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**Symptoms of Problematic Pornography Use in a Sample of Treatment Considering and Treatment Non-Considering Men: A Network Approach**

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### Abstract

*Background:* Pornography use may become problematic for 1 to 6% of the people and may be associated with adverse consequences leading to treatment-seeking behavior. Although the identification of the central symptoms of problematic pornography use (PPU) may inform treatment strategies, no prior study has applied the network approach to examine the symptoms of PPU.

*Aim:* The aims of the present study were to explore the network structure of PPU symptoms, identify the topological location of pornography use frequency in this network, and examine whether the structure of this network of symptoms differs between participants who considered and those who did not consider treatment.

*Methods:* A large-scale online sample of 4,253 men ( $M_{\text{age}} = 38.33$  years,  $SD = 12.40$ ) was used to explore the structure of PPU symptoms in two distinct groups: Considered treatment group ( $n = 509$ ) and Not considered treatment group ( $n = 3,684$ ).

*Outcomes:* Participants completed a self-report questionnaire about their past-year pornography use frequency and PPU measured by the short version of the Problematic Pornography Consumption Scale (PPCS-6).

*Results:* The global structure of symptoms did not differ significantly between the Considered treatment and the Not considered treatment groups. Two clusters of symptoms were identified in both groups, with the first cluster including salience, mood modification, and pornography use frequency, and the second cluster including conflict, withdrawal, relapse, and tolerance. In both groups' networks, salience, tolerance, withdrawal, and conflict appeared as central symptoms, while pornography use frequency was the most peripheral symptom. However, mood modification had a more central place in the Considered treatment group's network and a more peripheral position in the Not considered treatment group's network.

*Clinical Translation:* Based on the results of the centrality analysis in the Considered treatment group, targeting salience, mood modification, and withdrawal symptoms first in the treatment may be an effective way of reducing PPU.

*Strengths & Limitations:* The present study appears to be the first to analyze the symptoms of PPU using a network analytic approach. Self-reported measures of PPU and pornography use frequency might have introduced some biases.

*Conclusion:* The network of PPU symptoms was similar in participants who did and those who did not consider treatment because of their pornography use, with the exception of the mood modification symptom. Targeting the central symptoms in the treatments of PPU seems to be more effective than focusing on reducing pornography use.

*Keywords:* network analysis; network of symptoms; pornography use frequency; problematic pornography use

## Introduction

Pornography consumption among young adults, adolescents, and even among pre-adolescent children has started to increase in the past decades—presumably due to the widespread access to the internet [1,2]. Based on findings of nationally-representative studies from Norway [3], Australia [4], and the US [5] with adult populations, 70 to 90 % of participants reported having ever viewed pornography in their lifetime, while 69 to 76% of men and 33 to 41% of women used pornography in the past year. However, only 4 to 6% of men and 1 to 2% of women reported having felt addicted to pornography [4,5]. Although pornography use may have little or no adverse effect on most people’s lives, it may become problematic for some and may result in severe adverse consequences (e.g., job loss, problems in romantic relationships [6–8]) leading to treatment-seeking behavior among men and women as well [9,10].

Although Compulsive Sexual Behavior Disorder (CSBD) was included in the 11th edition of *International Statistical Classification of Diseases and Related Health Problems* (ICD-11) [11], there is no official diagnostic criteria or definition for problematic pornography use (PPU) [12,13]. Given that PPU is often considered as a manifestation of CSBD [12,14], PPU may be described as a persistent pattern of uncontrollable, intense, and repetitive pornography use despite significant distress and impairment in diverse areas of functioning, such as relationship disturbances or occupational problems [15,16]. Despite the growing number of scientific studies in the field of CSBD research [17–21], it cannot be conclusively determined whether CSBD should be considered as an impulsivity-related, compulsivity-related, or addictive disorder [22–25].

To gain more insight about the network structure of PPU symptoms and provide a basis for potential future intervention strategies, the aims of the present study were to (a) explore the network structure of PPU symptoms, (b) identify the topological location of pornography use

frequency in this network, and (c) examine whether the structure of this network of symptoms differs between participants who considered seeking treatment for pornography use and those who did not report such considerations. The identification of most central symptoms of PPU should inform treatment strategies that aim to reduce problematic aspects of using pornography [26,27].

*A Brief Introduction to Network Analysis in the Context of Problematic Sexual Behaviors*

The conventional model of psychopathology posits that there is a common cause—a latent disorder—that determines the symptoms. At the same time, the network approach suggests that disorders may rather be described as complex systems of connected symptoms that have direct interactions with each other [26,27]. In this approach, symptoms are represented as nodes that are connected by edges. If there are strong connections between the symptoms (i.e., nodes), they will tend to show highly synchronized behaviors<sup>1</sup>. In addition, groups or ‘communities’ of symptoms (that are more strongly related to each other than to other symptoms) can be identified, which enables more detailed insight into activation pathways within a network of symptoms. To summarize, the presented network analytic approach can: (a) elucidate the structure of symptoms of a specific disorder, (b) identify core symptoms, and (c) explore the clustering of symptoms which would inform and guide (e.g., by focusing on core or bridging symptoms) treatment strategies to reduce the disorder and achieve a healthy state [26,27].

To the best of the authors’ knowledge, no prior study has applied the network approach to examine the symptoms of PPU. Nevertheless, a recent pioneering study conducted among more than 3,000 Croatian men and women investigated the network of hypersexuality symptoms,

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<sup>1</sup> To estimate networks, different methods can be applied. There are models that in which edges represent partial correlations between two nodes after conditioning on all other nodes in the network [54], thus, negative associations may be present between the nodes, while there are other networks in which edges are not partial correlations but are simply represented by 0 (not present) or 1 (present).

including relevant sexual behaviors, such as pornography use frequency [28]. The findings suggested that psychological distress, negative emotions, and loss of control relating to sexual urges, feelings, and behaviors occupied a central position (i.e., were core symptoms) in the network, and the identified network was highly similar in men and women. Interestingly, the frequency of pornography use was a peripheral symptom in the hypersexuality network, which is in line with the findings of a largescale survey study reporting that individuals' online pornography use frequency had positive, but an only weak association with their levels of hypersexuality [29]. In sum, although network analysis may provide a novel approach to identify the most important targets for interventions treating different psychiatric disorders or problematic behaviors [26,27], its application regarding problematic sexual behaviors is still in its infancy. Thus, the present study, as well as the previously described network study on hypersexuality [28], may serve as potential illustrations of the usefulness of this approach for future studies in the field of problematic sexual behaviors.

#### *Core and Peripheral Symptoms of PPU*

Based on the components model of addiction [30] and in accordance with the diagnostic guidelines of CSBD [31], PPU includes six dimensions [32,33]. *Salience* refers to the importance of pornography use in one's life and how it may impact their lives by significantly dominating their thinking, feelings, and behaviors [34]. *Tolerance* describes the need for a gradual increase in pornography use to reach the same level of prior satisfaction. *Mood modification* concerning pornography use refers to its use in reducing negative feelings, emotions, and stress [34–36]. *Conflict* describes the intraindividual and interpersonal problems that appear as a result of pornography use, such as feelings of lower self-esteem, loneliness, or problems in relationships with important people in one's life [6,34,36,37]. *Withdrawal* refers to the psychological or physiological symptoms that appear in the absence of pornography use, such as the experience of



mental distress [6,36]. *Relapse* refers to the control problems related to pornography use when individuals try to reduce or stop their pornography use, but their attempts are unsuccessful, and they return to previous behavioral patterns of pornography use [34,36].

Based on Griffiths' suggestions [30,38], all the components/symptoms mentioned above should be present in the case of problematic behaviors (or addictions), such as PPU (see [39]). However, as some authors suggested, some of these components may be more important than others when pathological versus high-engagement in a given activity is examined [40–42]. More specifically, some symptoms should be considered as “core” symptoms of problematic or pathological behaviors, while others are “peripheral” symptoms or those that may also be present in the case of frequent but non-problematic use [40–42]. The conflict, relapse, and withdrawal components may be considered as the core symptoms, while salience, tolerance, and mood modification are considered to be the peripheral symptoms of problematic/pathological behaviors [40]. The peripheral symptoms may be present in the case of problematic behaviors and high-engagement in the given activities as well, while the core criteria may only be present in problematic behaviors [41]. In other words, individuals with high engagement towards a given activity may experience salience, tolerance, and mood modification symptoms, but not conflict, relapse, and withdrawal. In contrast, individuals with problematic use may report all the aforementioned symptoms [41]. Moreover, when only the peripheral symptoms are present (i.e., high engagement), no major adverse consequences may be observed, and the individual rather experiences enjoyment in relation to the activity. However, when both the core and peripheral symptoms are present, it is more likely that adverse and harmful consequences would occur in one's life [40–42].

It is important to note that the studies above conceptualized mood modification as euphoria (i.e., positive reinforcement or pleasure as a result of the given behavior [40]), while

Griffiths' component model emphasizes the negative aspects of mood modification (i.e., using the given activity to cope with negative emotional states) [30,38]. Therefore, it may be assumed that conflict, relapse, and withdrawal will take more central positions, while salience, tolerance, and mood modification will appear as more peripheral symptoms in the PPU network.

#### *The Role of Frequent Pornography Use in PPU Symptomatology*

Although the quantity of pornography use (i.e., frequency of use or time spent using pornography) may be considered as an essential correlate of PPU, recent results suggest that it may not be a reliable indicator or symptom of PPU in itself [43,44]. The differentiation between the frequency of pornography use and PPU has started to emerge in the past few years as clinicians and researchers realized that the high frequency of pornography may not always be associated with PPU, as well as that self-reported PPU may be present with a relatively low frequency of pornography use as a result of moral incongruence towards pornography use [44–46]. Both variable-centered and person-centered statistical approaches in cross-sectional and longitudinal settings suggest that PPU and the frequency of pornography use are related, but that the associations are small to moderate in size [8–10,33,43,44,47]. These findings indicate that the two phenomena are similar to strong sexual desire and high sexual frequency on the one hand and hypersexuality, on the other hand [48]. Therefore, it may be hypothesized that the frequency of pornography use will be positioned as a peripheral symptom in the PPU network. However, it is possible that the network position of pornography use will be different in individuals who considered treatment, relative to those who did not consider treatment for pornography use [9,10,49].

#### *Current Study*

The first aim of this data-driven study was to explore the network of PPU symptoms, which was operationalized based on the components model of addiction [30]. Based on the

literature on problematic online activities [40–42], we hypothesized that conflict, relapse, and withdrawal would take more central positions, while salience, tolerance, and mood modification would be positioned more peripherally in the PPU network.

The second aim was to identify the location of the frequency of pornography use in the symptoms network. Based on previous studies with various analytical approaches [33,43,44,50], we hypothesized that pornography use frequency would appear as a peripheral element of PPU. Finally, although prior findings suggest higher pornography use frequency in individuals interested in treatment for pornography use [9,10,49], it did not provide any insight into how pornography use frequency may be located in their PPU network of symptoms, compared to individuals who did not consider such treatment. Also, the location of problematic pornography use symptoms in these groups has never been examined and compared. Thus, we treat the issue of the network invariance across two groups of participants—those who considered a treatment for problematic pornography use and their peers who never considered it—as a research question to explore.

## **Material and Methods**

### *Procedure and Participants*

Data collection occurred on a popular Hungarian news portal via an online survey from May to July in 2019. The study was advertised as a research project about different sexual behaviors, including solo and partnered sexual activities as well. The survey took approximately 25-30 minutes to complete. Participants were informed about the aims of the study and potential compensation (i.e., participants had a chance to win 15 gift cards in a value of 40 USD each). Informed consent was obtained from the participants before data collection, and they were ensured about their anonymity. No personal information that may allow identification was asked

and a secure online platform (*Qualtrics Research Suite*) was used for data collection.<sup>2</sup> Out of 12,026 individuals who accepted to participate in the study, 55 were excluded for inconsistent response patterns, 5,389 quit before completing any pornography use-related questions, 212 indicated that they did not use pornography in the past year, 204 did not complete the Problematic Pornography Consumption Scale, and 54 reported being currently or had been treated for their pornography use<sup>3</sup>. Due to their low number, participants who have been treated or are currently in treatment for pornography use were omitted from the present analyses. Therefore, 6,112 participants met the criteria mentioned above (69.6% male, 30.1% female, and 0.3% indicated the “other” category). Due to their small proportion in the sample, especially in the considering treatment group (58 women, 0.9%), women were excluded from the analysis. The sample was further split into two groups—participants who responded they were thinking about seeking help for their pornography use ( $n = 509$ ) and the participants who did not consider treatment-seeking ( $n = 3,684$ )<sup>4</sup>.

Overall, the sample consisted of 4,253 men aged between 18 and 76 years ( $M_{\text{age}} = 38.33$  years,  $SD = 12.40$ ). Regarding place of residence, 2,036 lived in the capital (47.9%), 1,750 in a town (41.2%), and 467 in a village (11.0%). As for the level of education, 66 had a primary level of education or less (1.6%), 207 had a vocational degree (4.9%), 1,328 had a high school degree (31.2%), and 2,652 had a college or university degree (62.4%). Regarding relationship status, 1,202 were single (28.3%), 3,022 were in any kind of romantic relationship (i.e., being in a

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<sup>2</sup>Participants who wanted to participate in the prize draw had to provide their email address. However, their email addresses and responses were stored in separate files; therefore, it was not possible to connect their email address to their responses. Data were processed completely anonymously in accordance with the General Data Protection Regulation (GDPR) (EU) 2016/679.

<sup>3</sup>Participants (51 men, 94.4%) who were currently or had been treated for their pornography use reported an average score of 3.56 ( $SD = 1.63$ ; range: 1-7) on the PPCS-6.

<sup>4</sup> A total of 60 participants did not answer the question about treatment-seeking, thus, they were not included in the present analyses.

relationship, engaged, or married) (71.1%), and 32 indicated the “other” option (0.8%).

Regarding past-year pornography use, participants watched online pornography two to three times a week and reported spending 28.32 minutes with it per each session ( $SD = 22.54$ ) (Table 1).

This study was conducted following the Helsinki Declaration and was approved by the Institutional Ethical Review Board of the related university. Informed consent was obtained from the participants. Before presenting the pornography-related measures, a previously established definition of pornography was presented following recent recommendations [51,52]:

*“Pornography is defined as material (e.g., text, picture, video) that (1) creates or elicits sexual feelings or thoughts and (2) contains explicit exposure or descriptions of sexual acts involving the genitals, such as vaginal or anal intercourse, oral sex, or masturbation.”* [33].

### *Measures*

#### **Short Version of the Problematic Pornography Consumption Scale (PPCS-6 [39]).**

The PPCS-6 assesses PPU via six items with one item per each component [33]: salience, tolerance, mood modification, relapse, withdrawal, and conflict. The PPCS-6 was developed based on the original, long version of the Problematic Pornography Consumption Scale (PPCS-18) [33] by selecting the most adequate items from each factor considering both theoretical and statistical approaches [39]. The PPCS-6 had positive, strong associations ( $r$ s ranging from .96 to .97) with the PPCS-18 in three independent samples, and its validity was also established with such constructs as the frequency of pornography use, pornography use duration, masturbation frequency, and hypersexuality [39]. Participants indicated their answers on a seven-point Likert scale (1 = never; 7 = very often) regarding the past six months. The PPCS-6 demonstrated adequate reliability in the present study ( $\alpha = .84$ ).

**Pornography Use Frequency** [39]. Respondents indicated their past-year frequency of online pornography use on an 11-point scale ranging from 1 = „never” to 11 = „more than seven times a week”.

**Consideration of Treatment-Seeking.** The consideration of treatment-seeking for pornography use was assessed with one question: „Have you ever thought that you have a problem with your porn viewing habits that may require you to seek professional help (professional help includes visiting a counselor, a therapist, a psychologist, or a psychiatrist)?”. Participants indicated their answers on a two-point scale (1 = yes, 0 = no).

### *Statistical Analysis*

The structure of PPU was explored using a network analytic approach. The six items of the PPCS-6 were treated as nodes in a PPU network. The frequency of pornography use was added as the seventh node, to address its relationship with the items indicating PPU. To estimate the network, we used a Gaussian graphical model (GGM; [53]), in which edges represent partial correlations between two nodes after conditioning on all other nodes in the network [54]. Thus, an edge indicates that two nodes are correlated, either positively or negatively, while the absence of an edge demonstrates conditional independence between the nodes. Since items were measured on an ordinal scale, the polychoric correlation matrix was used as the input for network estimation [55].

Further, the GGM was regularized using graphical LASSO (Least Absolute Shrinkage and Selection Operator) in combination with EBIC model selection [56]. This approach, which controls for false-positive edges by shrinking small (i.e., marginal) edges to zero [57], has been found to produce more interpretable and stable solutions [54]. When visualizing the network, edge strength is represented by line width and (darker) color, with full lines representing positive and dashed lines negative associations between nodes. The placing of nodes was based on the

Fruchterman-Reingold algorithm that places more connected nodes closer to each other [58]. To facilitate visual comparison between networks representing different groups of participants, they were drawn using the same (average) layout. Statistical differences between these networks were assessed by the Network Comparison Test (NCT) [59], which explores if the networks substantially differ in: (a) global network connectivity (i.e., the sum of edge weights' absolute values) and (b) global network structure. If significant differences are found in network structure, post-hoc tests are used to identify edges that are responsible for the difference. Considering the NCT was shown to be sensitive to unequal sample sizes [59], and the considering treatment group was significantly smaller than the rest of the sample, repeated random subsampling from the larger group was used to avoid bias.

To uncover possible groups of symptoms and additionally compare the networks, communities, or clusters of nodes were identified in both networks using the *spinglass* algorithm. This modularity-based community detection algorithm connects nodes into communities so that the number and strength of edges within a community are larger than the number and strength of edges between the communities [60]. Since the result of the algorithm depends on the seed used, the most frequent solution across 1,000 differently seeded iterations was selected.

Centrality plots were created for each network to answer the first two research questions. As a measure of node centrality, we used the expected influence metric [61], which is based on the sum of edge weights a node shares with all other nodes. Unlike the widely used strength centrality, expected influence takes into account the sign of edge weight (i.e., positive and negative partial correlations) and not just its strength.

Finally, we explored the stability of network estimates in both groups. To that aim, non-parametric bootstrapped 95% confidence intervals (CIs) around edge weights were calculated; case-dropping subset bootstrap was used to test the accuracy of expected influence centrality

[62]. The method correlates the expected influence value obtained with all available cases with values obtained with increasingly fewer cases, ultimately resulting in the so-called correlation stability coefficient (the maximum proportion of cases that can be dropped to retain, with 95% probability, the correlation with the original expected influence value  $\geq .70$ ). Based on simulation studies, the recommended value of the stability coefficient should not be  $< .25$  and preferably  $> .50$  [62].

All analyses were carried out in R (Version Version 3.5.2.), using *qgraph* [63], *bootnet* [64], and *NetworkComparisonTest* packages [65].

## Results

### *Descriptive Statistics*

Descriptive statistics for age, the average PPCS-6 score, and the frequency of pornography use are presented in Table 1. Individuals considering treatment-seeking (Considered treatment;  $n = 509$ ) were significantly younger compared to those who reported never considering help-seeking (Not considered treatment;  $n = 3,684$ ) ( $t_{(770)} = -10.07$ ,  $p < .001$ , Cohen's  $d = 0.43$ ). They also scored substantially higher on the PPCS-6 ( $t_{(607)} = 21.67$ ,  $p < .001$ , Cohen's  $d = 1.09$ ), as well as they reported higher frequency of pornography use ( $t_{(759)} = 13.05$ ,  $p < .001$ , Cohen's  $d = 0.56$ ).

\*\*\* TABLE 1 ABOUT HERE \*\*\*

### *Network Structure*

Figure 1 depicts the estimated PPU networks in the two groups (Considered treatment vs. Not considered treatment groups) of participants. From 21 possible edges, there were 19 non-zero edges in the former and 20 in the latter network. The average edge weight was 0.13 in the Considered treatment group and 0.14 in the Not considered treatment group. As the stability of estimates is based on sample size (i.e., power), higher edge stability was observed in the Not



considered treatment group compared to the Considered treatment group (see Supplementary Material).

\*\*\* FIGURE 1 ABOUT HERE \*\*\*

The expected influence estimate by groups is presented in Figure 2. The estimate had very good stability in both groups (correlation stability coefficient was .93 for the Not considered treatment group and .65 for the Considered treatment group; see Supplementary Material). Since there were no negative edges, the expected influence values are identical to strength centrality.

In the *Considered treatment-seeking group*, Saliency was characterized by the highest centrality (i.e., influence), followed by Mood Modification, Tolerance, and Withdrawal. In contrast, in the *Not considered treatment-seeking group*, the highest centrality was observed for Tolerance, followed by Saliency and Conflict. In both networks, pornography use frequency occupied the most peripheral position and was most strongly related to Saliency.

\*\*\* FIGURE 2 ABOUT HERE \*\*\*

#### *Network Comparison and Clustering*

According to the NCT, the two networks did not substantially differ in global strength ( $S = 0.17$ ,  $p = .084$ ) or global network structure ( $M = 0.12$ ,  $p = .706$ ). However, due to a substantial difference in group sizes, which has been shown to affect the test [59], the analyses were repeated by comparing the Considered treatment group with five random subsamples drawn from the larger, Not considered treatment group. In none of the five tests, we observed significant differences in the global structure. However, although the two networks had a similar structure, three of five tests showed substantial differences in global strength, with the PPU network of symptoms more densely interconnected in participants in the Not considered treatment group. The results of the *springlass* algorithm provide additional evidence for the similarity between the groups' network structure. The most frequent solution, obtained in 935 out of 1,000 iterations in

the Not considered treatment group and 948 iterations in the Considered treatment group, was identical for both groups. Two clusters were obtained, with the first including Salience, Mood Modification, and Pornography Use Frequency, and the second cluster including Conflict, Withdrawal, Tolerance, and Relapse. Noteworthy, the Considered treatment group scored higher on both clusters ( $t_{\text{CLUSTER1}}(4191) = 5.341, p < .001$ , Cohen's  $d = 0.81$ , and  $t_{\text{CLUSTER2}}(4191) = 21.549, p < .001$ , Cohen's  $d = 1.12$ ) than participants in the Not considered treatment group.

### **Discussion**

Following prior pioneering studies in sex research and problematic online behaviors [28,66,67], the present study used a novel, network analytic approach to examine the symptoms of PPU in individuals who considered and those who did not consider treatment for pornography use. By focusing on the network of PPU symptoms, the results of the present study suggested that the global structure of symptoms did not differ significantly between the Considered treatment and the Not considered treatment groups. Salience, tolerance, and conflict appeared as central symptoms, while pornography use frequency was the most peripheral symptom in both groups' networks. Nevertheless, some minor differences between the two networks were identified and will be discussed.

#### *Clusters of Symptoms of PPU in Individuals (Not) Considering Treatment*

The present study identified two clusters of symptoms in both the Considered treatment and the Not considered treatment groups. The first cluster included salience, mood modification, and pornography use frequency, while the second cluster comprised conflict, withdrawal, relapse, and tolerance. These two clusters were in accordance with the distinction between core and peripheral symptoms that prior studies proposed [40–42], with the exception of tolerance that belonged to the core symptoms' cluster. It should be noted that tolerance may be more strongly related to conflict, withdrawal, and relapse symptoms in the case of PPU than in other

problematic behaviors [40–42] potentially due to binge pornography use [37] that will be discussed later.

The two identified clusters may represent the previously proposed differences between the preoccupation with pornography use and PPU [41,42]. Highly engaged individuals may think about pornography use frequently (i.e., salience), they may use it on a regular basis or even with a high frequency [43] and sometimes to alleviate stress or reduce negative feelings. Such preoccupation with pornography use may not have negative life consequences and may be associated with positive emotions. However, when the symptoms in the first cluster are combined with the symptoms from the second cluster, PPU may be more likely. In this case, individuals would not only be preoccupied with pornography use but would also feel that they cannot control it (i.e., withdrawal and relapse)—which would negatively affect their obligations and personal relationships (i.e., conflict). Since individuals considering treatment had a significantly higher average score on the cluster indicating PPU, compared to the not considering treatment group, one possibility is that a higher score on this cluster may lead to a higher likelihood of seeking help. Conceptualizing PPU as a mixture of both clusters of symptoms appears to be in accordance with a recent mixed-method study reporting that more than 95% of the therapists and the volunteers who provide service for PPU endorsed all six dimensions of the PPCS as important characteristics of the phenomenon [68].

#### *Core and Peripheral Symptoms of PPU in Individuals (Not) Considering Treatment*

Even though the previously described first cluster resembled the proposed peripheral, while the second cluster the core symptoms of problematic behaviors (except for tolerance) [40], a different centrality pattern was identified based on the centrality plots. Although the centrality ranking of symptoms differed in the Considered treatment and Not considered treatment groups, salience, withdrawal, tolerance, and conflict were more centrally positioned in both groups.

Partially in line with the proposed conceptualization of core symptoms [40–42] and our hypothesis, conflict and withdrawal appeared as central symptoms of PPU, but not relapse. Although salience and tolerance were proposed to be more peripheral [40–42], they were observed to occupy more central positions in the PPU network.

A potential explanation for the finding that *tolerance* belonged to core symptoms is a recent insight about “pornographic binges” (i.e., using pornography for many hours a day or multiple times a day) [37]. In this study of nine treatment-seeking men for compulsive sexual behaviors that used qualitative and quantitative diary assessment for ten weeks, binge pornography use was present in seven men, suggesting that it may be an important symptom of PPU. In regard to *salience*, its more central location than expected [40–42] may be explained by its strong association with pornography use frequency that took a peripheral position in both groups’ PPU symptoms networks. At the same time, pornography use frequency had the strongest connection with salience, while it had substantially weaker associations with the other symptoms. Thus, salience may represent a bridge between pornography use frequency and the other symptoms of PPU, resulting in a more central location for salience. Turning to *relapse*, repeatedly failing in an attempt to control one’s pornography use despite negative consequences [30], may be considered as a manifestation of impulse control problems. Thus, our finding that relapse had a more peripheral position in the PPU symptoms network than expected resonates with recent studies reporting that PPU may only be weakly related to impulsivity [69,70]. Nevertheless, future studies are needed to examine these potential explanations.

When examining and comparing the location of the symptoms in the Considered treatment and Not considered treatment-seeking groups, one outstanding difference was that *mood modification* took a more central place in the Considered treatment group’s network, while it had a more peripheral position in the Not considered treatment group’s network. This

difference may be explained by the previously described conceptual differences between how prior studies operationalized mood modification and how it is defined in Griffiths' components model [30] that provided the theoretical basis for the PPCS-6 measure. Prior studies conceptualized mood modification as euphoria [40], while Griffiths' model emphasizes the negative aspects of mood modification [30,38]. Our results suggest—in line with prior studies and the self-medication model [35,37,71–73]—that using pornography to cope with negative emotions and stress may be related to higher levels of perceived PPU and treatment-seeking considerations [68].

#### *The Role of Frequent Pornography Use in the Symptomatology of PPU*

As for the frequency of pornography use, the results of the present study supported our hypothesis that pornography use frequency is a peripheral symptom of PPU. Pornography use frequency was the most peripheral of the PPU network symptoms in both groups. The finding is in line with the theoretical conceptualization of core and peripheral symptoms [40], prior empirical findings of the associations between pornography use frequency and PPU [8–10,33,43,44,47], and the recent network analysis of hypersexuality symptoms [28]. As discussed previously, PPU and the frequency of pornography use are positively, but only weakly to moderately, related, potentially due to individual differences in moral incongruence towards pornography use, sexual desire, or other characteristics [8–10,33,43,44,47,74,75]. From a statistical perspective, we used partial correlations to establish the nodes in the PPU symptoms network. Therefore, every PPU item's variance was largely explained by other PPU items, hence the small partial correlation with the frequency of pornography use.

However, it has been observed that individuals interested in treatment for their pornography use and treatment-seeking individuals report a higher frequency of pornography use than those who were not interested in treatment [9,10,49]. The current study's findings confirm

these reports. Nevertheless, pornography use frequency should not be considered a core symptom of problematic pornography use [43].

### *Potential Clinical Implications*

Several intervention programs and treatments have been proposed to help individuals with problematic sexual behaviors, suggesting that cognitive behavior therapy (CBT), acceptance and commitment therapy (ACT), and mindfulness-based approaches may be effective ones [13,76–82]. However, there seems to be no agreement on which therapeutic approach would be the most preferable. The current study's results may contribute to the identification of the most effective treatment(s) for PPU by providing information about the core symptoms of PPU. Based on the assumption that interventions targeting centrally positioned symptoms would be more effective than interventions that deal with more peripheral symptoms [26,27], our findings suggest that salience, mood modification, and withdrawal symptoms should be targeted first.<sup>5</sup> However, further studies assessing the effectiveness of treatment approaches focusing on these symptoms are needed to support our notion. Another potential implication is related to the peripheral location of pornography use frequency in the network of the symptoms of PPU. Based on this finding and prior empirical insights that frequent pornography use may not be associated with PPU [43,83,84], focusing primarily on the reduction of pornography use or complete abstinence from pornography are not likely effective therapeutic approaches [36].

### *Limitations and Future Studies*

Although the present study was the first one analyzing the symptoms of problematic pornography use applying a network analytic approach [26,27], some limitations should be

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<sup>5</sup> It is important to note that some clinicians would argue in favor of working on the peripheral symptoms first, as these are likely less resistant to change [27,61,89]. The rationale is that such positive experience (of the reduction or disappearance of a symptom) may improve the individual's motivation to further engage in and adhere to the treatment.

discussed. The present study applied self-report measures of problematic pornography use and pornography use frequency that may lead to possible biases (e.g., social desirability or recall bias) distorting the results. Questions about the type of pornography that participants were not included in the study. Therefore, it is possible that some individuals in the Considered treatment group reported treatment-seeking behavior due to the type of pornography they used (e.g., child or juvenile pornography [85]).

Women or individuals currently in treatment for pornography use were not included in the present study due to their low number in the sample. Future studies should examine whether the present findings may be generalized to these populations. Moreover, future studies may include masturbation frequency and additional measures of potential symptoms of PPU (e.g., craving for pornography use [86]) given their moderate-to-strong associations with PPU and pornography use frequency [29,87,88]. The network analytic approach should be used in clinical samples to enable the examination of the similarities and differences between the structure of symptoms identified in this community-based sample and clinical samples and to corroborate the clinical validity of the current study's findings.

### *Conclusions*

The present study applied a novel approach—network analysis—in the field of sex research to examine and identify the core symptoms of PPU, which may inform treatment strategies aiming to reduce PPU [26,27]. The network of PPU symptoms was similar in treatment considering and not considering participants, with salience, tolerance, withdrawal, and conflict being located as central symptoms. Considering that pornography use frequency was the most peripheral symptom in both networks, treatments for PPU that would focus on the aforementioned symptoms are more likely to be effective than interventions based on abstaining from pornography use [36,43].

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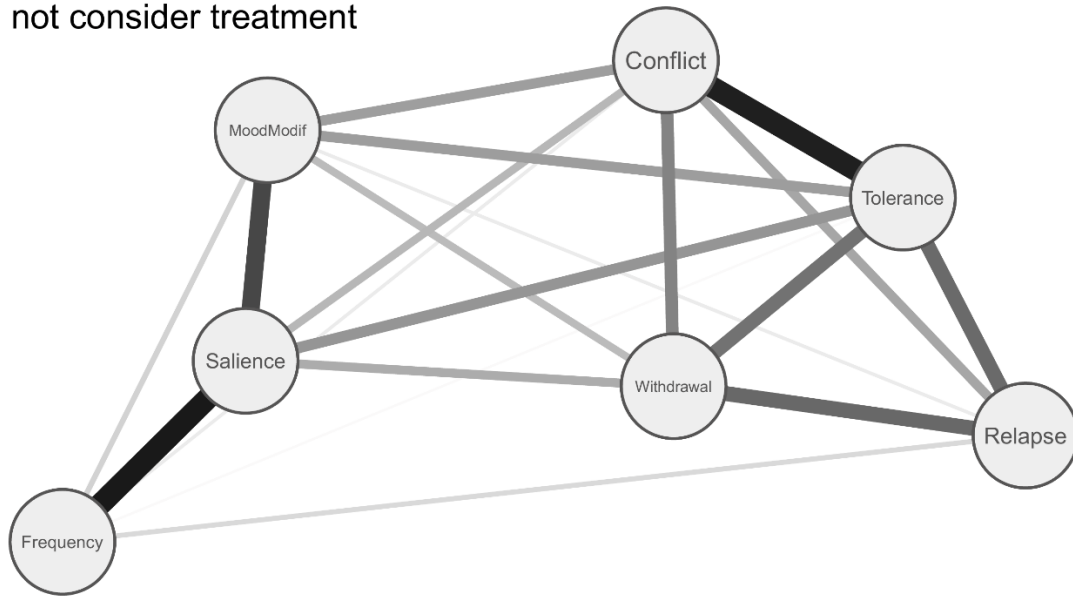
Table 1. Detailed demographic, socio-economic, and pornography use characteristics of the sample in the Considered treatment and Not considered treatment groups

Characteristics	Considered treatment	Not considered treatment	Chi square tests of independence / Independent samples t-tests
	( <i>n</i> = 509) <i>n</i> (%) / <i>M</i> (SD)	( <i>n</i> = 3,684) <i>n</i> (%) / <i>M</i> (SD)	
Mean age in years (SD)	34.13 (9.65)	38.92 (12.61)	$t(769.73) = -10.07, p < .001$
Residence	288 (56.5%)	1,721 (46.7%)	$\chi^2 (3, N = 4,193) = 18.54, p < .001$
Capital city	78 (15.3%)	645 (17.5%)	
County towns	103 (20.2%)	902 (24.5%)	
Towns	40 (7.9%)	416 (11.3%)	
Villages			
Highest level of education			$\chi^2 (3, N = 4,193) = 3.03, p = .387$
Primary school degrees or less	9 (1.8%)	55 (1.5%)	
Vocational degree	17 (3.3%)	183 (5.0%)	
High school degree	165 (32.4%)	1,139 (30.9%)	
Degree of higher education (e.g., bachelors, masters or doctorate degree)	318 (62.5%)	2,307 (62.6%)	
Current education			$\chi^2 (3, N = 4,193) = 23.661, p < .001$
Studied in high school	8 (1.6%)	62 (1.7%)	
Studied in higher education	116 (22.8%)	547 (14.8%)	
Studied in another educational institute	35 (6.9%)	210 (5.7%)	
Did not study in any form of education	350 (68.8%)	2,865 (77.8%)	
Work status			$\chi^2 (3, N = 4,193) = 4.58, p = .205$
Full-time job	382 (75.0%)	2,829 (76.8%)	
Part-time job	45 (8.8%)	257 (7.0%)	
Casual job	33 (6.5%)	191 (5.2%)	
Did not have a job	49 (9.6%)	407 (11.0%)	
Subjective socioeconomic status			$\chi^2 (3, N = 4,193) = 10.34, p = .111$
My life circumstances are among the worsts	0 (0.0%)	2 (0.1%)	
My life circumstances are much worse than average	7 (1.4%)	19 (0.5)	
My life circumstances are worse than average	28 (5.5%)	146 (4.0%)	
My life circumstances are average	105 (20.6%)	857 (23.3%)	
My life circumstances are better than average	229 (45.0%)	1,585 (43.0%)	
My life circumstances are much better than average	129 (25.3%)	991 (26.9%)	
My life circumstances are among the bests	11 (2.2%)	84 (2.3%)	
Marital status			$\chi^2 (3, N = 4,193) = 48.46, p < .001$
Single	173 (34.0%)	835 (22.7%)	
In a relationship	174 (34.2%)	1,232 (33.4%)	
Engaged	24 (4.7%)	130 (3.5%)	
Married	121 (23.8%)	1,299 (35.3%)	
Divorced	12 (2.4%)	148 (4.0%)	
Widow/widower	0 (0.0%)	13 (0.4%)	
Other	5 (1.0%)	27 (0.7%)	

Children			
No child	363 (71.3%)	1,987 (53.9%)	$\chi^2 (3, N = 4,193) = 68.34, p < .001$
One child	66 (13.0%)	484 (13.1%)	
Two children	47 (9.2%)	740 (20.1%)	
Three children	26 (5.1%)	355 (9.6%)	
Four children	7 (1.4%)	90 (2.4%)	
Five children	0 (0.0%)	22 (0.6%)	
Six to nine children	0 (0.0%)	5 (0.1%)	
Ten or more children	0 (0.0%)	1 (<0.1%)	
Sexual orientation			
Heterosexual	406 (79.8%)	3,115 (84.6%)	$\chi^2 (3, N = 4,193) = 19.40, p = .007$
Heterosexual with homosexuality to some extent	46 (9.0%)	241 (6.5%)	
Bisexual	14 (2.8%)	88 (2.4%)	
Homosexual with heterosexuality to some extent	7 (1.4%)	44 (1.2%)	
Homosexual	25 (4.9%)	169 (4.6%)	
Asexual	1 (0.2%)	8 (0.2%)	
Unsure	6 (1.2%)	12 (0.3%)	
“Other”	4 (0.8%)	7 (0.2%)	
Moral incongruence regarding pornography use <sup>a</sup> (range: 1-7)	3.30 (1.78)	2.42 (1.47)	$t(607.60) = 10.59, p < .001$
Self-perceived addiction to pornography use <sup>a</sup> (range: 1-7)	4.33 (1.64)	2.51 (1.55)	$t(4191) = 24.74, p < .001$
Frequency of pornography use <sup>b</sup> (range: 1-11)	8.72 (1.62)	7.68 (2.08)	$t(758.67) = 13.05, p < .001$
Duration of pornography use per each occasion (minutes)	34.54 (29.00)	27.51 (21.47)	$t(606.61) = 21.67, p < .001$
PPCS-6 total score (range: 1-7)	3.46 (1.34)	2.11 (1.10)	$t(587.34) = 5.27, p < .001$
Item 1 (Salience)	3.98 (1.82)	2.79 (1.80)	$t(4191) = 14.03, p < .001$
Item 2 (Mood modification)	3.78 (1.89)	2.55 (1.67)	$t(621.72) = 13.97, p < .001$
Item 3 (Conflict)	2.95 (1.86)	1.71 (1.23)	$t(570.42) = 14.55, p < .001$
Item 4 (Tolerance)	2.88 (1.78)	1.67 (1.20)	$t(573.29) = 14.77, p < .001$
Item 5 (Relapse)	4.41 (2.00)	2.24 (1.74)	$t(619.94) = 23.27, p < .001$
Item 6 (Withdrawal)	2.72 (1.86)	1.70 (1.30)	$t(578.99) = 12.05, p < .001$

Note. *M* = mean; *SD* = standard deviation. Based on the Bonferroni correction for multiple comparisons,  $p < .0025$  indicates a significant difference between the groups. PPCS-6 = Short version of the Problematic Pornography Consumption Scale. <sup>a</sup> = Item: “I believe that pornography use is morally wrong.”; Answer options: 1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: neither agree, nor disagree, 5: somewhat agree, 6: agree, 7: strongly agree [5]; <sup>b</sup> = 1: never, 2: once in the last year, 3: 1-6 times in the last year, 4: 7-11 times in the last year, 5: monthly, 6: 2-3 times a month, 7: weekly, 8: 2-3 times a week, 9: 4-5 times a week, 10: 6-7 times a week, 11: more than 7 times a week.

Did not consider treatment



Considered seeking treatment

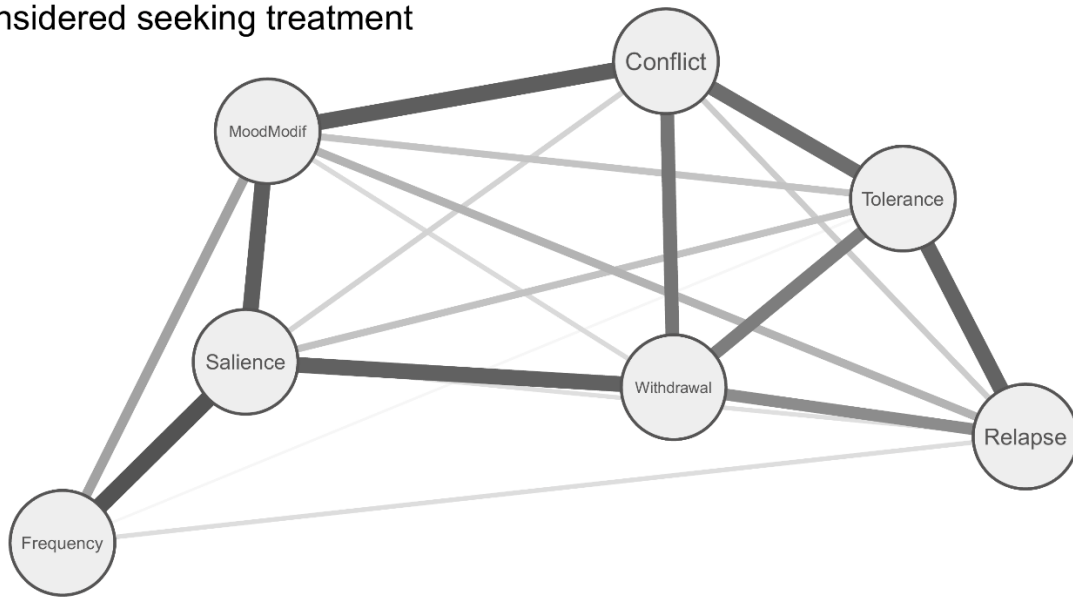


Figure 1. Regularized partial correlation networks across the two groups of participants (Considered treatment,  $n = 509$ ; Not considered treatment,  $n = 3,684$ ). *Note.* Saliency = *I felt that porn is an important part of my life.*; MoodModif (Mood Modification) = *I released my tension by watching porn.*; Conflict = *I neglected other leisure activities as a result of watching porn.*; Tolerance = *I felt that I had to watch more and more porn for satisfaction.*; Relapse = *When I vowed not to watch porn anymore, I could only do it for a short period of time.*; Withdrawal = *I became stressed when something prevented me from watching porn.*; Frequency = Frequency of pornography use in the past year: 1: never, 2: once in the last year, 3: 1-6 times in the last year, 4: 7-11 times in the last year, 5: monthly, 6: 2-3 times a month, 7: weekly, 8: 2-3 times a week, 9: 4-5 times a week, 10: 6-7 times a week, 11: more than 7 times a week.

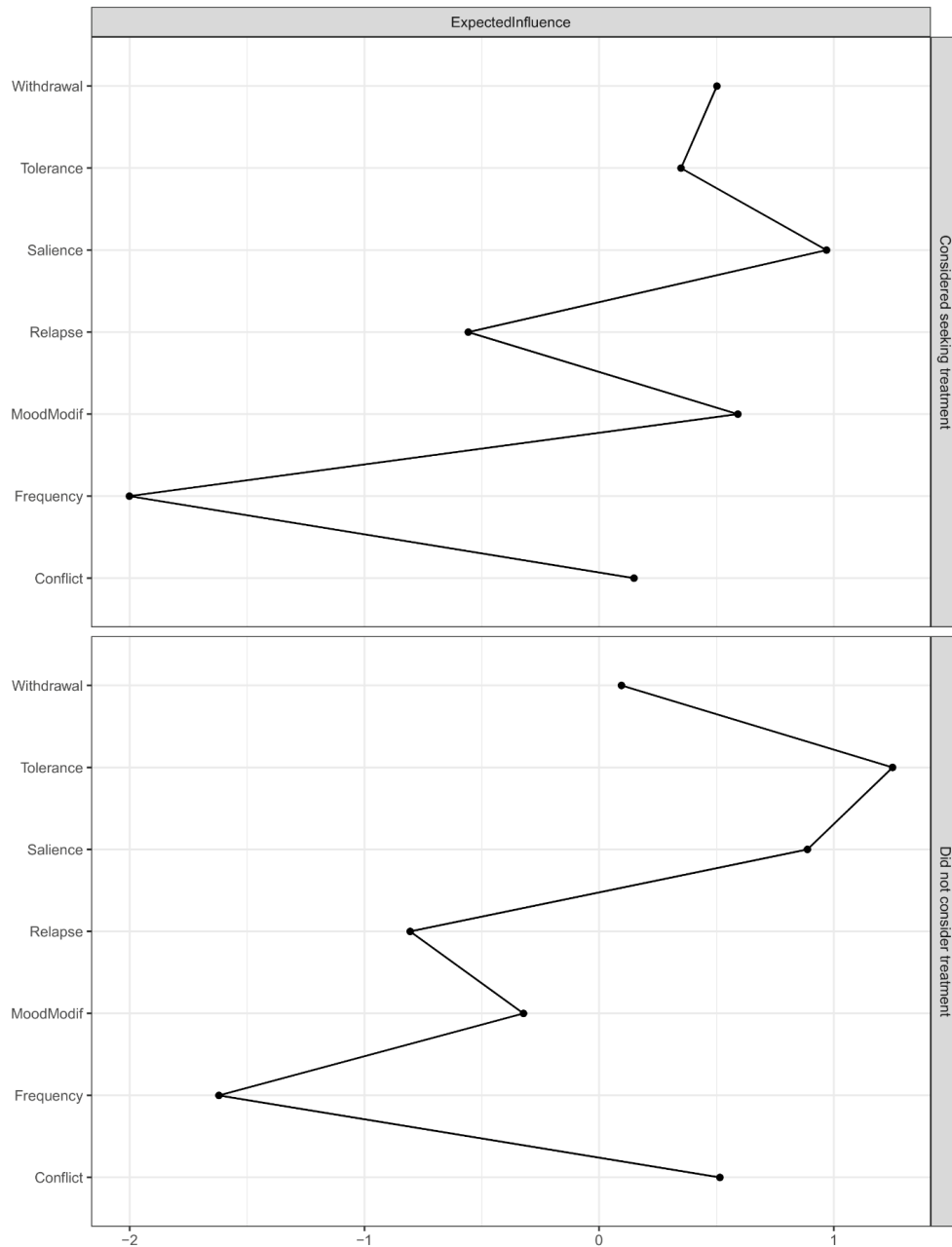


Figure 2. Expected influence centrality plotted by the two groups of participants (Considered treatment,  $n = 509$ ; Not considered treatment,  $n = 3,684$ ). *Note.* Saliency = *I felt that porn is an important part of my life.*; MoodModif (Mood Modification) = *I released my tension by watching porn.*; Conflict = *I neglected other leisure activities as a result of watching porn.*; Tolerance = *I felt that I had to watch more and more porn for satisfaction.*; Relapse = *When I vowed not to watch porn anymore, I could only do it for a short period of time.*; Withdrawal = *I became stressed when something prevented me from watching porn.*; Frequency = Frequency of pornography use: 1: never, 2: once in the last year, 3: 1-6 times in the last year, 4: 7-11 times in the last year, 5: monthly, 6: 2-3 times a month, 7: weekly, 8: 2-3 times a week, 9: 4-5 times a week, 10: 6-7 times a week, 11: more than 7 times a week.