

Masked liking of pornography: implicit associations in men with compulsive sexual behavior

Jannis Engel, PhD^{1,*}, Antonia Waechter, Bsc¹, Maria Veit, Msc¹, Jonas Kneer, Msc¹, Christopher Sinke, PhD¹, Matthias Brand, PhD^{2,3}, Tillmann H.C. Krueger, MD¹

¹Department of Psychiatry, Social Psychiatry and Psychotherapy, Division of Clinical Psychology and Sexual Medicine, Hannover Medical School, 30625 Hannover, Germany

²Department of General Psychology, Cognition and Center for Behavioral Addiction Research, University of Duisburg-Essen, 47057 Duisburg, Germany

³Erwin L. Hahn Institute for Magnetic Resonance Imaging, 45141 Essen, Germany

*Corresponding author: Arbeitsbereich Klinische Psychologie und Sexualmedizin, Klinik für Psychiatrie, Sozialpsychiatrie und Psychotherapie, Zentrum für Seelische Gesundheit, Medizinische Hochschule Hannover, Carl-Neuberg-Str. 1, 30625 Hannover, Germany. Email: engel.jannis@mh-hannover.de

Abstract

Background: Compulsive Sexual Behavior Disorder is a new category in the 11th version of the International Classification of Diseases and is showing neuropsychological similarities to substance dependencies and behavioral addictions.

Aims: This experimental study aims to further our knowledge on implicit associations in Compulsive Sexual Behavior (CSB) with a clinical sample.

Methods: Participants completed an Implicit Association Test modified with pornographic pictures. In addition, problematic sexual behavior and sensitivity toward sexual excitation were assessed.

Outcomes: We collected data on implicit associations from 47 heterosexual men with CSB (age, $M = 36.51$, $SD = 11.47$) and a control group of 38 men without the condition (age: $M = 37.92$, $SD = 12.33$).

Results: Results show significantly more positive relationships between implicit associations of pornographic pictures with positive emotions, as well as with problematic sexual behavior and sensitivity toward sexual excitation, in men with CSB vs. men without CSB. Furthermore, implicit associations, sexual excitation, and sexual inhibition due to threat of performance consequences differentiated significantly between groups using a binary stepwise logistic regression analysis. The findings are in line with those of previous subclinical investigations and support the assumption of pronounced positive implicit associations in CSB. Moreover, as suggested by the I-PACE model of addictive behaviors, implicit associations may be crucial to the maintenance of behavioral addictions.

Clinical implications: Implicit associations could be addressed in therapy to illustrate cognitive processes of those affected and as an outcome measure in research on treatment efficiency.

Strengths & limitations: The present study is the first to investigate implicit associations in CSB in a clinical sample. Findings are limited to heterosexual men.

Conclusion: Findings can be seen in accordance with a proposed classification of CSB as a behavioral addiction.

Keywords: compulsive sexual behavior; addictive behavior; implicit associations; hypersexual disorder; problematic pornography use.

Introduction

The World Health Organization included Compulsive Sexual Behavior Disorder (CSBD) in the 11th revision of the International Classification of Diseases (ICD-11)¹ as an impulse control disorder. CSBD is characterized as intense, repetitive sexual impulses or urges over an extended period of time (6 months or more) resulting in sexual behavior, increasing priority of sexual behaviors, and continuation of the behavior despite negative consequences accompanied by marked distress or significant impairment in personal, family, social, educational, occupational, or other important areas of functioning.¹ Sexual behavior can manifest itself in the form of problematic pornography use (PPU), which is the most commonly reported sexual behavior in CSBD patients.^{2,3}

In particular, sexual excitation and, to a lesser extent, sexual inhibition due to threat of performance consequences may represent an important precondition for CSB, while sexual inhibition due to performance failure appears to play a less important role.^{4,5} These findings were confirmed in the present sample.⁶ According to the I-PACE model (Interaction of Person-Affect-Cognition-Execution), addictive behaviors are the result of the interactions between predisposing variables, affective and cognitive responses to specific stimuli, and executive functions, such as decision making.⁷ A possible pathway to addictive behavior to pornographic stimuli could be that predisposing variables (eg, high sexual arousal or adverse early childhood experiences) interact with affective responses (eg, urges to consume pornography) that

Received: April 11, 2024. Accepted: November 5, 2024

© The Author(s) 2025. Published by Oxford University Press on behalf of The International Society of Sexual Medicine.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License

(<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

lead to decisions to approach pornographic stimuli despite negative consequences (eg, neglect of responsibilities). In the early stages of the development of an addictive behavior, the gratification induced by pornography consumption leads increases positive implicit associations. Whereas in later stages of the addiction process, positive implicit associations toward addictive stimuli (ie, pornographic images) remain, but a shift from an experience from gratification to compensation can be observed. Implicit associations represent non-volitionally accessible positive or negative evaluations and are affective responses according to the I-PACE model. The affective responses include, in the early stages of the development of CSB, diminished executive control functions and, in the later stages, stimuli-specific reductions in inhibitory control, which contribute to difficulties in resisting temptation despite knowledge of negative long-term consequences. As cue-reactivity and craving emerge and inhibitory control may diminish, the behavior is considered to be guided increasingly by automatic neural systems, thus reinforcing the cycle of addiction and perpetuating addictive behaviors.⁷

The Incentive Sensitization Theory by Robinson and Berridge states addiction-related cues increasingly attract attention and elicit “wanting” and incentive motivation to consume the drug resulting in an implicit action tendency.⁷ Cue-reactivity and craving are thought to be increasingly based on automatic processes triggered by neural adaptations while positive subjective effects of drug intake are considered to decrease.⁷

The seemingly uncontrolled processing of drug-related stimuli may underlie dysfunctional decision-making behavior. One form of these involuntary automatic processes are implicit cognitions that occur as part of a associative network when addiction-related stimuli are presented. In accordance, in substance use disorders and behavioral addictions, implicit cognitions in particular have been shown to be a reliable predictor of addictive behaviors, despite being aware of the harm.^{8,9} They can be represented by implicit arousal, eg, attentional bias, implicit associations and attitudes.⁹ In CSB, studies on cue-reactivity and craving, as well as attentional bias have yielded comparable results.¹⁰⁻¹⁵

In this context, Snagowski, Wegmann, Pekal, Laier, & Brand¹⁶ designed a study to measure implicit associations in men with a tendency toward cybersex addiction. Accordingly, Snagowski et al.¹⁶ modified the Implicit Association Test¹⁷ (IAT) with pornographic pictures. With the IAT one can measure unconscious cognitive biases. Snagowski et al.¹⁶ found stronger positive implicit associations between pornographic images and tendencies toward CSB. Snagowski et al.¹⁶ questioned whether the results they found would also show up in clinical populations, since they only studied a sample from the general population.

The present study is a conceptual expansion of the study by Snagowski et al.¹⁶ with a clinical sample. We hypothesize that implicit associations to pornographic pictures are more positive in men with CSB than in men without CSB (hypothesis 1). Moreover, with our hypothesis 2 we tested the results of Snagowski et al.¹⁶ and expected positive relationships between symptoms of problematic online sexual activities (measured with s-IATsex), sexual excitation (measured with Sexual Excitation Scale [SES]), and symptoms of hypersexual behavior (measured with HBI-19). In addition, we expected that implicit associations, sexual excitation, pornography consumption and sexual inhibition due to threat of performance consequences predict group classification (hypothesis 3).

Methods and procedure

Participants

The study was approved by the ethics committee of the Hannover Medical School in Germany. All participants were able to speak German and understood the study instructions and gave written, informed consent prior to the investigation. Participants received monetary compensation (100€). Participants were recruited through a press release by the Hannover Medical School and social media (eg, www.facebook.com, www.instagram.com). A total of 539 men with self-identified CSB contacted the study team via email of which 260 responded to an email requesting a telephone number (see Figure 1). Two hundred and one individuals could be reached via phone and were screened in a semi-standardized telephone interview of ~45 min conducted by a trained psychologist using criteria proposed by Kafka.¹⁸ The questionnaires used in this study were mailed to eligible participants. Three participants whose scores did not meet the cut-off (53) of the Hypersexual Behavior Inventory 19¹¹ were excluded post hoc. The study was conducted before the publication of the ICD-11 criteria for CSBD,¹ the data all participants were collected between December 2016 – August 2017. Some differences between the concepts of hypersexual disorder and CSBD should be noted. Moral incongruence was explicitly mentioned as an exclusion criterion in the CSBD criteria, but not in hypersexual disorder.¹¹ However, we would argue that moral incongruence is implicitly included in the HD criteria, as they state that symptoms must be “recurrent and intense”.¹⁸ In contrast to CSBD in the ICD-11,¹ the criteria for hypersexual disorder include maladaptive emotion regulation strategy as a symptom.¹⁹ In summary, it can be argued that the criteria for CSBD and HD describe the same underlying condition, as they share crucial criteria, such as impaired control over sexual impulses leading to negative consequences, accompanied by unsuccessful efforts to control behavior.¹² The present study was part of the Sex@Brain study in which questionnaires, neuropsychological, epigenetic and magnetic resonance imaging techniques were used to investigate the clinical presentation of CSB.

Men without CSB were recruited via advertisements on the intranet home page of the Hannover Medical School. In total, 56 of 85 participants who contacted the study team provided a telephone number. Forty-one of these could be reached and were screened for the absence of CSB symptoms. Men with CSB did not differ from men with CSB in regard of age ($P = 0.587$) and education ($P = 0.503$). Data from three men without CSB were excluded from the analysis (one reported a severe head injury prior to participation in the study, one reported a homosexual orientation, and one control participant did not appear for assessment). In total 85 heterosexual men participated in this study. Sexual orientation was assessed with a Kinsey-scale. Forty-seven as part of the CSB group ($M_{\text{age}} = 36.51$, $SD_{\text{age}} = 11.47$), and 38 as part of the men without CSB group ($M_{\text{age}} = 37.92$, $SD_{\text{age}} = 12.33$). For socio-demographic comparisons see Table 1.

Measures

Implicit association test

The IAT¹⁷ assesses the strength of cognitive associations between a target and attribute concept by determining the speed of assignment of the stimulus material to the respective concept. The experiment was carried out in a research laboratory at the Hannover Medical School. To ensure comparability

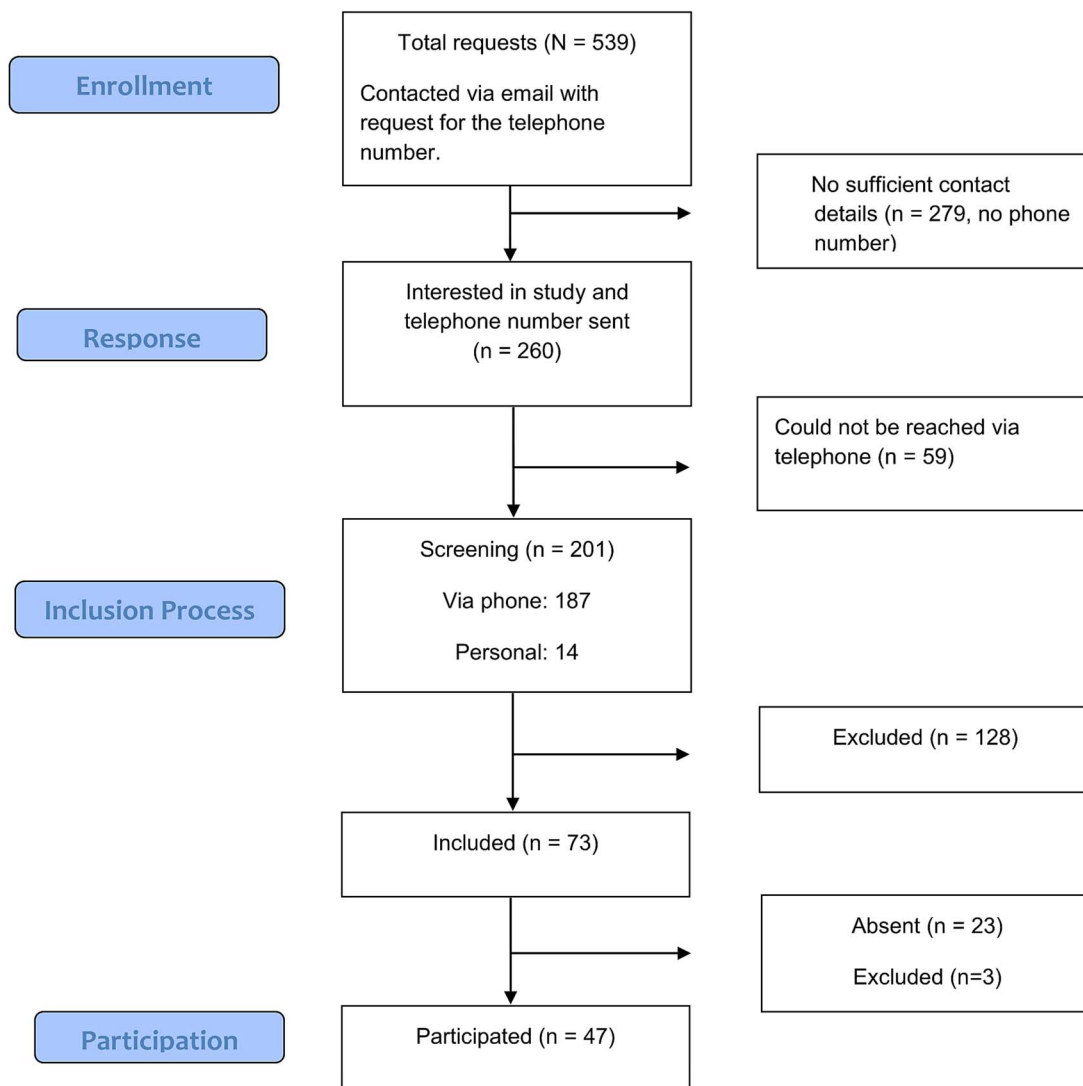


Figure 1. Recruitment of the men with CSB.

with Snagowski et al.,¹⁶ the same version of the IAT modified with pornographic pictures was used. Target concepts were “pornography” vs. “jogging”, whereas attribute concepts were “positive” vs. “negative”. For each category, 10 pictures were chosen and displayed in the according rounds. See Figure 2 for more information on the progression of rounds. The pictures representing the attribute concepts “positive” and “negative” were taken from the International Affective Picture System (IAPS).¹³ Pictures of the category “pornography” showed sexually explicit outdoor scenes of a man and a woman during vaginal intercourse. The actors in the pictures were approximately between 20 and 30 years old. To ensure a certain comparability with the images of the “pornography” group, photos of a male and female jogger (ie, two people running next to each other) with a neutral facial expression were selected for the other concept. They were matched in color, complexity, and background with the stimuli of the “pornography” condition.²⁰

The attribution and target concepts were presented in different combinations as recommended by Nosek et al.²¹ and executed by Snagowski et al.,¹⁶ resulting in trials which are congruent (“pornography or positive” vs. “jogging or negative”) to our hypothesis 1 of more positive implicit associations in

men with CSB than in men without CSB (“pornography or positive” vs. “jogging or negative”) or trials that are incongruent (“pornography or negative” vs. “jogging or positive”) to our hypothesis 1. Each round, the participants were asked to assign the pictures to the appropriate concept as quickly as possible using a standard keyboard (by pressing “Q” and “P” with the left and right hand) and the reaction times were measured. The pictures were presented on a 19-inch Monitor standing 90 cm away. As the dependent variable, the IAT-score was used, more specifically, the D_{2SD} -score (dividing the difference between test block means by the standard deviation of all the latencies in the two test blocks; latencies get deleted if $> 10\,000$ ms; adding an error penalty of 2 standard deviations) since it is considered to be more appropriate than other scoring algorithms.¹⁶ A positive score indicates a stronger positive implicit association with the respective stimulus.

Questionnaires

The 19 items of the German version of the Hypersexual Behavior Inventory—19 (HBI-19)²² depict the symptoms of an Hypersexual Disorder, as proposed by Kafka¹⁷ but which were ultimately rejected for DSM-5.²² It assesses three factors: *Control* (eg, “My sexual cravings and desires feel stronger

Table 1. Socio-demographic characteristics of participants in the Sex@Brain study.

Socio-demographic Variables	%	Men with CSBD		Men without the condition	
		M (SD)	%	M (SD)	P-value
Age		36.51 (11.47) Range: 20–59		37.92 (12.33) Range: 20–61	0.587 ^a
Highest Educational Qualification ^b					0.503 ^b
Secondary school leaving certificate of secondary education (4 years)	4		3		
Secondary school leaving certificate (5 years)	11		5		
Completed apprenticeship	28		26		
Secondary school leaving certificate (8 years)	21		40		
University degree	34		26		
Employment status					0.458 ^b
Unemployed	9		14		
In training	27		30		
Retired	4		8		
Employed	66		48		
Relationship status					0.076 ^b
Single status	39.5		39.5		
In a relationship	57.4		46.8		
Duration current/last relationship (in months)		73.1 (95.18)		70.96 (96.12)	0.92 ^a
Number of children		0.74 (1)		0.77 (1.03)	0.936 ^c

Abbreviations: CSBD, Compulsive Sexual Behavior Disorder; SD: Standard deviation. ^aStatistical analysis: t-test. ^bStatistical analysis: Fisher–Freeman–Halton’s exact test. ^cStatistical analysis: Wilcoxon–Mann–Whitney test.

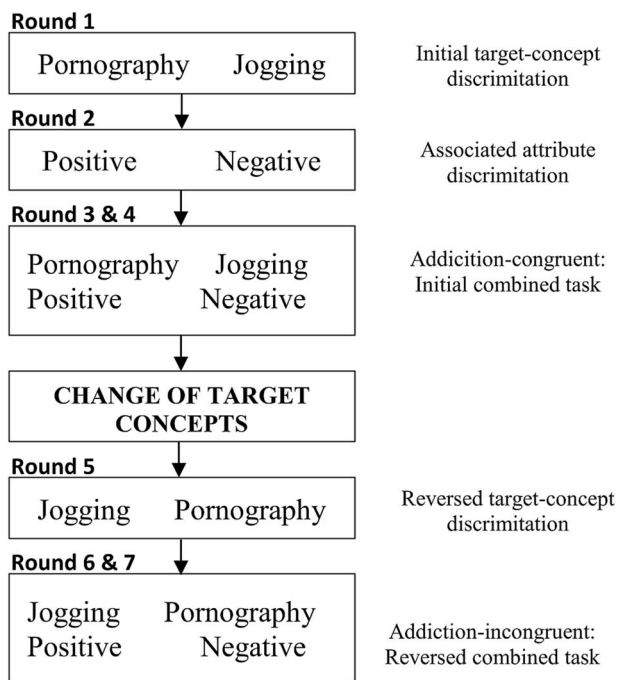


Figure 2. Overview of the implicit association test procedure (based on Snagowski et al., 2015). The aim of rounds 1 and 2 was to practice the target and attribute concepts. In rounds 3 and 4, which were separated by a short break, the target and attribute concepts were combined in a congruent combined task (“pornography or positive” vs. “jogging or negative”). After these rounds, the target concepts were swapped and practiced again in round 5. Subsequently, rounds 6 and 7 represent rounds with an incongruent task (“jogging or positive” vs. “pornography or negative”), again separated by a short break.

than my self-discipline.”), *coping* (eg, “I use sex to forget about the worries of my daily life.”), and *consequences* (eg, “My sexual behavior controls my life.”). In our sample, internal consistency was high (Cronbach’s $\alpha = .98$).

The short version of the Internet Addiction Test adapted to Online Sexual Activities¹⁹ measures symptoms of problematic online sexual activities. The term “problematic” refers to difficulties to control the extent of online sexual behaviors and not the consumption of “problematic” contents, eg, child abusive images. The two-factor structure of the s-IATsex contains subscales measuring *loss of control/time management* (eg, “How often do you find that you stay on Internetsex sites longer than you intended?”) and *craving/social problems* (eg, “How often do you feel depressed, moody, or nervous when you are online, which goes away once you are back on internet sex sites?”). In our sample, internal consistency was high (Cronbach’s $\alpha = .96$).

In order to assess individual tendencies to sexual inhibition and excitation, the Sexual Inhibition Scales (SIS)-SES²³ were used. The questionnaire assesses three factors: *Sexual* excitation (SES; eg, “When I think of a very attractive person, I easily become sexually aroused.”), sexual inhibition due to performance failure (SIS1; eg, “If I am concerned about pleasing my partner sexually, I easily lose my erection”), and sexual inhibition due to threat of performance consequences (SIS2; eg, “If there is a risk of unwanted pregnancy, I am unlikely to get sexually aroused”). Answers are recorded on a 4-point-scale ranging from 1 (= strongly agree) to 4 (= strongly disagree).²³ In our sample, internal consistencies measured by Cronbach’s alpha were high, namely .7 (SIS2), .87 (SIS1), and .93 (SES).

To assess pornography consumption, participants were asked to report their average pornography consumption (average minutes per day during the last week).

Statistical analysis

All data analyses were performed on SPSS version 24 (IBM® Corporation, Armonk, NY, USA) for Windows. Statistical analyses were carried out using independent, two tailed t-tests (hypothesis 1) and correlation analyses (hypothesis 2). A binary logistic regression analysis according to the forced

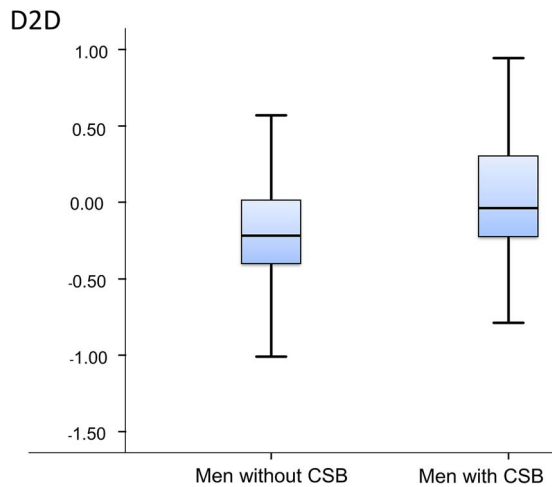


Figure 3. Values of IAT-score (D2SD) in men with vs. without CSB. **P*-value <0.05 was considered significant.

entry method with group classification as the dependent dichotomous variable was performed to identify which personality domains differed between men with and without CSB (hypothesis 3).

Results

Comparisons between men with CSB and men without CSB

The main analysis of IAT-scores (hypothesis 1) between men with CSB and men without CSB revealed significantly higher scores in men with CSB (men with CSB $M = 0.01 \pm 0.40$, men without CSB $M = -0.22 \pm 0.37$, $t(83) = -2.71$, $p = .004$, $d = 0.59$), indicating more positive associations toward pornographic pictures in men with CSB compared to the control participants, see Figure 3. The mean value of the IAT-score in the CSB group did not show positive or negative implicit associations. Men without CSB showed strong negative associations.

Men with CSB showed significantly higher HBI-19 scores, as well as higher s-IATsex scores (men with CSB $M = 72.37 \pm 10.31$, men without CSB $M = 30.08 \pm 10.16$, $t(78) = -18.81$, $P < .001$, $d = 4.12$). Furthermore, men with CSB showed a statistically significant higher sexual excitation scores (SES) and higher pornography consumption per day compared to men without CSB (men with CSB $M = 60.92 \pm 9.79$, men without CSB $M = 50.41 \pm 9.39$, $t(83) = 5.31$, $P < .001$, $d = 1.09$). Sexual inhibition due to threat of performance (SIS1) consequences was increased in men with CSB compared to without CSB (men with CSB $M = 35.79 \pm 8.18$, men without CSB $M = 32.39 \pm 5.39$, $t(83) = 2.30$, $P = .024$, $d = 0.48$). Sexual inhibition due to threat of performance consequences (SIS2) was decreased in men with CSB compared to without CSB (men with CSB $M = 25.66 \pm 4.9$, men without CSB $M = 29.45 \pm 4.26$, $t(83) = 3.75$, $P < .001$, $d = -0.81$). Results can be viewed in Table 2.

Correlation analysis

Correlations of the whole sample between the IAT-score and variables that were selected to ensure comparability with

Snagowski et al.¹⁶ are displayed in Table 3. Significant positive relationships between the positive implicit associations (IAT-score) and symptoms of hypersexual behavior, as well as s-IATsex were observed. Moreover, positive relationships between the s-IATsex and sexual excitation, as well as symptoms of hypersexual behavior were observed (hypothesis 2).

Binary logistic regression analysis

Sexual excitation (OR = 1.13, 95% CI [1.04–1.23]), sexual inhibition due to threat of performance consequences (OR = 0.85, 95% CI [.72–.99]) and pornography consumption (OR = 1.04, 95% CI [1.02–1.07]) differed significantly between men with and without CSB (hypothesis 3). The IAT-score (OR = 4.96, 95% CI [.98–25.16]) did not differentiate significantly between groups ($P = .053$). The specified regression model had an acceptable fit (Nagelkerke $R^2 = 0.65$; Hosmer-Lemeshow test: $\chi^2(8) = 6.33$, $df = 8$, $P = .61$). The mean classification accuracy was 85.4% (.88 specificity, .82 sensitivity). For further information see Table 4.

Discussion and conclusions

General discussion

The current study is the first to include a clinical sample and a group of men without CSB in the context of implicit associations toward pornographic pictures in CSB. The main result of the current study is that men with CSB showed stronger implicit associations between pornographic pictures and positive emotions compared to men without CSB (confirmed hypothesis 1). This effect was observed even though the associations with erotic stimuli were negative in the group of men without CSB and neutral in the group of men with CSB. The finding emphasizes that implicit cognitions may play an important role in CSB, as suggested by theoretical models, ie, the I-PACE model.⁷ Hypothesis 2 was only partly confirmed as only symptoms of hypersexual behavior, symptoms of cybersex addiction were significantly associated to the IAT-score, but not sexual excitation. Contrary to our hypothesis 3, implicit associations and sexual inhibition due to threat of performance consequences did not differ between groups when sexual arousal and pornography consumption were taken into account, whereas the latter two significantly differed between groups. In the following we discuss the findings in detail.

In accordance with hypothesis 1, men with CSB showed relatively stronger implicit associations between pornographic pictures and positive emotions than men without CSB. However, it is important to consider not only the relative differences between groups, but also the absolute level of implicit associations. This approach shows that implicit associations with pornography are neutral among men with CSB ($M = .01$, $SD = .39$), while they are negative among men without CSB. This effect may be due to the laboratory setting, in which both groups show less sexual response than would be the case, for example, when consuming pornography on a home computer or smartphone. In a naturalistic experiment conducted at home, stronger positive associations with pornography would be expected in both groups. In addition, it is possible that males with CSB, in particular, have individuals who, due to negative experiences with pornography, have a stronger suppression of the sexual response when shown pornographic images, and that this mitigates the positive association with pornographic images in this group. In apparent contradiction

Table 2. Comparison between men without CSBD and men with CSBD.

Variable	CSBD Group		Without CSBD		Test statistic	P-value	Effect size (d)
	N	M (SD)	N	M (SD)			
IAT-score	47	.01 (.40)	38	-.22 (.37)	$t(83) = -2.709$	= .004	0.594
SES(sum)	47	60.92 (9.79)	38	50.41 (9.39)	$t(83) = 5.314$	< .001	1.094
SIS1(sum)	47	35.79 (8.18)	38	32.39 (5.39)	$t(83) = 2.304$	= .024	.482
SIS2(sum)	47	25.66 (4.9)	38	29.45 (4.26)	$t(83) = 3.75$	< .001	-.819
HBI-19total	47	72.37 (10.31)	37	30.08 (10.16)	$t(78) = -18.813$	< .001	4.127
s-IAT-sextotal	47	29.55 (14.50)	38	17.11 (7.07)	$t(83) = -11.225$	< .001	1.056
Pornography consumption per day (min) last week	45	87.53 (125.5)	37	18.93 (19.82)	$t(80) = -3.613$	< .001	94.01

Note. IAT-Score (D2SD): higher scores indicate higher positive implicit association toward pornography; SES: Sexual Excitation Scale, higher scores indicate a greater proneness toward sexual excitation; SIS1 higher scores indicate a greater proneness toward sexual inhibition due threat of performance failure, SIS2 higher scores indicate a greater proneness toward sexual inhibition due threat of performance consequences, s-IAT-sex: score of short Internet Addiction Test Sex, higher scores indicate greater symptoms of problematic cybersexual behavior; HBI-19: Hypersexual Behavior Inventory, higher scores indicate greater symptoms of hypersexual behavior. Abbreviations: CSBD, Compulsive Sexual Behavior Disorder; IAT, Implicit Association Test; SD, Standard deviation; SES, Sexual Excitation Scale.

Table 3. Bivariate correlations between the IAT score and selected variables (whole sample).

	IAT-score	SES	s-IAT-sex	HBI-19	SIS1	SIS2
IAT-score	—					
SES	.156	—				
s-IAT-sex	.214*	.484**	—			
HBI-19	.330**	.568**	.841**	—		
SIS1	.239*	.196	.327**	.308**	—	
SIS2	-.090	-.439**	-.364**	-.436**	0.38	—

Note: IAT-score (D2SD): measure of implicit associations; SES: Sexual Excitation Scale measuring proneness toward sexual excitation, lower values indicate higher proneness toward sexual excitation; s-IAT-sex: score of short Internet Addiction Test Sex measuring problematic cybersex; HBI-19: Hypersexual Behavior Inventory measuring hypersexual behavior. * $P < .05$. ** $P < .01$.

Table 4. Regression analysis.

	95% CI for Odds Ratio			
	B (SE)	Lower	Odds Ratio	Upper
<i>Included</i>				
Constant	-3.37 (3.33)			
Sexual excitation	0.12 (0.04)	1.04	1.13	1.23
IAT-Score	1.60 (0.83)	0.98	4.96	25.16
Pornography consumption	0.04 (0.01)	1.02	1.04	1.07
Sexual Inhibition due to threat of performance consequences	-0.17 (0.08)	0.72	0.85	0.99

Note: $R^2 = 0.48$ (Cox & Snell), 0.65 (Nagelkerke); Hosmer & Lemeshow: $\chi^2(8) = 6.33$, $df = 8$, $P = .61$ Abbreviation: IAT, Implicit Association Test.

to our findings, surveys show that recreational users have higher positive attitudes toward pornography than unregulated users of pornography.²⁴ Thus, men with CSB may report negative cognitive attitudes toward pornography, but then show positive implicit associations in an experiment.

The results of the binary logistic regression analysis show that sexual arousal and the amount of pornography consumed per day in the last week before the experiment differentiated significantly between the groups (hypothesis 3). However, as expected, the IAT score and sexual inhibition due to the threat of performance consequences did not. In particular, the non-significant result of the IAT score in the binary logistic regression analysis ($P = .053$) should be considered here. A possible reason for the lack of statistical significance despite showing a large odds ratio of 4.96 is the large confidence interval (0.98–25.16). This large variance may be reduced if a larger sample was employed. In summary, this finding weakens the certainty of our findings and suggests that further research is needed to show whether there are positive implicit associations with PPU in men with CSB or whether there is

also a subgroup of men with CSB who have, for example, negative implicit associations with pornography.

Given that implicit associations are known to be associated with addictive behaviors in behavioral addictions such as internet use disorders²⁵ as well as in substance use disorders²⁶ our results suggest that similar cognitive processes appear to play a role in CSB. In line with this, the results are consistent with assumptions of current addiction frameworks, such as the I-PACE model and IST.^{7,9} The I-PACE model states that when an addictive behavior is pronounced, the impulsive system (eg, implicit associations) becomes dominant and the reflective system is hijacked,²¹ eg, that (positive) affective responses to pornographic images, as measured by the IAT, are higher in men with CSB than in men without CSB, possibly increasing the likelihood of dysfunctional PPU in men with CSB. However, it is important to distinguish between positive associations that are not volitionally accessible and the “liking” or “wanting” of a cue. Against the background of IST, the positive association, in our case the pronounced connection between a relatively stronger positive valence and

pornographic stimuli, can possibly be understood as both, unconscious “wanting” or “liking” in the pronounced course of addictive behaviors. According to the I-PACE model, the repeated experience of gratification due to the acting out of addictive behavior leads to enhanced positive implicit associations resulting in altered affective and cognitive responses eg, cue-reactivity and craving. In later stages of addictive behaviors the sensation of gratification gets reduced and compensation is rather experienced we the problematic behavior is acted out. Subsequently, the decision-making process appears to rely increasingly on automatic rather than controlled processes resulting in addictive behaviors.⁷ More generally, positive implicit cognitions may strengthen the “feels-better path” (representing positive and negative reinforcement of the behavior) and may conflict with “stop-now” self-control processes in CSB.²⁷

Implicit associations may exert influence on cue-reactivity, eg, attentional bias toward sexually explicit cues in individuals with CSB. The incentive sensitization theory (IST) suggests that increased cue-reactivity is the result of neural adaptations and incentive salience attribution.⁹ Incentive salience attribution in turn causes drug-related stimuli (eg, explicit stimuli) to become more attractive and desirable resulting in goal-directed seeking and instrumental behavior.⁹

The higher proneness toward explicit stimuli in individuals with CSB found in our study could contribute to dysfunctional decision making and continued behaviors despite long-term negative consequences. The findings are in line with findings on altered cognition in PPU, such as attentional biases toward sexual stimuli and impairments in decision making, as reviewed by.¹⁸

Employing the IAT in therapy may help to promote awareness for those affected of CSB which can be a crucial part of psycho-education. For example, the IAT has been used as a tool to illustrate cognitive processes that can then serve as an entry point for discussion and reflection.²⁸ Furthermore, measuring implicit associations could be used as an outcome measure in research on treatment effectivity, as has been done in for psychotherapy research on social anxiety disorder with positive effects.²⁹ Reduced IAT scores (indicating fewer positive associations with pornographic images) in the context of the I-PACE model could indicate lower affective reactions and thus increased executive control with which patients with CSB avoid pornographic images.⁷ Moreover, the I-PACE model also has psychoeducational value, as it can be used to illustrate to patients how involuntary processes (eg, implicit associations) can lead to the development and maintenance of CSB.

Limitations

There are some limitations regarding the sample and methods and it is important to stress that these are preliminary results coming from a relatively small sample size and are among the first neuropsychological results from the field of CSB. Since our sample consisted of heterosexual men only, our results cannot be generalized to women, or men with different sexual orientations. Furthermore, in this study, we did not control for how sexually arousing the presented images were perceived by the subjects. With regard to the I-PACE model⁷ time of emergence of implicit associations may also be of interest, as they assumably emerge in later stages of addiction in particular. In addition, it would be valuable if future studies on CSB were to match healthy control subjects with a similar

profile of sexual excitation and inhibition in order to verify whether effects are due to CSB or other factors. To our knowledge, this point has been neglected in studies on CSB.

Acknowledgments

This work is partly based on the master thesis of Antonia Waechter (“Implicit associations in men with Compulsive Sexual Behavior Disorder”) at the University of Bielefeld.

Funding

This research project was partly funded by the European Society for Sexual Medicine Research Grant (15-20).

Conflicts of interest

The authors report no conflicts of interest.

References

1. WHO. *International Statistical Classification of Diseases and Related Health Problems*. 11th ed. Geneva:World Health Organization; 2019: <https://icd.who.int/>.
2. Grubbs JB, Kraus SW. Pornography use and psychological science: a call for consideration. *Curr Dir Psychol Sci*. 2021;30(1):68–75. <https://doi.org/10.1177/0963721420979594>
3. Reid RC, Carpenter BN, Hook JN, *et al*. Report of findings in a dsm-5 field trial for hypersexual disorder. *J Sex Med*. 2012;9(11):2868–2877. <https://doi.org/10.1111/j.1743-6109.2012.02936.x>
4. Bancroft J, Vukadinovic Z. Sexual addiction, sexual compulsivity, sexual impulsivity, or what? Toward a theoretical model. *J Sex Res*. 2004;41(3):225–234. <https://doi.org/10.1080/00224490409552230>
5. Bancroft J, Graham CA, Janssen E, Sanders SA. The dual control model: current status and future directions. *J Sex Res*. 2009;46(2-3):121–142. <https://doi.org/10.1080/00224490902747222>
6. Engel J, Veit M, Sinke C, *et al*. Same same but different: a clinical characterization of men with hypersexual disorder in the sex@brain study. *J Clin Med*. 2019;8(2):157. <https://doi.org/10.3390/jcm8020157>
7. Robinson TE, Berridge KC. The incentive sensitization theory of addiction: some current issues. *Philos Trans R Soc B Biol Sci*. 2008;363(1507):3137–3146. <https://doi.org/10.1098/rstb.2008.0093>
8. Rooke SE, Hine DW, Thorsteinsson EB. Implicit cognition and substance use: a meta-analysis. *Addict Behav*. 2008;33(10):1314–1328. <https://doi.org/10.1016/j.addbeh.2008.06.009>
9. Kessler A, Schmidt LD, Brandorcid M, Wegmann E. Implicit cognitions in problematic social network use. *J Behav Addict*. 2023;12(3):590–598. <https://doi.org/10.1556/2006.2023.00035>
10. Snagowski J, Wegmann E, Pekal J, Laier C, Brand M. Implicit associations in cybersex addiction: adaption of an implicit association test with pornographic pictures. *Addict Behav*. 2015;49:7–12. <https://doi.org/10.1016/j.addbeh.2015.05.009>
11. Reid RC, Garos S, Carpenter BN. Reliability, validity, and psychometric development of the hypersexual behavior inventory in an outpatient sample of men. *Sex Addict Compulsivity*. 2011;18(1):30–51. <https://doi.org/10.1080/10720162.2011.555709>
12. Gola M, Lewczuk K, Potenza MN, *et al*. What should be included in the criteria for compulsive sexual behavior disorder? *J Behav Addict*. 2022;11(2):160–165. <https://doi.org/10.1556/2006.2020.00090>

13. Bóthe B, Koós M, Demetrovics Z. Contradicting classification, nomenclature, and diagnostic criteria of compulsive sexual behavior disorder (CSBD) and future directions: commentary to the debate: "Behavioral addictions in the ICD-11." *J Behav Addict*. 2022;11(2):204–209. <https://doi.org/10.1556/2006.2022.00030>
14. Lang PJ, Bradley MM, Cuthbert BN. *International Affective Picture System (IAPS): Affective Ratings of Pictures and Instruction Manual* Technical Report A-8. Gainesville, FL: Univ Florida; 2008.
15. Lang PJ, Bradley MM, Cuthbert BN. *International Affective Picture System (IAPS): Affective Ratings of Pictures and Instruction Manual*. NIMH, Center for the Study of Emotion & Attention Gainesville; 2005.
16. Nosek BA, Greenwald AG, Banaji MR. The implicit association test at age 7: a methodological and conceptual and conceptual review. *Autom Process Soc Think Behav*. 2007;265–292
17. Glashouwer KA, Smulders FTY, De Jong PJ, Roefs A, Wiers RWHJ. Measuring automatic associations: validation of algorithms for the implicit association test (IAT) in a laboratory setting. *J Behav Ther Exp Psychiatry*. 2013;44(1):105–113. <https://doi.org/10.1016/j.jbtep.2012.07.015>
18. Kafka MP. Hypersexual disorder: a proposed diagnosis for DSM-V. *Arch Sex Behav*. 2010;39(2):377–400. <https://doi.org/10.1007/s10508-009-9574-7>
19. Kafka MP. What happened to hypersexual disorder? *Arch Sex Behav*. 2014;43(7):1259–1261. <https://doi.org/10.1007/s10508-014-0326-y>
20. Laier C, Pawlikowski M, Pekal J, Schulte FP, Brand M. Cybersex addiction: experienced sexual arousal when watching pornography and not real-life sexual contacts makes the difference. *J Behav Addict*. 2013;2(2):100–107. <https://doi.org/10.1556/JBA.2.2013.002>
21. Janssen E, Vorst H, Finn P, Bancroft J. The sexual inhibition (SIS) and sexual excitation (SES) scales: I. Measuring sexual inhibition and excitation proneness in men. *J Sex Res*. 2002;39(2):114–126. <https://doi.org/10.1080/00224490209552130>
22. Antons S, Mueller SM, Wegmann E, Trotzke P, Schulte MM, Brand M. Facets of impulsivity and related aspects differentiate among recreational and unregulated use of internet pornography. *J Behav Addict*. 2019;8(2):223–233. <https://doi.org/10.1556/2006.8.2019.22>
23. Brand M, Wegmann E, Stark R, et al. The interaction of person-affect-cognition-execution (I-PACE) model for addictive behaviors: update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neurosci Biobehav Rev*. 2019;104(May):1–10. <https://doi.org/10.1016/j.neubiorev.2019.06.032>
24. Brand M. Can internet use become addictive? *Science (80-)*. 2022;376(6595):798–799. <https://doi.org/10.1126/science.abn4189>
25. Brailovskaia J, Teichert T. "I like it" and "I need it": Relationship between implicit associations, flow, and addictive social media use. *Computers in Human Behavior* 2020; 113:106509. <https://doi.org/10.1016/j.chb.2020.106509>
26. Grigutsch LA, Lewe G, Rothermund K, Koranyi N. Implicit 'wanting' without implicit 'liking': A test of incentive-sensitization-theory in the context of smoking addiction using the wantingimplicit- association-test (WIAT). *Journal of Behavior Therapy and Experimental Psychiatry* 2019; 64:9–14.
27. Castro-Calvo J, Cervigón-Carrasco V, Ballester-Arnal R, Giménez-García C. Cognitive processes related to problematic pornography use (PPU): a systematic review of experimental studies. *Addict Behav Reports*. 2021;13:100345. <https://doi.org/10.1016/j.abrep.2021.100345>
28. Sukhera J, Wodzinski M, Rehman M, Gonzalez CM. The implicit association test in health professions education: a meta-narrative review. *Perspect Med Educ*. 2019;8(5):267–275. <https://doi.org/10.1007/s40037-019-00533-8>
29. Ritter V, Leichsenring F, Strauss BM, Stangier U. Changes in implicit and explicit self-esteem following cognitive and psychodynamic therapy in social anxiety disorder. *Psychother Res*. 2013; 23(5):547–558. <https://doi.org/10.1080/10503307.2013.802824>