not intended to examine the PCE-S construct structure's reliability and validity over time. These features need more investigation.

## 6. Conclusions

The PCE-S represents a specific and brief pornography craving experience instrument scale. It is also based on the Elaborated Intrusion theory of desire. Results showed that the PCE-S items are able to capture key constructs of the theory and correlate with measures of addictive cyberporn use.

### Author credit statement:

Conceptualization: YK. Investigation: FBB, JM, YK, and RC. Formal analysis: GVC. Writing-original draft: GVC and FBB. Writing-review & editing: all authors.

### Declarations:

### Ethics approval and consent to participate:

Participants gave digital informed consent for their survey contribution. Participation was voluntary and restricted to those aged  $\geq 18$

years. All data was anonymously collected. The survey was conducted in accordance with the Research Ethics Committee of Tours-Poitiers in France (no. 2020-04-05).

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The material, the data, and the R code supporting the present study findings are available on the Open Science Framework repository at the following link: <https://osf.io/mt6re/>.

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## Appendix A. Supplementary materials

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2023.107858>.

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