Journal of Behavioral Addictions 2(2), pp. 100–107 (2013)
DOI: 10.1556/JBA.2.2013.002
First published online April 12, 2013

Cybersex addiction: Experienced sexual arousal when watching pornography and not real-life sexual contacts makes the difference

CHRISTIAN LAIER[1], MIRKO PAWLIKOWSKI[1], JARO PEKAL[1], FRANK P. SCHULTE[1,2] and MATTHIAS BRAND[1,2]*

[1]General Psychology: Cognition, University of Duisburg-Essen, Duisburg, Germany
[2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

(Received: November 30, 2012; revised manuscript received: January 17, 2013; accepted: January 19, 2013)

Background and aims: Cybersex addiction is discussed controversially, while empirical evidence is widely missing. With respect to its mechanisms of development and maintenance Brand et al. (2011) assume that reinforcement due to cybersex should lead to the development of cue-reactivity and craving explaining recurrent cybersex use in the face of growing but neglected negative consequences. To support this hypothesis, two experimental studies were conducted. *Methods:* In a cue-reactivity paradigm 100 pornographic cues were presented to participants and indicators of sexual arousal and craving were assessed. The first study aimed at identifying predictors of cybersex addiction in a freely recruited sample of 171 heterosexual males. The aim of the second study was to verify the findings of the first study by comparing healthy ($n = 25$) and problematic ($n = 25$) cybersex users. *Results:* The results show that indicators of sexual arousal and craving to Internet pornographic cues predicted tendencies towards cybersex addiction in the first study. Moreover, it was shown that problematic cybersex users report greater sexual arousal and craving reactions resulting from pornographic cue presentation. In both studies, the number and subjective quality of real-life sexual contacts were not associated to cybersex addiction. *Discussion:* The results support the gratification hypothesis, which assumes reinforcement, learning mechanisms, and craving to be relevant processes in the development and maintenance of cybersex addiction. Poor or unsatisfying sexual real-life contacts cannot sufficiently explain cybersex addiction. *Conclusions:* Positive reinforcement in terms of gratification plays a major role in cybersex addiction.

Keywords: Internet addiction, pathological Internet use, cybersex, sexual arousal, craving

INTRODUCTION

Internet addiction is discussed with growing interest in both scientific literature and clinical practice. Approximately 1.5–8.2% individuals report symptoms of dependency regarding their Internet use associated with subjective complaints in everyday life (Weinstein & Lejoyeux, 2010). While there is no doubt about the clinical significance of this phenomenon, there is still no agreement about its classification. Therefore it has been named differently, e.g. addictive (Widyanto & Griffiths, 2006; Young, 2004), pathological (Davis, 2001), or problematic (Caplan, 2002) Internet use. Based upon similarities with other behavioral and substance addictions (Block, 2008; Garcia & Thibaut, 2010; Grant, Brewer & Potenza, 2006; Potenza, 2006, 2008), Internet use disorder will be included in the appendix of DSM-V (Holden, 2010), which emphasizes the clinical relevance and the lack of empirical evidence on this topic, so far.

It was postulated that cybersex is one specific Internet application with a great risk for developing an addictive use (Griffiths, 2001; Young, Pistner, O'Mara & Buchanan, 1999). Indeed, the current use of Internet pornography may predict patterns of Internet addiction (Meerkerk, Van den Eijnden & Garretsen, 2006). Generally, cybersex comprises diverse sexually motivated behaviors on the Internet, e.g. watching pornographic material, taking part in sexually motivated chats or in sex via webcam, but also searching online for offline sex partners or gathering information about sex (Döring, 2009). These activities can be grouped into solitary-arousal (e.g. watching pornography), partnered-arousal (e.g. sex chats), and non-arousal activities (e.g. information search) (Shaughnessy, Byers & Walsh, 2011). It was reported that cybersex is done by a great variety of individuals, e.g. adolescents (Brown & L'Engle, 2008), students (Goodson, McCormick & Evans, 2001; Shaughnessy et al., 2011) and adults of all ages (Cooper, Scherer, Boies & Gordon, 1999; Daneback, Cooper & Månsson, 2005) and in both males and females (cf. Döring, 2009). Watching pornography seems to be a widespread cybersex activity in males (Short, Black, Smith, Wetterneck & Wells, 2012). Watching Internet pornography is thought to be encouraged by its easy, mostly free or affordable accessibility, while users assume a high degree of both anonymity and subjective control (Cooper, McLoughlin & Campbell, 2000; Griffiths, 2000; Young et al., 1999). For females' cybersex activities valid data are rather limited. Some studies suggest that females particularly use interactive cybersex applications, such as sex chats (Danebak et al., 2005) and their Internet pornography consumption depends upon the individual attitude towards pornography in general (Shaughnessy et al., 2011).

Most individuals benefit from cybersex use, e.g. they experience sexual arousal (Paul, 2009; Shaughnessy et al., 2011), improve their sex life, gain sexual knowledge,

* Corresponding author: Prof. Dr. Matthias Brand, General Psychology: Cognition, University of Duisburg-Essen, Forsthausweg 2, D-47057 Duisburg, Germany; Phone: +49-203-3792541; Fax: +49-203-3791846; E-mail: matthias.brand@uni-due.de

change attitudes towards sex and life in general (Hald & Malamuth, 2008), and enrich their real-life sexual contacts (Grov, Gillespie, Royce & Lever, 2011). While the negative impact of pornography on opposite gender role-models (Barak, Fisher, Belfry & Lashambe, 1999), sexual socialization (Stulhofer, Busko & Landripet, 2010), and partnerships (Whitty & Quigley, 2008) has also found its introduction into (Internet) pornography literature, there are several cybersex specific negative consequences discussed. Some individuals report problems in controlling their cybersex use, accompanied by missing sleep, forgetting appointments, or disregarding responsibilities (Cooper, Delmonico, Griffin-Shelley & Mathy, 2004; Griffiths, 2001; Young, 2008). It was demonstrated that some individuals suffer from cybersex addiction (Kuss & Griffiths, 2011), linked to personal distress due to an inability to control one's cybersex use, persistent experience of negative consequences in individuals' life, and unsuccessful efforts to reduce the behavior.

In Davis' cognitive-behavioral model (Davis, 2001) it is described that a specific pathological Internet use (e.g. cybersex addiction) might develop due to a pre-existing psychopathology, but the role of immediate reinforcement gained by Internet pornography use is also emphasized. Complementary to this, Young claims that anticipating and receiving sexual gratification is the key factor underlying the development of cybersex addiction (Young, 2008). Brand et al. (2011) report an association between sexual arousal ratings of Internet pornographic cues and tendencies towards cybersex addiction. The authors argue that the rewarding effects of pornography should lead to the development of cue-reactivity and craving as main mechanisms of development and maintenance of cybersex addiction. These assumptions still need empirical evidence. In particular, potential differences with respect to sexual arousal and craving to Internet pornographic cues should be investigated in problematic cybersex users (PCU) compared to healthy, unproblematic cybersex users (HCU).

We hypothesized that indicators of sexual arousal and craving to Internet pornographic cues should predict tendencies towards cybersex addiction. Moreover, sexual arousal and craving to Internet pornographic cues should be greater in PCU compared to HCU. Two experimental investigations were conducted, in which a cue-reactivity paradigm including Internet pornographic cues was applied. In the first study, the hypothesis was tested by a regression approach with a freely recruited sample of heterosexual males. In the second study, we compared a sample of PCU and a matched sample of HCU with respect to indicators of sexual arousal and craving measured by the same experimental paradigm used in Study 1.

STUDY 1

Participants

In this study, 171 heterosexual men (M_{age} = 24.56, *SD* = 5.22) participated. They were recruited by advertisements in public or on campus of the University of Duisburg-Essen. We explicitly addressed heterosexual males of legal age. We indicated that study participation would include a confrontation with explicit pornography of legal sexual practices. All participants gave written informed consent prior to the investigation, confirmed their heterosexual preference via questionnaire and were paid at an hourly rate for participation (€10/h). All questionnaires and the experimental paradigm were administered in a computer-based laboratory setting. The study was approved by the local ethics committee. Mean years of education was *M* = 12.53 (*SD* = 1.08). All participants indicated that they have used cybersex at least once in their life. Mean age of first cybersex use was *M* = 15.86 (*SD* = 4.48).

METHODS

Internetsex Addiction Test (s-IATsex)

The severity of cybersex addiction was assessed with a short version of the Internet Addiction Test (s-IAT) (Pawlikowski, Altstötter-Gleich & Brand, 2013) modified for cybersex. The s-IAT was shown to have a high internal consistency, good congruent, discriminant, and incremental validity and good further psychometric properties. The modification of the questionnaire to cybersex use was done comparably to Brand et al. (2011). Terms like "online" or "Internet" were replaced by the terms "online sexual activity" or "Internet sex sites." An example item is "How often do you find that you stay on Internetsex sites longer than you intended?" In the s-IATsex twelve items had to be answered on a five-point scale from 1 (never) to 5 (very often) resulting in sum scores ranging from 12 to 60. In the validation study by Pawlikowski et al. (2013), a cut-off score of >30 indicates problematic Internet use, which was also applied to the s-IATsex in our study. In our sample, internal consistency was good (Cronbach's α = .841).

Experimental paradigm

The experimental paradigm comprised a randomized presentation of 100 standardized explicit Internet pornographic cues of ten categories having ten cues each (Laier, Schulte & Brand, 2012). Pictures displayed heterosexual sex (vaginal, anal sex, cunnilingus, fellatio), homosexual sex (anal and oral sex between two men, tribadism and oral sex between two women) as well as single masturbating men and women. Only adult individuals and no fetish relevant material were displayed. Cues had to be rated with respect to sexual arousal (1 = sexually not arousing to 5 = sexually very arousing). Additionally, viewing times (VT) as an unobtrusive measurement of sexual attraction to the presented stimulus were recorded (Imhoff et al., 2010). Of particular interest were the sexual arousal ratings and the VT of "heterosexual pornography" (vaginal, oral and anal sex between a man and a woman, tribadism, oral sex between two women and masturbating women), because these pictures reflect the material frequently watched by heterosexual men and such pictures were used in a sum of previous studies (e.g., Brand et al., 2011; Laier et al., 2012). This merged category was named "heterosexual pornography" in order to indicate that this is material which is "made for the heterosexual males' eyes". The other three picture categories (anal sex and oral sex between two men and one masturbating man) were merged and named "homosexual pornography".

Prior to (t1) and directly after (t2) the experimental paradigm, participants indicated their sexual arousal from 0 (not sexually aroused) to 100 (very sexually aroused) as well as their need to masturbate from 0 (no need to masturbate) to 100 (very great need to masturbate). As indicators of crav-

ing, the sexual arousal indicated at t1 was subtracted from sexual arousal at t2 (craving Δ sexual arousal). Accordingly, the need to masturbate at t1 was subtracted from the need to masturbate at t2 (craving Δ need to masturbate).

Cybersex use and real-life sexual contacts

Participants were asked how many hours per week they spend for cybersex, to indicate how often they watch pornographic pictures or videos on the Internet in relation to their overall cybersex use with a scale from 1 (never) to 5 (very often), and how often they masturbate when watching pornography on the Internet (1 = never to 5 = very often). Moreover, we assessed an approximation of the number of sexual contacts in the last six months. If there was at least one sexual contact within the last six months, participants were asked to indicate how satisfied they were with the frequency (1 = not satisfied to 5 = very satisfied) and the quality (1 = not satisfied to 5 = very satisfied) of their sexual contacts.

RESULTS

The mean score of the s-IATsex was 19.27 (*SD* = 6.22, range: 12–40). When using cybersex, participants watched rather often pornographic videos on the Internet (*M* = 2.81, *SD* = 1.04) and rather rarely pornographic pictures (*M* = 1.21, *SD* = 1.09). They masturbated rather often when watching pornography (videos or pictures) on the Internet (*M* = 3.04, *SD* = 1.08). Mean hours per week spent for cybersex was 3.65 (*SD* = 5.86, *n* = 112). Mean number of sexual contacts in the last six months was 25.42 (*SD* = 33.25), the satisfaction with the frequency of sexual contacts was moderate (*M* = 1.46, *SD* = 1.12), and the satisfaction with the quality of sexual contacts was also moderate (*M* = 1.98, *SD* = 1.06).

The results of the experimental paradigm are illustrated in Figure 1. Regarding sexual arousal ratings, repeated measures ANOVA (within-factor with ten levels, which means all ten pornographic picture categories were included, no between-factor) revealed a significant effect of the within-subject factor "pornographic picture category" (Wilks' Lambda = .06, $F(9, 162) = 259.23$, $p < .001$, $\eta^2 = .94$). According to the preference of a heterosexual male, we calculated the mean sexual arousal for "heterosexual pornography" and "homosexual pornography" (including sex between men or single masturbating men). As indicated by *t*-test for dependent groups, "heterosexual pornography" *(M_1)* was rated as more sexually arousing than "homosexual pornography" *(M_2)* ($M_1 = 3.37$, $SD = .70$, $M_2 = 1.11$, $SD = .33$, $t(170) = 41.34$, $p < .001$, Cohen's *d* for dependent samples = 4.48) with a very large effect size (Cohen, 1992). Regarding VT a second repeated measures ANOVA (again with the within-factor having ten levels, which means all ten pornographic picture categories were included, no between-factor) revealed a significant effect of the within-subject factor "pornographic picture category" (Wilks' Lambda = .23, $F(9, 162) = 60.37$, $p < .01$, $\eta^2 = .77$). As indicated by *t*-test for dependent groups, "heterosexual pornography" *(M_1)* was watched longer than "homosexual pornography" *(M_2)* ($M_1 = 4.05$, $SD = 1.42$, $M_2 = 2.18$, $SD = 1.06$, $t(170) = 20.12$, $p < .001$, Cohen's *d* for dependent samples = 2.17) with a large effect (Cohen, 1992).

As indicated by *t*-tests for dependent groups, the experimental paradigm lead to a significant increase of subjective sexual arousal ($M_{t1} = 8.18$, $SD = 13.95$, $M_{t2} = 26.57$, $SD = 25.39$, $t = -10.63$, $p < .001$, Cohen's *d* for dependent samples = –1.15) and in the need to masturbate ($M_{t1} = 6.58$, $SD = 10.94$, $M_{t2} = 22.19$, $SD = 26.43$, $t = -8.54$, $p < .001$, Cohen's *d* for dependent samples = –.78). Both effects are large (Cohen, 1992). A description of variables is shown in Table 1. The s-IATsex was correlated with variables indicating sexual arousal and craving due to pornographic pictures (Table 2) with low to moderate effects (Cohen, 1992).

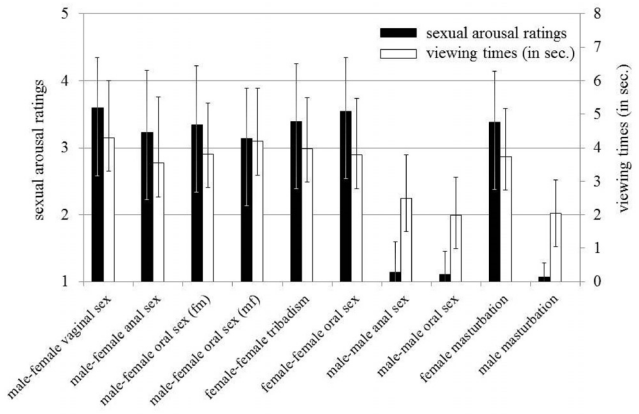

Figure 1. Results of the experimental pornographic picture presentation. Sexual arousal rating to the ten pornographic picture categories is represented by black bars and left axis. VT measure is represented by white bars and right axis. Error bars represent standard deviations

Table 1. Description of variables concerning cybersex consuming behavior, indicators of gratification as well as indicators of compensation

N = 171	*M*	*SD*
Sexual arousal rating (heterosexual pornography)[1]	3.37	.70
Viewing times (heterosexual pornography)[2]	4.05	1.42
Sexual arousal rating (homosexual pornography)[1]	1.11	.33
Viewing times (homosexual pornography)[2]	2.18	1.06
Sexual arousal t1[3]	8.18	13.95
Sexual arousal t2[3]	26.57	25.39
Need to masturbate t1[3]	6.58	10.94
Need to masturbate t2[3]	22.19	26.43
Craving Δ (sexual arousal)	18.39	22.63
Craving Δ (need to masturbate)	14.02	25.98

[1] scale from 1 (not arousing) to 5 (very arousing);
[2] in seconds;
[3] scale from 0 to 100.

To predict the s-IATsex hierarchical regression analysis was conducted. In its first step, the rating of "heterosexual pornography" together with their VT measurement explained 5.00% variance of the s-IATsex ($F(2,168) = 4.39$, $p = .014$). When adding craving Δ (need to masturbate) in the second step, variance explanation increased significantly (changes in $R^2 = .038$, changes in $F(1, 167) = 7.03$, $p = .009$). The whole model was significant and explained 8.80% of the s-IATsex ($R^2 = .088$, $F(3, 167) = 5.38$, $p = .001$). For further values of this regression analysis see Table 3.

The s-IATsex was not correlated with the number of sexual contacts in the last six months, the satisfaction with the frequency and the quality of sexual contacts. Results are presented in Table 4.

To investigate potential moderating effects of the satisfaction dimensions on the relationship between the number

Table 2. Correlations of subjective complaints in everyday life due to cybersex usage as measured by the s-IATsex with indicators of sexual arousal due to Internet pornographic pictures

N = 171	s-IATsex	Sexual arousal rating (heterosexual pornography)	Viewing times (heterosexual pornography)	Sexual arousal rating (homosexual pornography)	Viewing times (homosexual pornography)	Sexual arousal t2	Need to masturbate t2	Craving Δ (sexual arousal)
Sexual arousal rating (heterosexual pornography)	**.16***							
Viewing times (heterosexual pornography)	**.15***	–.06						
Sexual arousal rating (homosexual pornography)	.10	**.19***	–.11					
Viewing times (homosexual pornography)	.06	**.25****	**.55****	**.30****				
Sexual arousal t2	**.16***	**.30****	–.09	.17*	**.15***			
Need to masturbate t2	**.27****	**.25****	–.05	.07	.11	**.77****		
Craving Δ (sexual arousal)	.12	**.32****	–.07	**.19***	**.15***	**.84****	**.68****	
Craving Δ (need to masturbate)	**.23****	**.24****	–.02	.07	.09	**.53****	**.86****	**.74****

* $p \leq .05$ (correlation is significantly different from zero with alpha = 5%, two-tailed);
** $p \leq .01$ (correlation is significantly different from zero with alpha = 5%, two-tailed).

Table 3. Hierarchical regression analyses with indicators of the sexual arousal and craving predicting the s-IATsex as dependent variable

Main effects of the single predictors in the whole model	*β*	*T*	*p*
"Sexual arousal rating (heterosexual pornography)"	.12	1.59	.114
"Viewing times (heterosexual pornography)"	.16	2.11	.036
"Craving Δ (need to masturbate)"	.20	2.65	.009

Table 4. Correlations of the s-IATsex with variables concerning the number and the variability of as well as satisfaction with real-life sexual contacts

N = 171	s-IATsex	Number of sexual contacts (6 months)	Satisfaction (frequency)
Number of sexual contacts (6 months)	.02		
Satisfaction with sexual contacts (frequency)	–.07	**.55****	
Satisfaction with sexual contacts (quality)	.05	**.42****	**.61****

** $p \leq .01$ (correlation is significantly different from zero with alpha = 5%, two-tailed).

of sexual contacts with tendencies towards cybersex addiction, two hierarchical, moderated regression analyses with the s-IATsex as dependent variable were conducted (all variables centralized, Cohen, Cohen, West & Aiken, 2003). In the first model, the number of sexual contacts (last six months) did not explain s-IATsex variance significantly ($R^2 < .01$, $F(1, 169) = .05$, $p = .81$). Neither adding the satisfaction with the frequency of sexual contacts in the second step (changes $R^2 = .01$, changes in $F(1, 168) = 1.73$, $p = .19$) nor adding the interaction of both in the third step (changes $R^2 < .01$, changes in $F(1, 167) = .07$, $p = .78$) lead to a significant increase of variance explanation. The whole model was not significant ($R^2 = .01$, $F(3, 167) = .62$, $p = .61$). In the second model, after the number of sexual contacts was used as predictor in the first step again, the satisfaction with the quality of sexual contacts did not add significantly to explanation of s-IATsex variance (changes $R^2 < .01$, changes in $F(1, 168) = 0.34$, $p = .56$). The interaction of both did not lead to a significant increase of variance explanation of the s-IATsex (changes $R^2 < .01$, changes in $F(3, 167) = 0.36$, $p = .55$). The whole model was not significant ($R^2 = .004$, $F(3, 167) = 0.25$, $p = .86$).

STUDY 2

Participants

For this study, we explicitly alluded for heterosexual males of legal age who perceived problems regarding controlling their cybersex use. They were recruited by advertisements in local newspapers in several cities as well as by announcements in the public and on campus of the University of Duisburg-Essen. All participants gave written informed consent prior to the investigation, confirmed their heterosexual preference via questionnaire and were paid at an hourly rate for participation (€10/h). None of them has participated in Study 1. The study was approved by the local ethics committee. We recruited 25 PCU ($M_{age} = 23.96$, $SD = 2.91$) and a sample of 25 HCU matched for age and education ($M_{age} = 22.88$, $SD = 1.86$). The groups did not differ with respect to age ($t(48) = 1.56$, $p = .12$), years of education ($M_{PCU} = 12.40$, $SD = 1.22$, $M_{HCU} = 12.12$, $SD = 1.36$, $t(48) = .764$, $p = .45$), or their age of first cybersex use ($M_{PCU} = 15.88$, $SD = 2.12$, $M_{HCU} = 14.88$, $SD = 1.99$, $t = .21$, $p = .84$). Moreover, a Chi-square test for independence (with Yates continuity correction) indicated no significant association between group and partnership (χ^2 (1, $n = 50$) = 2.03, $p = .15$, $phi = .24$).

METHODS

The same methods as used in Study 1 were applied (s-IATsex, experimental paradigm, and questionnaires).

RESULTS

The mean score of the s-IATsex in the PCU group was 34.72 ($SD = 4.04$, range: 31–44, all participants included had a score in the s-IATsex of 31 or higher, which is the cut-off score for problematic use (Pawlikowski et al., 2013). Relatively to their overall Internet use, PCU indicated to watch

Table 5. Differences regarding indicators of sexual arousal, craving, and real-life sexual contacts between problematic and healthy cybersex users revealed by independent *t*-tests

	PCU (*N* = 25)		HCU (*N* = 25)		*t*	*p*	*d*[1]
	M	*SD*	*M*	*SD*			
Sexual arousal rating (heterosexual pornography)	3.58	.55	3.46	.63	.79	.43	.20
Viewing times (heterosexual pornography)	3.20	1.94	3.92	1.90	–1.33	.19	–.37
Sexual arousal rating (homosexual pornography)	1.41	.88	1.04	.12	2.07	**.043***	.59
Viewing times (homosexual pornography)	1.75	1.10	1.83	.86	–.28	.78	–.08
Sexual arousal t1	19.84	22.31	4.16	8.24	3.29	**.002****	.93
Sexual arousal t2	54.92	28.65	29.12	27.29	3.26	**.002****	.92
Need to masturbate t1	18.32	22.65	5.20	12.29	2.55	**.014***	.72
Need to masturbate t2	50.16	29.78	19.52	22.18	4.13	**<.001****	1.17
Craving Δ (sexual arousal)	35.08	25.93	24.96	22.89	1.46	.15	.41
Craving Δ (need to masturbate)	31.84	20.90	14.32	16.90	3.26	**.002****	.92
Number of sexual contacts (last six months)	27.32	36.13	17.08	32.17	1.06	.29	.30
Satisfaction with sexual contacts (frequency)	1.83	1.03	2.10	1.02	–.87	.39	–.26
Satisfaction with sexual contacts (quality)	2.13	.97	2.60	.60	–1.88	.07	–.58

[1] Cohen's *d* for independent samples;
* $p \leq .05$;
** $p \leq .01$.

pornographic videos on the Internet frequently (M = 3.08, SD = 1.26) and pornographic pictures occasionally (M = 1.52, SD = 1.12). They indicated to masturbate frequently when watching Internet pornography (M = 3.32, SD = .90). Hours per week spent for cybersex was not indicated by all individuals (n = 19, M = 6.74, SD = 4.11). The mean score of the s-IATsex in the HCU group was 18.00 (SD = 4.07, range: 12–25). Relatively to their overall cybersex use, HCU indicated to watch pornographic videos on the Internet sometimes (M = 2.27, SD = 1.06) and pornographic pictures rarely (M = 1.12, SD = 1.13), and to masturbate rather often when watching Internet pornography (M = 2.76, SD = 1.16). Again, hours per week spent for cybersex was not indicated by all individuals (n = 18, M = 2.00, SD = 2.22). Still, a significant difference regarding hours spent for cybersex weekly was observed between the two groups ($t(35) = 4.33$, $p < 0.001$, Cohen's d for independent samples = 1.43). The results of the experimental paradigm for PCU and HCU are shown in Table 5 and illustrated in Figure 2. The PCU group showed higher subjective sexual arousal and a greater need to masturbate when being confronted with pornographic pictures. The increase of the need to masturbate from baseline to after watching the pornographic pictures was also higher in the PCU group compared to the HCU group.

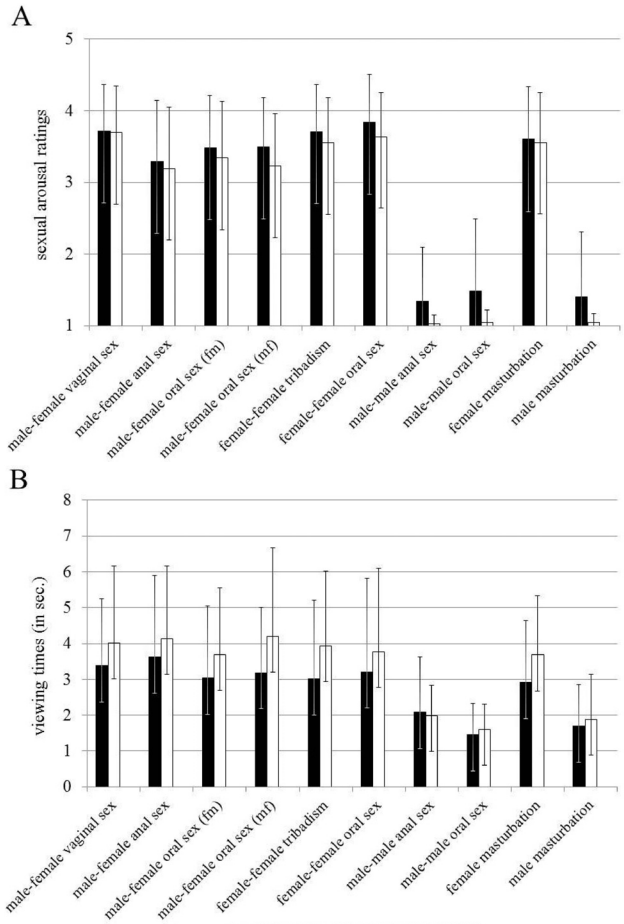

Figure 2. Results of the experimental pornographic picture presentation. Sexual arousal ratings (A) and viewing times (B) of the ten pornographic picture categories by problematic cybersex users (PCU, black bars) and healthy cybersex users (HCU, white bars). Error bars represent standard deviations

DISCUSSION

The main result of the first study is that tendencies towards cybersex addiction correlated with and were predicted by indicators of sexual arousal and craving to pornographic cues. Study 2 demonstrates that PCU did not rate the pornographic pictures as more arousing, but indicated greater subjective sexual arousal and a greater need to masturbate during the whole experiment and greater craving reactions. The number of and satisfaction with sexual real-life contacts were not associated to tendencies towards cybersex addiction in both studies. The findings of the two studies support the gratification hypothesis of cybersex addiction (Young, 2008), in which positive reinforcement received by cybersex leads to the development of cue-reactivity and craving.

The findings that indicators of sexual arousal and craving predicted tendencies towards cybersex addiction and that the experienced arousal is greater in PCU compared to HCU is in line with the theoretical assumption that anticipating and receiving sexual gratification is one key element in the development of cybersex addiction (Kuss & Griffiths, 2011; Young, 2008). It was postulated that cybersex is highly reinforcing and that learning mechanisms should lead

to cue-reactivity and craving at least in some individuals (Brand et al., 2011). In fact, receiving reinforcement and consequentially conditioned learning as well as the development of craving are known to be key factors for the development and maintenance of substance addictions (Berridge, Robinson & Aldridge, 2009; Hyman, Malenka & Nestler, 2006; Koob & Volkow, 2010).

Physiologically, the effect of reinforcement is related to the mesolimbic reward system. Positive and negative reinforcement (Wightman & Robinson, 2002), also through natural reinforcement as food or sex (Kelley & Berridge, 2002; Wise, 2002), leads to an increase of dopamine release. Neuroimaging studies point out the involvement of neural structures related to the reward in sexual arousal (Arnow et al., 2002; Paul et al., 2008; Redouté et al., 2000) and orgasm (Holstege et al., 2003) leading to the conclusion that sexual arousal is highly reinforcing (Georgiadis & Kringelbach, 2012). Moreover, there is evidence showing conditioned sexual arousal in humans (Hoffmann, Janssen & Turner, 2004; Klucken et al., 2009; Lalumiere & Quinsey, 1998). Taken together, sexual arousal as an unconditioned stimulus can become associated with initially neutral stimuli potentially mediating future sexual behavior. Based upon these findings, classical and instrumental learning mechanisms (Martin-Soelch, Linthicum & Ernst, 2007) should lead to an association of internal (e.g. emotions, stress) or external (e.g. computer, home environment) stimuli with the reinforcing effects of cybersex resulting in cue-reactivity and craving reactions, associated to repeated cybersex use elicited by conditioned stimuli. This is in line with literature on other behavioral and substance addictions (Braus et al., 2001; Garavan, Pankiewicz & Bloom, 2000; Goudriaan, De Ruiter, Van den Brink, Oosterlaan & Veltman, 2010; Gray, LaRowe & Upadhyaya, 2008; Grüsser et al., 2004; Ko et al., 2009; Parker & Gilbert, 2008; Starcke, Schlereth, Domaß, Schöler & Brand, 2012; Thalemann, Wölfling & Grüsser, 2007; Yang et al., 2009).

The number of and satisfaction with sexual contacts was not associated with tendencies towards cybersex addiction in the first study and no differences concerning these variables were observed between PCU and HCU. In their review Kuss and Griffiths (2011) conclude that cybersex may have some complementary effects for some individuals, while in others cybersex serves as substitute of real-life sexual contacts potentially resulting in cybersex addiction. The findings of our two studies speak against such compensatory effects. Poor or unsatisfying sexual real-life contacts cannot sufficiently explain cybersex addiction, since even subjects who are satisfied by their sexual contacts may develop a cybersex addiction. This is also in line with Cooper, who argued that cybersex use may fulfill specific sexual fantasies, which may be a risk factor for developing problematic or pathological cybersex use, also in subjects who are principally satisfied by their real-life sexual contacts (Cooper et al., 2004).

Limitations and future studies

Cybersex addiction's severity was assessed with a short version of the Internet Addiction Test (Pawlikowski et al., 2013) modified for cybersex. Such modifications have been done before (Brand et al., 2011; Kim, Namkoong, Ku & Kim, 2008; Pawlikowski & Brand, 2011). Nevertheless, it is questionable if the cut-off scores of the s-IAT can be applied to the s-IATsex. Furthermore, the observed effects need to be investigated in females and in groups with homosexual orientation as well as in a more elaborately diagnosed clinical sample.

Future studies may also investigate the role of executive functions in controlling cybersex use. In hypersexuality, no differences in general executive functions were reported (Reid, Garos, Carpenter & Coleman, 2011), but the authors hypothesize that executive functions might be affected when individuals are confronted with addiction associated cues. It was shown that sexual cues interfere with inhibition, cognitive flexibility, working memory, and decision making (Laier, Pawlikowski & Brand, accepted pending minor revision; Laier et al., 2012; Macapagal, Janssen, Fridberg, Finn & Heiman, 2011), which could be related to the loss of control and the neglect of negative consequences reported by cybersex addicted individuals.

CONCLUSIONS

Positive reinforcement in terms of gratification plays a major role in cybersex addiction. Poor or unsatisfying sexual real-life contacts cannot sufficiently explain cybersex addiction.

ACKNOWLEDGEMENTS

All authors have no conflict of interest and no financial disclosures. The work of Christian Laier was supported by a grant of Villigst e.V.

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