



AKADÉMIAI KIADÓ

Reducing problematic pornography use with imaginal retraining—A randomized controlled trial

Journal of Behavioral Addictions

13 (2024) 2, 622–634

DOI:

10.1556/2006.2024.00018

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Received: December 28, 2023 • Revised manuscript received: February 26, 2024; March 20, 2024 • Accepted: March 21, 2024

Published online: April 26, 2024

FULL-LENGTH REPORT



ABSTRACT

Background and aim: Problematic pornography use (PPU) can be a manifestation of compulsive sexual behavior disorder (CSBD). Studies investigating PPU confirm approach-avoidance tendencies in response to pornographic stimuli in this population. This study shows indications of the significance of the efficacy of imaginal retraining, a variant of approach bias modification, as an intervention for PPU. **Methods:** A total of 274 participants (86.5% male; mean age = 30.65, $SD = 10.13$) with self-reported PPU were randomized to imaginal retraining (instruction video) or a waitlist control group. Assessments were conducted online at baseline and after the six-week intervention period. The primary outcome was a reduction in problematic pornography use. Compulsive sexual behavior, sexual desire, depressiveness, and satisfaction with the intervention served as secondary outcomes. **Results:** Retention was low (51.7%), but comparable between groups. The retraining was performed at least once a week (the per-protocol [PP] criterion) by 51.4% of participants. The PP analyses of 111 participants showed a significant reduction in problematic pornography use (primary outcome) in the intervention compared to the control group. The intention-to-treat analyses (ITT), however, did not corroborate this result. Despite low adherence, participants rated their satisfaction with the intervention positively. **Discussion and Conclusion:** Imaginal retraining can function as a low-threshold self-help intervention for PPU to overcome help-seeking barriers and may reduce PPU in a subgroup of users. Low adherence limits the results of this trial. Given the need for low-threshold interventions for PPU and/or CSBD, further research should focus on increasing adherence and should evaluate retraining for clinical groups. Modifications to augment efficacy are suggested.

KEYWORDS

problematic pornography use, online intervention, compulsive sexual behavior disorder, approach bias modification

INTRODUCTION

The regular consumption of pornography is highly prevalent among the general population, irrespective of gender (Herbenick et al., 2020; Lewczuk et al., 2022; Rissel et al., 2017). Most individuals do not report any negative consequences of their pornography use (Štulhofer, Wiessner, Koletić, Pietras, & Briken, 2022). However, if the usage becomes excessive and persistent, it may lead to distress or impairment. Prevalence estimates for problematic pornography use (PPU) range between 1% and 3% in women and 4% and 11% in men (Grubbs, Perry, Grant Weinandy, & Kraus, 2022; Grubbs, Kraus, & Perry, 2019;

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Rissel et al., 2017). PPU is not a formal diagnosis in the International Statistical Classification of Diseases and Related Health Problems (ICD) or the Diagnostic and Statistical Manual of Mental Disorders (DSM). Although no standardized definition for PPU exists, PPU can meet the diagnostic requirements for compulsive sexual behavior disorder (CSBD; Antons & Brand, 2021; Fernandez & Griffiths, 2021). With the introduction of the ICD-11, CSBD is a formal diagnosis, found in the impulse control disorders chapter. The diagnostic guidelines require difficulty controlling strong, repetitive sexual urges leading to persistent sexual behavior over a period of at least six months and causing significant distress or impairment in various areas of life, such as personal, family, social, educational, or occupational (World Health Organization, 2019). PPU can have a severe negative impact on well-being since it may be associated with personal distress (Droubay, Shafer, & Butters, 2020; Grubbs, Perry, Wilt, & Reid, 2018), sexual dissatisfaction (Leonhardt & Willoughby, 2019), depression, anxiety, and interpersonal conflict (Guidry, Floyd, Volk, Marital, & 2020 undefined, 2019).

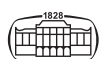
Despite the categorization of CSBD (and therefore associated PPU) as an impulse control disorder in the ICD-11, other nosological models have been proposed. One of these is the classification of CSBD as a behavioral addiction due to the lack of control over behavior, distress, tolerance development, and withdrawal symptoms (Lewczuk et al., 2022). Another theoretical framework for understanding addictive behaviors specifically related to internet use, including problematic pornography consumption, has been put forward by Brand, Young, Laier, Wölfling, and Potenza (2016). The authors developed the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, which considers predisposing factors (neurobiological and psychological), emotional and cognitive responses, and decreased executive processes. Additionally, reward expectancies, coping mechanisms, and emotional and cognitive biases are assumed to be mediators in addictive behavior. In this model, associations made are strengthened following behavioristic learning theory (i.e., positive and negative reinforcement; Brand et al., 2019; Brand et al., 2016).

In addition to the behavioral addiction model, the dual control model has been discussed and empirically investigated in the context of CSBD (Bancroft and Vukadinovic, 2010; Briken, 2020; Rettenberger, Klein, & Briken, 2016). This model assumes that CSBD may be related to a disbalance of excitatory and inhibitory factors. The model is closely tied to the approach-avoidance approach (Bancroft & Vukadinovic, 2010) which focuses on attentional and other processing biases involved in the pathogenesis of the behavior. Recently, a study by Wang and Huang (2022) presented findings of a distinct pattern of attentional bias toward pornographic stimuli in individuals with PPU. The researchers used an exogenous cueing task with pornographic pictures as cues to investigate attentional processing (i.e., enhanced attentional activation, delayed attentional deactivation, and attentional avoidance). Participants with high PPU tendencies demonstrated a preference for focusing

on pornographic cues that possessed significant incentive salience, followed by conscious avoidance of those cues. Wang and Huang interpret this as an attempt to alleviate subjective distress. Furthermore, a positive correlation between the approach bias and the severity of PPU was found (Wang & Huang, 2022). The findings indicate that PPU might share similarities with substance use disorder in terms of the attentional bias characterized by an approach-avoidance pattern, which aligns with the dual process model of addiction. Further studies show that both male and female students who consume pornography have a general tendency to approach pornographic stimuli (Sklenarik et al., 2019, 2020), particularly students with problematic pornography consumption (Sklenarik et al., 2019). However, Snagowski and Brand (2015) found that individuals with “online sex addiction” show either approach or avoidance tendencies toward pornographic stimuli (Snagowski, 2015). Another study showed that approach tendencies toward sexually preferred stimuli were associated with higher sexual arousal and lower sexual inhibition in heterosexual men (Turner et al., 2019). These results suggest that approach-avoidance tendencies in response to pornographic stimuli might be influenced by problematic consumption or vice versa.

Interventions for CSBD and PPU

Since CSBD and PPU can have a significant negative impact on physical and mental health, quality of life, and social interactions (Turner et al., 2022), treatment options are needed. In a recent systematic review, Antons et al. (2022) identified 24 studies evaluating various treatment approaches for CSBD or PPU (i.e., cognitive behavioral therapy (CBT)-based interventions, third-wave approaches, pharmacotherapy), with only four reporting on randomized controlled trials. Crosby and Twohig (2016) reported effectiveness of a modified acceptance and commitment therapy (ACT) manual for reducing symptom severity and behavior enactment compared to a control group. CBT-based group therapy for men with hypersexuality disorder compared to a control group without treatment was also successful regarding symptom reduction (Hallberg et al., 2019). Bóthe, Baumgartner, Schaub, Demetrovics and Orosz (2021) evaluated an internet-based, unguided intervention that was also based on CBT. Despite poor adherence, the self-help program was effective in reducing PPU and craving (Bóthe et al., 2021). Wang and Huang (2022) concluded from their study on attentional bias in individuals with high PPU tendencies that attentional bias modification (ABM) might be beneficial by reducing consumption of pornography. However, to our knowledge, no study has examined ABM for PPU explicitly. In addition to the psychological interventions, pharmacotherapy was evaluated as a treatment for PPU; Wainberg et al. (2006) found citalopram to be effective for reducing pornography use (among other purposes) in a sample of sexually diverse men. Overall, these studies tentatively suggest that treatment, especially CBT-based interventions, may improve CSBD and/or PPU.



Nevertheless, the small number of randomized controlled trials in the current literature shows the lack of available evidence-based treatment options. For individuals with PPU (i.e., those without a formal diagnosis) who wish to change their sexual behavior but are unable to do so on their own, it may be especially difficult to receive help. Shame, guilt, and fear of stigmatization can be insurmountable barriers. In addition, people seeking help often must wait months to begin psychotherapy (Singer et al., 2022). Internet-based self-help interventions can address these hurdles. Such interventions can be used anonymously and independently. However, this type of intervention should not be understood as a replacement for conventional psychotherapy.

Self-help interventions to reduce cravings

Due to the high treatment-seeking barriers for PPU, there is a need for interventions not guided by therapists to overcome hurdles such as shame and waiting time. An effective self-help technique known as imaginal retraining has been developed to reduce cravings for and consumption of substances like alcohol and nicotine. Imaginal retraining is based on the dual process model and is a variant of the classic ABM approach, which aims at changing the automated approach behavior toward preferred stimuli. The technique involves retraining unconscious physical processes and reversing addiction-like tendencies. Imaginal retraining has been tested using randomized controlled studies and has shown promising results in reducing cravings for problematic substances like alcohol (Moritz, Paulus, et al., 2019), nicotine (Moritz et al., 2020), and high-calorie foods (Moritz, Göritz et al., 2019) as well as consumption of nicotine in a subgroup (Moritz et al., 2020) and behavioral changes toward high-calorie food (for weight loss; Moritz, Göritz, et al., 2019). The technique has been found to be easy to use and well-accepted by participants in all studies. Further, a recent study found that the reduction in nicotine cravings is maintained after one year (Gehlenborg, Göritz, Moritz, Lüdtkke, & Kühn, 2022).

Based on the findings of Wang and Huang (2022) that lend support to the notion of approach-avoidance patterns in PPU, imaginal retraining might be able to reduce PPU. To test this hypothesis, we adapted the instructions for the imaginal retraining to fit self-reported PPU in order to provide a self-help intervention. The primary aim of this pilot study was to evaluate the effectiveness of an imaginal retraining for PPU on symptom reduction in a sample of individuals with self-reported PPU and the desire to reduce their pornography use.

METHODS

The study was directed at individuals between 18 and 75 years who wanted to reduce self-perceived PPU (self-report). No formal diagnosis (e.g., CSBD based on the ICD-11) nor fulfillment of any threshold criteria was required for participation in this pilot trial. Acute suicidal

ideation and a diagnosis of psychotic or bipolar disorder were exclusion criteria. The trial was preregistered with the German Clinical Trials Register (DRKS00027509).

Design

The online study was conducted as a two-arm randomized controlled trial with an intervention group and a waitlist control group over a six-week intervention period. Assessments were conducted at baseline (before the intervention period; T0) and six weeks after baseline (post-assessment; T1). Participants were allowed access to or continuation of standard care and other interventions. Participants in the intervention group received access to the imaginal retraining instruction video immediately after randomization, whereas participants in the control condition received access upon completion of the post-assessment (after six weeks). Data from 274 participants were included in the final analyses.

Procedure and participants

Participants were recruited via various digital advertisements, including the video streaming platform YouTube, online forums, social media posts, an email newsletter, and a podcast. Assessments were conducted online using the online survey platform Qualtrics®. Study participation was anonymous, and no personal information (e.g., name) was requested. At the beginning of the baseline assessment, electronic informed consent was required. First, questions on the participants' demographic background were posed as well as questions on their medical history (e.g., prior experience with psychotherapy; current treatment status; prior psychiatric diagnoses, if any). Next, psychopathological, and other scales were administered (see below). The trial required a valid email address for follow-up contact; participants were encouraged to create email addresses that would not allow any identification. At the end of the baseline assessment, participants were randomized to one of the two conditions (intervention vs. waitlist control; allocation ratio 1:1) via the Qualtrics® randomization algorithm (no allocation bias). Individuals allocated to the intervention group received immediate access to the intervention instruction video and were asked to use the technique daily, if possible, over the next six weeks. Participants in the control group were informed that they would receive access to the video after the post-assessment. Six weeks after baseline, an invitation to the post-assessment was sent via email. Additionally, up to three reminders for participation were dispatched (each after seven days without a response). At post assessment, participants allocated to the intervention group were asked about their usage of and satisfaction with the intervention in addition to the primary and secondary outcomes (see below).

The final sample consisted of 274 participants (86.5% male), of which half ($n = 137$, 50.0%) were allocated to the retraining group. Baseline sociodemographic and pornography use-relevant characteristics of the two conditions are displayed in Table 1. The groups did not differ in any of the characteristics (all $p > 0.055$). Participants were on average



Table 1. Means (standard deviation) and frequencies of sociodemographic and pornography consumption-relevant characteristics of the sample

	Imaginal Retraining (<i>n</i> = 137)	Waitlist Control Group (<i>n</i> = 137)	Overall (<i>n</i> = 274)	Statistics
<i>Sociodemographic variables</i>				
Age in years	31.8 (10.55)	29.59 (9.68)	30.65 (10.13)	<i>t</i> (272) = 1.89, <i>p</i> = 0.059
Education (% higher education)	74.5%	78.8%	76.6%	χ^2 (3) = 2.12, <i>p</i> = 0.547
Relationship (% single)	41.6%	49.6%	45.6%	χ^2 (3) = 1.89, <i>p</i> = 0.595
Employment (% full-time)	44.5%	43.1%	43.8%	χ^2 (7) = 4.65, <i>p</i> = 0.703
<i>Pornography consumption and related variables</i>				
PPCS	65.69 (21.85)	66.69 (22.28)	66.19 (22.03)	<i>t</i> (272) = 0.38, <i>p</i> = 0.708
CSBD-19	41.91 (12.33)	42.97 (12.19)	42.44 (12.25)	<i>t</i> (272) = 0.72, <i>p</i> = 0.473
SDIQ	50.74 (12.96)	50.55 (11.42)	50.65 (12.19)	<i>t</i> (272) = 0.12, <i>p</i> = 0.902
BPS	6.05 (2.55)	6.58 (2.57)	6.31 (2.57)	<i>t</i> (272) = 1.70, <i>p</i> = 0.09
<i>Other psychopathology</i>				
PHQ-9	8.77 (5.11)	9.01 (5.29)	8.89 (5.19)	<i>t</i> (272) = 0.37, <i>p</i> = 0.710
CTS	8.69 (3.38)	8.78 (3.60)	8.74 (3.50)	<i>t</i> (272) = 0.21, <i>p</i> = 0.836
WHO-QOL	3.50 (0.81)	3.58 (0.77)	3.54 (0.79)	<i>t</i> (272) = 0.82, <i>p</i> = 0.416

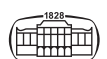
Note. PPCS = Problematic Pornography Consumption Scale; CSBD-19 = Compulsive Sexual Behavior Disorder Scale; SDIQ = Sexual Desire Inventory; BPS = Brief Pornography Screen; PHQ-9 = Patient Health Questionnaire; CTS = Childhood Trauma Screener; WHO-QOL-BREF = WHO Quality of Life global item.

31 years old ($M = 30.65$, $SD = 10.13$). The mean PPCS score was around 66 overall ($M = 66.19$, $SD = 22.03$), which is below the cut-off score for problematic pornography use of 76 (Böthe et al., 2018). At baseline, 95 participants (34.1%) had a PPCS score of 76 or higher and 65.3% scored below the cut-off. The total score of the CSBD-19 at baseline ($M = 41.91$, $SD = 12.33$) was also on average below its cut-off (50 points; Böthe et al., 2020), with 85 participants (31.0%) exceeding the high-risk threshold in the CSBD-19. The overall mean PHQ-9 ($M = 8.90$, $SD = 5.19$) indicates the presence of mild depressive symptoms.

Imaginal retraining

Imaginal retraining is an unguided self-help intervention (see <https://www.uke.de/craving>) that we conveyed via a short video clip. Retraining aims to weaken the associative links between a problematic behavior and its positive appraisal by having the user deliberately push the desired stimuli away in the hope of decreasing problematic behavior in the future. The video first highlights possible negative consequences of problematic (perceived as “out of control”) pornography use to increase motivation to change (psychoeducation). The psychological processes that drive the retraining technique are clarified to help participants

comprehend the rationale for the intervention; additionally, the interaction between body posture, thoughts, and emotions is outlined. The video illustrates how posture and emotion influence each other reciprocally (e.g., straightening the body leads to a slight improvement in mood, whereas adopting a bent-over posture tends to reduce well-being; Fridland & Wiers, 2018). Then, the imaginal retraining procedure is described. The technique consists of two sequences. In the first sequence (avoidance), participants are instructed to imagine their preferred key stimulus (e.g., a pornographic scene, specific character, or image) that they find problematic and the device on which they usually consume pornography. They are instructed to induct a negative mood while doing so by intentionally adopting a fitting body posture and combining it with negative thoughts. Participants are instructed to visualize themselves throwing or pushing their selected stimulus away from them (for instance, tossing a smartphone showing a pornographic scene against a wall) while actually performing the movement. As pushing away and downward movements are typically associated with rejection (Fridland & Wiers, 2018), the user is also advised to throw the imagined stimulus to the floor. For the second sequence (approach), participants are instructed to imagine an alternative (nonpornographic or not perceived as dysfunctional) sexually arousing



behavior or stimulus while taking a deep breath and standing up straight. They are then instructed to approach the alternative stimulus or perform the alternative behavior (e.g., kissing a loved person or touching specific body parts) in their imagination, again performing the actual movement. Users are instructed to experiment with the technique and try different (imaginary) scenarios. The recommended exercise frequency is twice a day for 5–10 min. The video was provided in German.

Measures

Primary outcome

Problematic Pornography Consumption Scale (PPCS). The PPCS (Böthe et al., 2018) is a multidimensional self-report questionnaire designed to measure PPU. The PPCS consists of 18 items assessing pornography use on a seven-point Likert scale (from 1 = “never” to 7 = “all the time”) using six different components (salience, mood modification, conflict, tolerance, relapse, and withdrawal). The possible total score ranges between 18 and 126, with the cut-off score for problematic use being 76. The PPCS has good to excellent internal consistency for the total scale (Cronbach’s $\alpha = 0.93$; Böthe et al., 2018).

Based on the CONSORT guidelines (Moher et al., 2010), the use of a single primary outcome is recommended in clinical trials. We chose the PPCS as the primary outcome for this trial since we believe it to be the most sensitive and suitable outcome regarding the primary aim of the intervention and trial (reduction of problematic pornography use) compared to the other related outcomes.

Secondary outcomes

Compulsive Sexual Behavior Disorder Scale (CSBD-19). The CSBD-19 (Böthe et al., 2020) is a multidimensional self-report questionnaire designed to measure compulsive sexual behavior. The questionnaire examines five different factors using 19 items that are answered on a four-point Likert scale (1 = “do not agree at all,” 2 = “somewhat do not agree,” 3 = “somewhat agree,” 4 = “completely agree”). The five factors of the CSBD-19 are derived from the ICD-11 diagnostic guidelines for CSBD: control, salience, dissatisfaction, negative consequences, and relapse. The reliability of the CSBD-19 is good (Cronbach’s $\alpha = 0.90$ to 0.94; Böthe et al., 2020).

Sexual Desire Inventory (SDIQ). The SDIQ (Spector, Carey & Steinberg, 1996) is a self-report questionnaire that measures interest or desire in sexual activity. The questionnaire consists of 11 items, with items 1 through 8 measuring dyadic sexual desire and items 9 through 11 measuring solitary sexual desire. The items are answered using an eight-point Likert scale (1 = “not at all,” 2 = “once a month,” 3 = “once every two weeks,” 4 = “once a week,” 5 = “twice a week,” 6 = “three to four times a week,” 7 = “once a day,” 8 = “more than once a day”). Internal consistency estimates (using Cronbach’s α coefficients) were

calculated for the Dyadic scale ($r = 0.86$) and the Solitary scale ($r = 0.96$) and indicated high reliability. Test-retest reliability was calculated as $r = 0.76$ over a period of one month (Spector et al., 1996).

Brief Pornography Screen (BPS). The BPS (Kraus et al., 2020) is a self-report questionnaire that measures problematic use of pornography. The questionnaire consists of five items that are answered using a three-point Likert scale (0 = “never,” 1 = “sometimes,” 2 = “frequently”). A total score between 0 and 10 can be obtained, with a higher score indicating more problematic use of pornography. The results of a principal component analysis and a confirmatory factor analysis show high internal consistency (Cronbach’s $\alpha = 0.89$ to 0.90; Kraus et al., 2020).

Patient Health Questionnaire – Depression module (PHQ-9). The PHQ-9 (Kroenke, Spitzer, & Williams, 1999) is a self-report questionnaire for assessing the severity of depressive symptoms in the last two weeks. The questionnaire consists of nine items rated on a four-point Likert scale (0 = “Not at all” to 3 = “Almost every day”). Severity is represented as the total score, ranging from 0 to 27, with higher scores indicating more severe depressive symptoms. Cronbach’s α for the PHQ-9 is good (Cronbach’s $\alpha = 0.88$; Gräfe, Zipfel, Herzog, & Löwe, 2004).

WHO Quality of Life global item (WHO-QOL). The WHO-QOL global item is an item from the WHO-QOL-BREF questionnaire (WHOQOL Group, 1998), which has a total of 26 items. Cronbach’s alpha for the WHO-QOL-BREF ranges from acceptable to good ($\alpha = 0.68$ to 0.82; Skevington, Lotfy, & O’Connell, 2004). For this study, only the global item was used to assess the general and overall quality of life on a five-point Likert scale (1 = “very poor” to 5 = “very good”).

Client Satisfaction Questionnaire (CSQ-8). The CSQ-8 (Schmidt, Lamprecht, & Wittmann, 1989) is a self-report questionnaire that measures global patient satisfaction after treatment. We used the German adaptation of the Client Satisfaction Questionnaire (CSQ-8; Attkisson & Zwick, 1982). The questions are answered on a four-point Likert scale (1–4, with different answers for each item). After recoding negatively formulated items, higher sum scores indicate higher satisfaction with treatment. The psychometric properties of the CSQ-8 are good, with internal consistency (Cronbach’s α) ranging from 0.88 to 0.92 (Kriz, Srh, Heidelberg, & Wittmann, 2008).

Moderators

University of Rhode Island Change Assessment (URICA). To assess willingness to change, a subset of items from the URICA (McConaughy, Prochaska, & Velicer, 1983) was administered at baseline. Responses are given on a five-point Likert scale (1 = “not at all true,” 2 = “somewhat not true,” 3 = “don’t know,” 4 = “somewhat true,”



5 = “very true”). Items were entered separately in the moderation analyses.

Childhood Trauma Screener (CTS). The CTS (Grabe et al., 2012) is a self-report questionnaire for adults for the retrospective assessment of abuse and neglect experiences. It was developed based on the German version of the Childhood Trauma Questionnaire (CTQ). The CTS captures five dimensions of childhood and adolescent maltreatment with one index item each: physical, sexual, and emotional abuse plus physical and emotional neglect. Items are answered on a five-point Likert scale (1 = “not at all,” 2 = “rarely,” 3 = “sometimes,” 4 = “frequently,” 5 = “very frequently”). High correlations ($r = 0.88$; $p < 0.0001$) with the CTQ total score are found (Grabe et al., 2012). The internal consistency is acceptable (Cronbach’s $\alpha = 0.76$; Grabe et al., 2012).

Sexual Inhibition/Sexual Excitation Scale (SIS/SES-SF). The SIS/SES-SF (Carpenter, Janssen, Graham, Vorst, & Wicherts, 2011) is a self-report questionnaire assessing sexual arousal (SE) and sexual inhibition (SI). SE and SI are assessed using 24 items on a four-point Likert scale (1 = “strongly disagree,” 2 = “disagree,” 3 = “agree,” 4 = “strongly agree”). The test-retest reliability ($M = 40$ days) of the English version of the SIS/SES-SF is moderate to good ($0.61 < r < 0.75$; Turner, Briken, Klein, & Rettenberger, 2014). The internal consistency of the German version (Cronbach’s α) of the SIS/SES-SF yielded values of 0.74 (SES), 0.55 (SIS1), and 0.67 (SIS2) for men and values of 0.75 (SES), 0.58 (SIS1), and 0.60 (SIS2) for women.

Statistical analyses

All analyses were conducted with IBM SPSS Statistics® 27 and the statistical software R (version 4.3.0). Differences in baseline scores between the groups (intervention vs. waitlist control) were assessed using independent t -tests and chi-square tests. Mixed ANCOVAs were used to evaluate the effectiveness of the retraining. Baseline scores of the primary and secondary endpoints were used as covariates. Both per-protocol (PP) and intention-to-treat (ITT) analyses were conducted. PP was defined as using the retraining technique at least once a week during the intervention period. Additionally, within-subject analyses in the PP sample were conducted using dependent t -tests. To check the robustness of the results regarding the effectiveness of the intervention in relation to missing data, ITT analyses using ANCOVAs for the primary and secondary endpoints were conducted. As there were no indications of the presence of external factors in relation to the missingness, the data were assumed to be missing at random, as is usual for off-treatment assessments (Bell, Fiero, Horton, & Hsu, 2014; Little & Rubin, 2002). A group-wise imputation was performed using multiple imputation by chain equation (fully conditional specification), with 100 imputation sets and 50 iterations each. The imputation model included several auxiliary variables as well as all variables relevant for the analyses to ensure congeniality. The quality of the imputation was examined

using the fraction of missing information and the relative increase of variance.

Effect sizes were calculated as partial eta squares for ANOVAs ($\eta_p^2 = 0.01$: small effect, $\eta_p^2 = 0.06$: moderate effect, $\eta_p^2 = 0.14$: large effect) and Cohen’s d for t -tests. Relations between effectiveness and intervention usage were evaluated with bivariate Pearson correlations. The significance level for all analyses was set at $p < 0.05$.

Ethics

The study was carried out in accordance with the Declaration of Helsinki. The local psychological ethics committee (LPEK) approved the study (LPEK-0302). Informed consent was obtained from all participants.

RESULTS

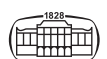
Retention was comparable across groups (controls: 56.2%; retraining: 48.2%, overall: 51.7%), $\chi^2(1) = 1.77$, $p = 0.183$. No significant differences in sociodemographic variables or baseline scores were found between non-completers and completers except for the CSBD-19 baseline score, which showed a higher score for completers ($M = 44.15$, $SD = 12.28$) compared to non-completers ($M = 40.75$, $SD = 12.02$; $t(271) = 2.32$, $p = 0.021$). The participant flow is shown in Fig. 1.

Of those in the retraining condition who completed the post-assessment, 33.4% acknowledged that they had not used the technique at all, whereas 15.2% had performed the exercises once in the intervention period. Nearly one-third (30.2%) had performed the exercises once a week, and 19.7% had performed the exercises multiple times a week. Only 1.5% of the participants had performed the exercises daily.

There were no statistically significant differences in the baseline measurements between those participants who used the technique at least once and those who did not (all $p > 0.132$).

Per-protocol analyses

Group differences for the primary and secondary outcomes were calculated using ANCOVAs with their respective baseline scores as covariates. For the within-subject analyses, dependent t -tests were used. The results are shown in Table 2. The analysis showed a significantly greater reduction in problematic pornography use (PPCS; primary outcome) in the intervention group compared to the waitlist control group, with a small to medium effect size ($F(1; 108) = 4.23$, $p = 0.042$, $\eta_p^2 = 0.038$). Additionally, the quality of life (WHO-QOL) showed a significantly greater increase in the retraining group compared to the control group ($F(1; 108) = 4.18$, $p = 0.043$, $\eta_p^2 = 0.038$). Regarding the between-group comparisons, none of the other secondary outcomes (CSBD, SDIQ, BPS, PHQ-9) turned out to be significant (all $p > 0.14$). The pre-post comparison within the intervention group with the PP data showed a decrease in problematic pornography use (PPCS; $t(33) = 2.03$,



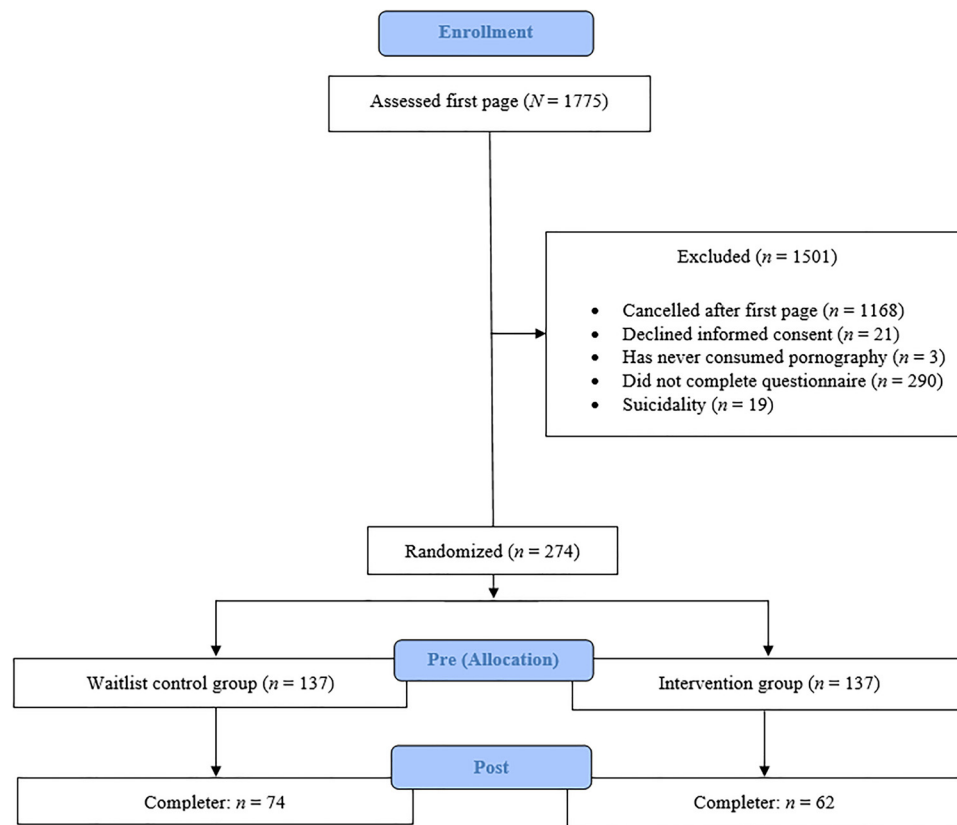


Fig. 1. Participant flow

$p = 0.050$, $d = 0.348$) and an increase in quality of life (WHO-QOL; $t(33) = -1.97$, $p = 0.058$, $d = -0.338$) that bordered at statistical significance at a small to medium effect sizes. The pre-post comparison within the control group showed a significant decrease in sexual desire (SDIQ; $t(76) = 2.89$, $p = 0.005$, $d = 0.330$). For the within-group comparison, none of the other outcomes reached significance (all $p > 0.19$).

Intention-to-treat analyses

The ITT analyses did not yield significant changes in any outcome except for the quality of life (WHO-QOL; $p = 0.034$, $\eta_p^2 = 0.033$). The results are shown in Table 3. Both the fraction of missing information (FMI) and the relative increase of variance (RIV) indicated that the amount of missing data in this trial was substantial and the proportion of uncertainty high, possibly as a result of the high nonadherence and unknown missing data mechanisms (Little & Rubin, 2002; Rubin, 1975).

Dose-response effects and moderation

Complete cases were used for this analysis. The frequency of participants' use of the technique (i.e., only watched video, but did not perform technique; performed exercises once during the study period; performed once weekly; performed several times a week; performed daily) did not correlate with changes in either the primary or any of the secondary outcomes (all $p > 0.13$).

No significant moderation (stages of change, URICA; sexual inhibition/sexual excitation, SIS/SES; child trauma, CTS) was found for the change in PPU (PPCS, primary outcome; all $p > 0.1$).

Subjective appraisal

Table 4 displays the subjective appraisals of the participants in the retraining group who performed the exercises at least once. Over 95% rated the quality of the retraining video as good or excellent, and 75% were overall satisfied with the intervention and found it helpful. Nearly 73% would use the retraining again and would recommend it to a friend. The scope of the intervention was satisfying for two-thirds (68%), and a similar proportion (65.9%) stated they had received the kind of intervention they wanted. The lowest agreement was with the statement regarding whether the retraining met their needs, with 63.6% responding positively.

DISCUSSION

Despite PPU being prevalent and often associated with distress and psychosocial and functional impairment, there are very few evidence-based interventions. Affected individuals may be uncomfortable talking about their PPU and ashamed to seek professional help. Therefore, effective, low-threshold self-help interventions might help to reduce PPU. In this randomized controlled trial, we examined the

Table 2. Results of between-group (ANCOVA) and within-group (*t*-test) comparisons in the PP-sample, with means and standard deviations in parentheses

	Waitlist control group (<i>n</i> = 77)		Retraining (<i>n</i> = 34)		Between groups	Within retraining	Within waitlist control group
	pre	post	pre	post			
PPCS	66.62 (21.44)	68.00 (21.21)	68.15 (21.90)	62.76* (23.05)	<i>F</i> (1; 108) = 4.23, <i>p</i> = 0.042, $\eta_p^2 = 0.038$	<i>t</i> (33) = 2.03, <i>p</i> = 0.050, <i>d</i> = 0.348	<i>t</i> (76) = -0.74, <i>p</i> = 0.459, <i>d</i> = -0.085
CSBD-19	44.51 (12.47)	44.31 (11.82)	43.42 (10.70)	41.74 (12.80)	<i>F</i> (1; 108) = 1.01, <i>p</i> = 0.929, $\eta_p^2 = 0.000$	<i>T</i> (33) = 1.09, <i>p</i> = 0.248, <i>d</i> = 0.187	<i>t</i> (76) = 0.26, <i>p</i> = 0.794, <i>d</i> = 0.030
SDIQ	50.71 (10.82)	47.03** (13.74)	48.59 (15.48)	48.29 (14.25)	<i>F</i> (1; 108) = 2.11, <i>p</i> = 0.150, $\eta_p^2 = 0.019$	<i>t</i> (33) = 0.24, <i>p</i> = 0.812, <i>d</i> = 0.041	<i>t</i> (76) = 2.89, <i>p</i> = 0.005, <i>d</i> = 0.330
BPS	6.36 (2.47)	6.35 (2.57)	6.21 (2.59)	5.94 (2.72)	<i>F</i> (1; 105) = 0.52, <i>p</i> = 0.473, $\eta_p^2 = 0.005$	<i>t</i> (33) = 0.94, <i>p</i> = 0.353, <i>d</i> = 0.162	<i>t</i> (73) = 0.05, <i>p</i> = 0.962, <i>d</i> = 0.006
PHQ-9	8.57 (4.92)	9.19 (6.00)	7.68 (5.22)	8.53 (6.12)	<i>F</i> (1; 108) = 0.01, <i>p</i> = 0.596, $\eta_p^2 = 0.002$	<i>t</i> (33) = -1.00, <i>p</i> = 0.324, <i>d</i> = -0.172	<i>t</i> (76) = 1.31, <i>p</i> = 0.194, <i>d</i> = -0.149
WHO-QOL	3.61 (0.84)	3.54 (0.98)	3.44 (0.86)	3.74* (0.93)	<i>F</i> (1; 108) = 4.18, <i>p</i> = 0.043, $\eta_p^2 = 0.038$	<i>t</i> (33) = -1.97, <i>p</i> = 0.058, <i>d</i> = -0.338	<i>t</i> (76) = 0.80, <i>p</i> = 0.427, <i>d</i> = 0.093

Note. PPCS = Problematic Pornography Consumption Scale; CSBD-19 = Compulsive Sexual Behavior Disorder Scale; SDIQ = Sexual Desire Inventory; BPS = Brief Pornography Screen; PHQ-9 = Patient Health Questionnaire; WHO-QOL = WHO Quality of Life global item. *BPS* *n* = 74; **p* < 0.05, ***p* < 0.01, ****p* < 0.001

effectiveness of the imaginal retraining technique adapted for PPU as a self-help intervention delivered via video in a sample of 274 individuals seeking to reduce their self-reported pornography use.

When analyzing the PP sample (post-assessment completed and intervention used at least once a week), problematic pornography use (primary outcome) decreased significantly in the retraining group after six weeks compared to the control group. Regarding secondary outcomes, no significant differences were found between the retraining and the control group except for a greater increase in quality of life in the retraining group compared to the control group. Interestingly, there was a within-group decline in sexual desire in the control group but not in the retraining group. At this point, we can only speculate that this decline is a chance finding or reflects a selective expectancy effect in a treatment-seeking yet untreated sample. Additionally, no moderator (usage frequency, willingness to change, SI/SE, neglect, or abuse experiences) for this change in pornography use was found. The ITT analyses showed no significant results, again except for the change in quality of life. Due to the rather conservative nature of the ITT analyses and the high dropout rate in this pilot study, the ITT results must be regarded as a conservative complement to the results of the PP analysis and interpreted with caution.

The results of this study are in line with the previous research on psychotherapeutic interventions for CSBD/PPU. In a recent systematic review of interventional trials for CSBD/PPU (Antons et al., 2022) a total of 24 studies were included, the majority (*n* = 18) examining psychotherapeutic interventions. Overall, small effect sizes for symptom decrease were reported. However, the overall low quality of the included trials (i.e., rarely randomized controlled, rarely preregistered), emphasizes the need for further, high-quality research (Antons et al., 2022).

Overall, the effects found in this pilot study are smaller than in other retraining studies evaluating the technique for problematic drinking ($\eta_p^2 = 0.311$ for primary outcome; Moritz, Paulus, et al., 2019) and consumption of high-calorie food ($\eta_p^2 = 0.051$; Moritz, Göritz, et al., 2019) but comparable with the results for smoking ($\eta_p^2 = 0.039$; Moritz et al., 2020). This could be due to several factors. First, previous retraining studies found effects on craving, which we did not assess specifically in this trial. Second, approach biases have been examined in the context of CSBD/PPU, but the underlying model of CSBD/PPU is not fully understood yet. Approach biases may not be the same for all addiction related or addiction like conditions as, for example, some studies found no approach bias in smokers (Wittekind, Lüdecke & Cludius, 2019; Wittekind, Reibert, et al., 2019) whereas the bias is more evident in problematic drinking (Kakoschke, Albertella, Lee, & Wiers, 2019). Participants in this study did not require a formal diagnosis of CSBD, and no symptom severity cut-off was set for eligibility for this pilot study. The mean PPCS and CSBD-19 scores at baseline were below the recommended cut-offs (Böthe et al., 2018, 2020), indicating a less impaired sample compared to those



Table 3. Results of the intention-to-treat analyses

Variable	F (df^a)	p	η_p^2	95% CI	RIV	FMI
PPCS	1.75 (538.93)	0.187	0.014	0.013; 0.014	0.747	0.437
PHQ-9	0.86 (536.162)	0.355	0.008	0.008; 0.009	0.931	0.492
SDIQ	0.58 (1,172.640)	0.446	0.005	0.004; 0.005	0.802	0.454
BPS	2.78 (406.10)	0.096	0.024	0.022; 0.025	1.043	0.520
WHO-QOL	4.152 (396.33)	0.034	0.033	0.031; 0.034	0.959	0.499

Note. PPCS = Problematic Pornography Consumption Scale; SDIQ = Sexual Desire Inventory; PHQ-9 = Patient Health Questionnaire; BPS = Brief Pornography Screen; WHO-QOL = WHO Quality of Life global item; RIV = relative increase of variance; FMI = fraction of missing information. ^aApproximated df based on multivariate imputation.

Table 4. Positive appraisal (adapted from the Client Satisfaction Questionnaire (CSQ-8) of the intervention group ($n = 44$). Means and standard deviation in parentheses

Item	M (SD)	Positive appraisal in %
How would you rate the quality of the intervention? (4 = excellent, 3 = good, 2 = less good, 1 = poor)	3.34 (0.57)	95.5%
Did you receive the kind of intervention you wanted? (1 = definitely not, 2 = not really, 3 = generally yes, 4 = definitely yes)	2.64 (0.69)	65.9%
To what extent did the intervention meet your needs? (4 = it met almost all, 3 = it met most, 2 = it met only a few, 1 = it did not meet any)	2.70 (0.59)	63.6%
Would you recommend the intervention to a friend? (1 = definitely not, 2 = somewhat not, 3 = I think so, 4 = definitely yes)	2.91 (0.74)	72.7%
How satisfied are you with the scope of the intervention you received here? (1 = dissatisfied, 2 = slightly dissatisfied, 3 = mostly satisfied, 4 = very satisfied)	2.73 (0.62)	68.2%
Did the intervention help you deal with your problems more appropriately? (4 = very, 3 = somewhat, 2 = not really, 1 = not at all)	2.86 (0.67)	75.0%
Overall, how satisfied are you with the intervention? (1 = dissatisfied, 2 = slightly dissatisfied, 3 = mostly satisfied, 4 = very satisfied)	2.89 (0.81)	75.0%
Would you use the intervention again? (1 = definitely not, 2 = I don't think so, 3 = I think so, 4 = definitely yes)	2.95 (0.71)	72.7%

Note. Negatively formulated items were recoded so that this numeric score always applies: 1 = negative evaluation, 4 = positive evaluation. Positive appraisal: 3 and 4 combined.

in other studies (e.g., [Bóthe et al., 2021](#)). Only around 30% of the participants in this trial exceeded the cut-off for a high risk of problematic pornography use. This might have led to floor effects in the analyses.

Participants evaluated the quality of the intervention and their overall satisfaction with it positively. This stands in contrast to their low adherence to the recommended usage of the imaginal retraining. Even though we found no dose-response relationship in this trial, the low frequency of use may also have contributed to the results.

Some limitations of this study must be considered. First, it should be noted that only the problematic pornography use assessed with the PPCS but not the other secondary outcomes (BPS and CSBD-19) decreased significantly. Since the secondary outcomes did not support the reduction in symptomatology, effectiveness of the intervention must be interpreted with caution. There were multiple, partly overlapping measurements (PPCS, BPS, CSBD-19) used in this study, and the result of the PPCS would not withstand a correction for multiple testing. However, since we defined only one preregistered primary outcome a priori, correction for multiple testing was deemed unnecessary. Additionally, the gender of the participants in this study was not well balanced because the majority were men. However, this was

expected considering the preponderance of men with PPU. The unbalanced gender ratio is also found in other studies on treatment for CSBD/PPU. [Antons et al. \(2022\)](#) reported in their systematic review including 1,058 participants that over 90% were male. Also, we did not assess the sexual orientation of the participants. The retraining video is designed and worded inclusively for all genders and sexual orientations. Nevertheless, sexual orientation could be an influencing factor in this setting. The retention rate in this study was higher compared to another study examining the effectiveness of an online self-help intervention for PPU (48.2% for our intervention group vs. 11% in [Bóthe et al., 2021](#)), but adherence was still low. Only a small percentage of the participants in the retraining group followed the recommendation to use the retraining daily. Poor adherence is a known problem in studies on Internet-based interventions, regardless of the disorder examined. A meta-analysis by [Cuijpers, Noma, Karyotaki, Cipriani, and Furukawa \(2019\)](#) that included 155 studies with 15,191 depressive participants showed that self-help interventions (guided and unguided) have a higher risk for dropouts compared to care as usual. Other reviews substantiate these findings (e.g., [Karyotaki et al., 2015](#); [Saad, Bruno, Camara, D'Agostino, & Bolea-Alamanac, 2021](#)). The low



intervention adherence might be explained by the form in which the technique was provided. The instruction video was stored on a website that was only accessible via the link provided in an email to the intervention group. Although the participants were encouraged to download the video for easy access, we cannot validate that they did. The video contains psychoeducational content in the beginning, before the technique is explained. Watching the video only once might not be sufficient to implement the retraining in everyday life, but the length of the video and the repetitive psychoeducation might have discouraged participants from watching the video more often and thus from using the retraining. Therefore, it could be beneficial to present the technique in a standalone, shorter video. In addition, frequency of use, which partly defined the PP sample, was only assessed via self-report. Due to the nature of the retraining, no objective data regarding usage (e.g., log-in frequency) could be assessed; hence, the self-reporting of the participants had to be relied upon. The same applies to all measures in this study. Self-report measures in anonymous online studies have advantages, especially regarding stigmatization and social desirability. However, they can be biased by motivations or perception of the participant. An additional clinician-rated assessment would improve validity of the results in future studies.

Notwithstanding these limitations, results suggest that retraining might be a feasible and promising theory-based intervention in reducing participants' PPU, given the significant reduction in the primary outcome in the PP sample. The retraining is a cost-free and low-threshold intervention for anyone with access to the internet. We deem it worthwhile to undertake further research efforts to identify moderators and target subgroups more specifically, if necessary, as well as increase adherence. For future research, it would be worth evaluating whether the retraining is beneficial for clinical groups with higher symptom severity (i.e., patients with CSBD) and whether a variant of the intervention called 3p, which combines imaginal retraining with decoupling, a technique successfully tested in body-focused repetitive behaviors (e.g., Moritz, Penney, Bruhns, Weidinger, & Schmotz, 2023), would result in higher efficacy (Moritz, Göritz, Kühn, & Gehlenborg, 2023). Additionally, the validity of results in future studies would improve if an active control group were implemented.

Funding sources: No financial support was received for this study.

Authors' contributions: AB: formal analysis, investigation, project administration, writing—original draft; JG: methodology, investigation, project administration, writing—review & editing; LS: formal analysis, writing—review & editing; SM: conceptualization, methodology, writing—review & editing, supervision; PB: conceptualization, methodology, writing—review & editing, supervision.

Conflict of interest: The authors declare no conflict of interest.

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