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**Running Head:** Measuring Pornography Craving

**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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Highlights:

- Craving is now acknowledged as a fundamental feature of addictive behaviors.
- There is a lack of an approved measure for assessing the pornography craving experience.
- The Strength of Pornography Craving Experience (PCE-S) is based on the Elaborated Intrusion theory of desire and appears to reflect major theory elements.
- The PCE-S is associated with compulsive cyberporn use assessments.

## **Strength of Pornography Craving Experience (PCE-S): psychometric properties of a new measure based on the Elaborated Intrusion theory of desire**

### **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 to 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.

**Keywords:** craving, pornography craving, compulsive cyberporn, pornography problematic use.

## **1. Introduction**

Cyberporn, or online pornography, is growing rapidly. It's the most common cybersexual activity (Fisher & Barak, 2001; Ross et al., 2012). Cyberporn can become addictive, making it a risky Internet activity (Brand et al., 2020; De Alarcón et al., 2019; Koós, 2022; Müller, 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.

Early investigations described problematic online sexual activity with an exaggerated use duration despite its negative effects (Cooper et al., 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 et al., 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 et al., 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 (American Psychiatric Association, 2013) criterion for substance use disorder diagnosis (Cornil et al., 2019; Mallorquí-Bagué et al., 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 underlies the Alcohol Craving Experience Questionnaire (ACE) (Statham et al., 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 et al., 2010, 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 et al., 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 et al., 2022).

### **2.3 Ethics**

The Research Ethics Committee of (anonymized) 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: 0h to 40h), 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 et al., 2019; Meerkerk et al., 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 et al., 2019; Varfi et al., 2019). In this 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 et al., 2013; Devos et al., 2020; Kim et al., 2022; Wéry et al., 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 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) – Figure 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 – Figure 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 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.

[Insert Table 1 here]

Tests of univariate normality indicated that all items were normal, except item 8 which was slightly right skewed (skewness = .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 = .876 (a value greater than 0.8 can be considered good); Bartlett's test of sphericity  $X^2(45) = 11183.65$ ,  $p = <.001$ . 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.

[Insert Table 2 here]

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 greater than 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. Figure 1 shows the path diagram of the improved model with the standardized estimates.

[Insert Figure 1 here]

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 Figure 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 greater than 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 ( $X^2$  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.

[Insert Table 3 here]

### **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-binary = 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=.93); median = 2.37. The Percentiles were: 25% = 1.63, 50% = 2.38; 75% = 3.13.

[Insert Figure 2 here]

Figure 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,  $\chi^2 = 351.14$ ,  $df = 3$ ,  $p < .001$ . 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 ( $F[1, 749] = 331.54$ ,  $p < .001$ ) was the most powerful discriminator, followed by Intensity ( $F[1, 749] = 302.97$ ,  $p < .001$ ) and Imagery ( $F[1, 749] = 231.60$ ,  $p < .001$ ). The structure coefficient matrices showed that the three factors were highly correlated with the discriminant functions ( $r = .72$ ;  $r = .16$  [imagery];  $r = .82$ ;  $r = .46$  [intensity];  $r = .86$ ;  $r = .89$  [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,  $\chi^2[3] = 73.3$ ,  $p < .001$ . Figure 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 Figure 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.

[Insert Figure 3 here]

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).

[Insert Table 4 here]

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.

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, 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 et al., 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 et al., 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 et al., 2015) such as Tetris game as suggested by some reports (Skorka-Brown et al., 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 et al., 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.

## **Abbreviations**

PCE-S = Pornography Craving Experience – Strength form.

ACE = Alcohol Craving Experience questionnaire.

ACE-S = Alcohol Craving Experience questionnaire - Strength form

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.

## 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 ([anonymized](#)).

**Availability of data and materials:** 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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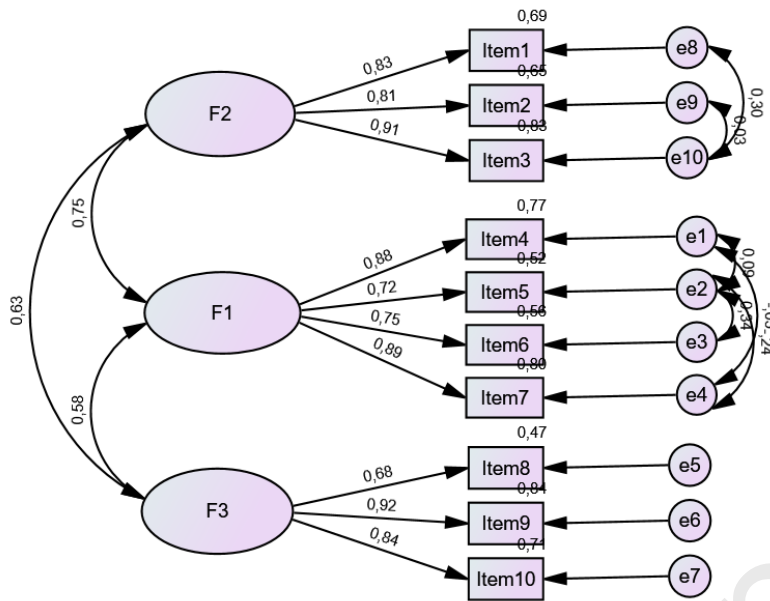
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## FIGURES

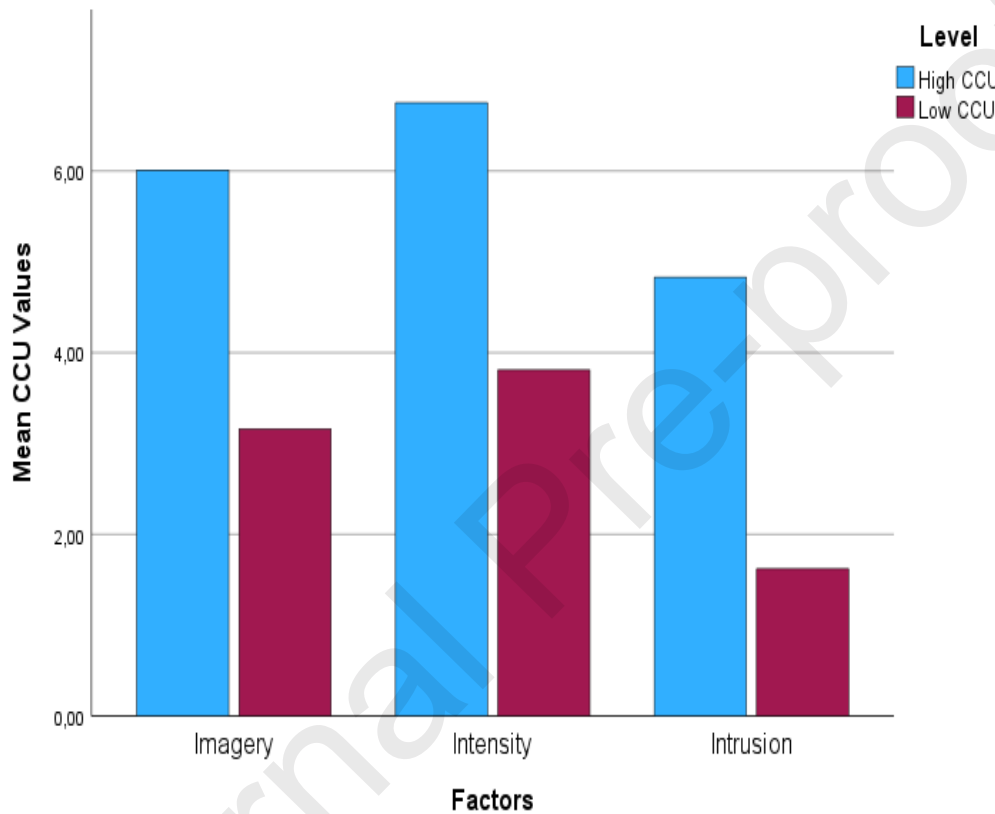
**Figure 1.** The CFA path diagram of the first improved model (10 items) with the standardized estimates



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 are the correlations. The values on the arrow linking the each of the three factors to the corresponding items are the factors loadings (standardized estimates). The factor loadings indicate how well each item is representative of its unobservable construct (factor). Its values go from 0 to 1. The values on top of each rectangle are the square of the standardized factor loadings; they give the proportion of the explained variance (R<sup>2</sup>) 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.

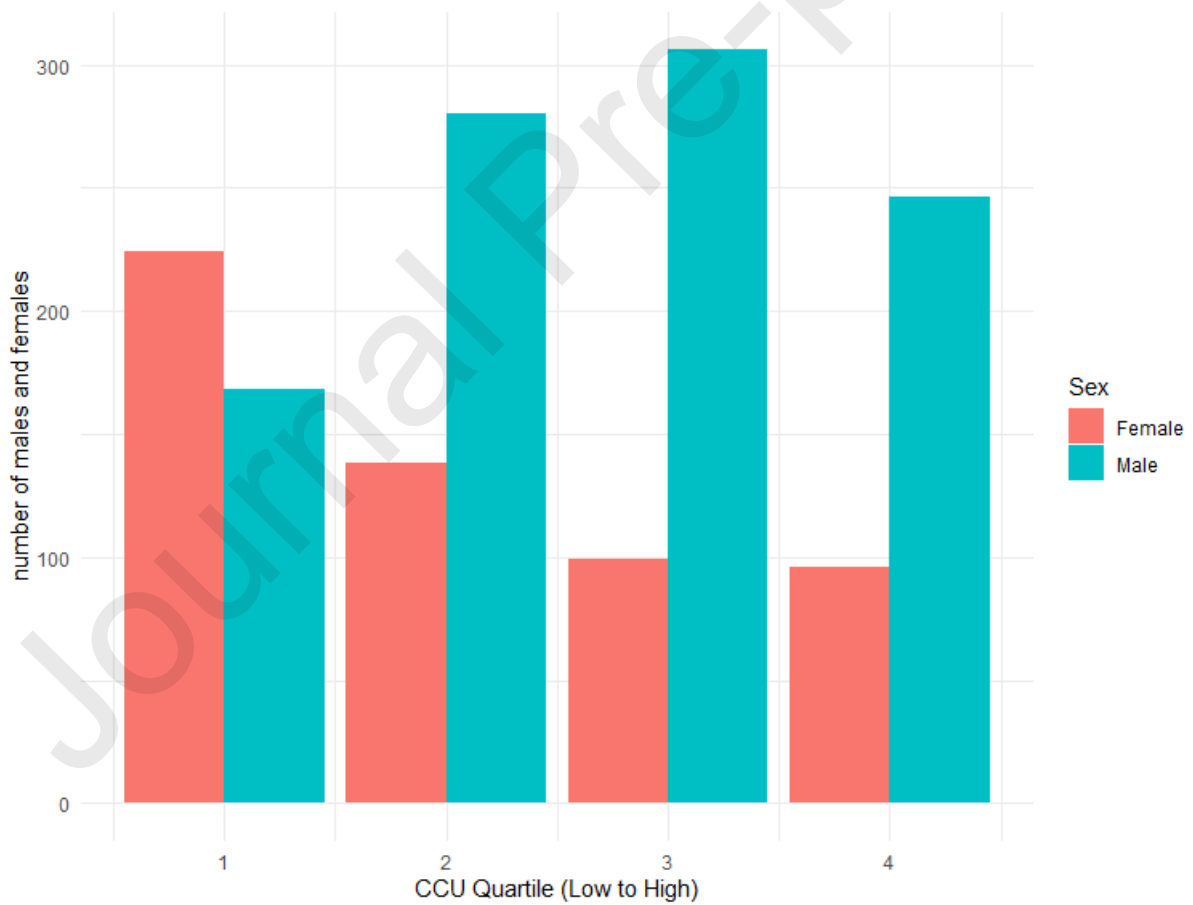
**Figure 2.** Mean scores for participants with lower risk of CCU and higher risk on Imagery, Intensity and Intrusion for Pornography Craving Experience–Strength (PCE-S).



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.

**Figure 3.** Number of participants in each CCU quartile by sex



NB: color should be used for this figure in print.

## TABLES

**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 | -.326    | -1.005   |
| Item 5: At that time, how vividly did you hear yourself doing it?                         | 0-10  | 3.39 | 3.09 | .481     | -.971    |
| Item 6: At that time, how vividly did you imagine your emotional feelings while doing it? | 0-10  | 4.15 | 3.18 | .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 | -.498 | -.796 |
| <b>Factor 2: Intensity</b>   |      |      |      |       |       |
| Item 1: At that time, how much did you want it?                                      | 0-10 | 6.16 | 2.50 | -.562 | -.112 |
| Item 2: At that time, how much did you need it?                                      | 0-10 | 4.41 | 2.88 | .093  | -.912 |
| Item 3: At that time, how strong was the urge to have it?                            | 0-10 | 5.71 | 2.75 | -.363 | -.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 | .925  | -.117 |
| Item 9: At that time, how intrusive were the thoughts?                               | 0-10 | 3.54 | 3.08 | .442  | -.974 |
| Item 10: At that time, how hard was it to think about anything else?                 | 0-10 | 3.58 | 3.13 | .448  | -.993 |

SD = standard deviation

**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</math> = 0.89)</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</math> = 0.90)</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                                       |



|           |        |        |        |        |        |        |        |        |       |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 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* |

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

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

UPPS-P urgency = Negative + Positive urgency combined score

**Table 4.** Predicting CCU score from Sex and PCE-S scales

|               | <b>Estimate</b> | <b>Std.Error</b> | <b>t</b> | <b>p</b> |
|---------------|-----------------|------------------|----------|----------|
| (Intercept)   | 1.52            | 0.07             | 21.996   | <.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     | <.001    |
| Intrusion     | 0.1             | 0.01             | 8.499    | <.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    |

## APPENDIX

Appendix 1**Table A.** Number of participants by region of residence

| <b>Continents</b> | <b>Country of residence<br/>(From 47 different nationalities)</b> | <b>N</b> | <b>%</b> |
|-------------------|---|----------|----------|
| America           | Canada  | 78       | 4.4      |
|                   | Chile   | 3        | 0.2      |
|                   | Mexico  | 6        | 0.3      |
|                   | United States   | 461      | 26.0     |
|                   | Belgium   | 1        | 0.1      |
|                   | Czech Republic  | 1        | 0.1      |
|                   | Estonia   | 2        | 0.1      |
|                   | Hungary   | 5        | 0.3      |

|                   |                |     |      |
|-------------------|----------------|-----|------|
| Europe            | Ireland        | 22  | 1.2  |
|                   | Italy          | 8   | 0.5  |
|                   | Netherlands    | 6   | 0.3  |
|                   | Poland         | 12  | 0.7  |
|                   | Portugal       | 8   | 0.5  |
|                   | Slovenia       | 3   | 0.2  |
|                   | Spain          | 6   | 0.3  |
|                   | Sweden         | 1   | 0.1  |
|                   | Switzerland    | 2   | 0.1  |
|                   | United Kingdom | 807 | 45.6 |
| Rest of the world | South Africa   | 116 | 6.5  |
|                   | New Zealand    | 15  | 0.8  |
|                   | Korea          | 1   | 0.1  |
|                   | Australia      | 25  | 1.4  |
|                   | Latvia         | 1   | 0.1  |

Note: the information in this table was based on the 1590 participants who indicate the country where they lived and their nationalities.

**Table B.** EFA: factor loading for each item

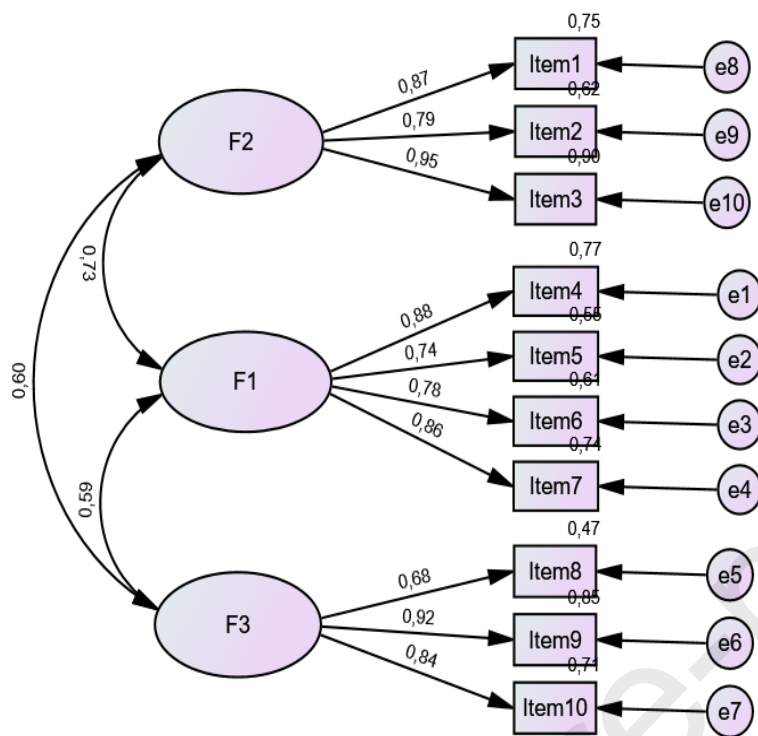
| Items   | Factors |           |           |
|---|---------|-----------|-----------|
|   | Imagery | Intensity | Intrusion |
| Item 4: At that time, how vividly did you picture doing it?                               | .82     |           |           |
| Item 5: At that time, how vividly did you hear yourself doing it?                         | .73     |           |           |
| Item 6: At that time, how vividly did you imagine your emotional feelings while doing it? | .75     |           |           |
| Item 7: At that time, how vividly did you imagine the physical feelings of doing it?      | .80     |           |           |
| Item 1: At that time, how much did you want it?   |         |           | .43       |
| Item 2: At that time, how much did you need it?   |         |           | .35       |
| Item 3: At that time, how strong was the urge to have it?                                 |         |           | .42       |
| Item 8: At that time, how hard were you trying not to think about it?                     |         | .68       |           |
| Item 9: At that time, how intrusive were the thoughts?                                    |         | .57       |           |



|  |  |     |  |
|--|--|-----|--|
| Item 10: At that time, how hard was it to think about anything else? |  | .44 |  |
|--|--|-----|--|

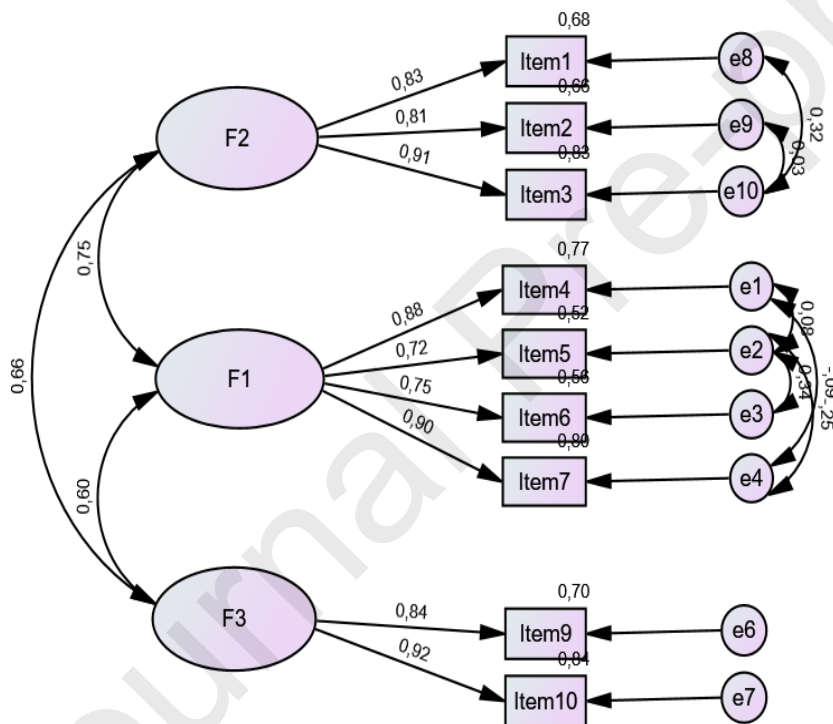
## Appendix 2

**Figure A.** The path diagram of the initial CFA model with the standardized estimates



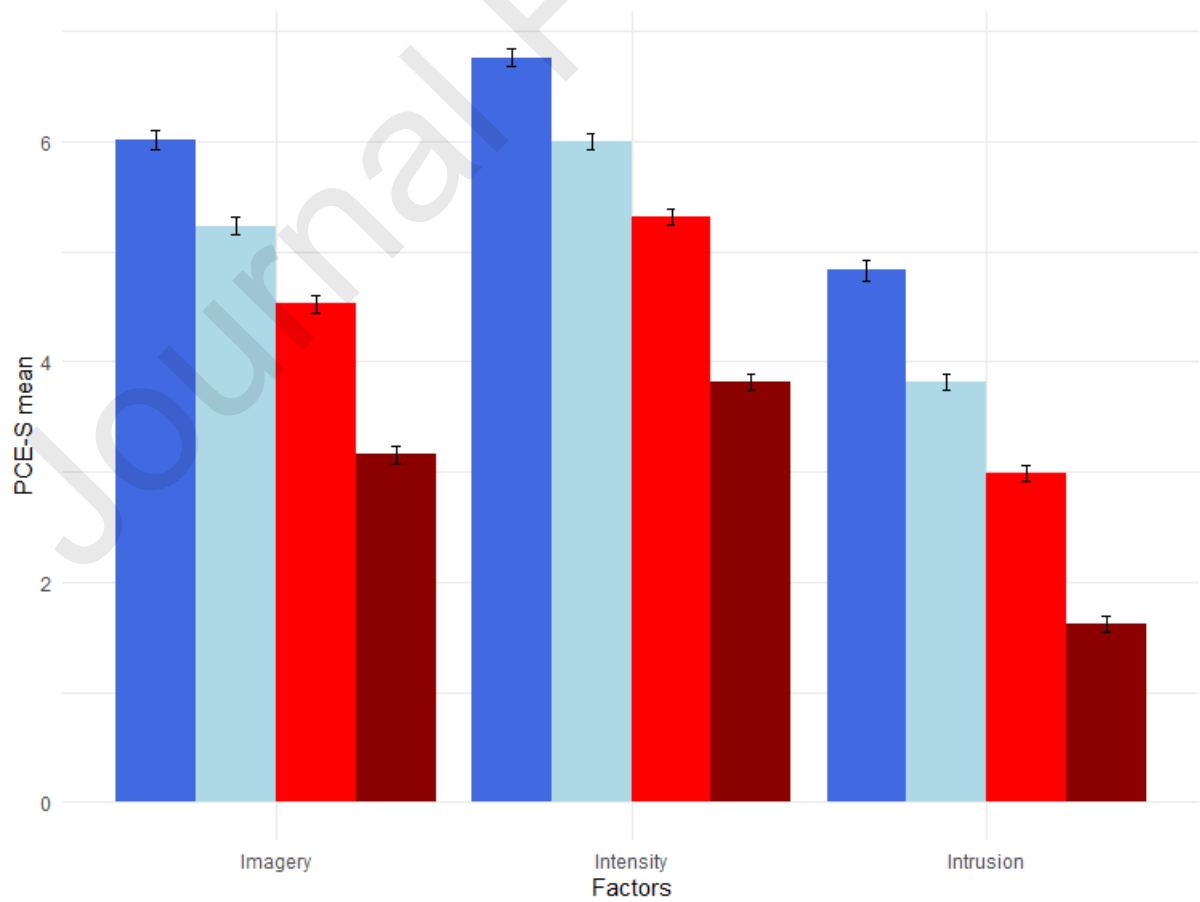
Confirmation factor analysis of the questionnaire. The ellipses represent the factors and the rectangles represent the different items. The residual variances are shown in the small circles.

**Figure B.** The CFA path diagram of the improved model with one item (item 8) deleted 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.

**Figure C.** The mean PCE score for participants within each quartile of the CCU



**Author Credit Statement**

Initial Conception of the study: YK. Conception of the survey and writing of the questions: FBB, JM, YK, and RC. Data analysis: GVC. First draft: GVC and FBB. Final draft: All authors

**Conflicts of Interest:**

The authors do not have any conflicts of interest to report.

**Declaration of Interest Statement:**

None