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Decision-Making in Gambling Disorder, Problematic Pornography Use, and Binge-Eating Disorder: Similarities and Differences

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Abstract

Purpose of Review: The present review attempts to provide a comprehensive and critical overview of the neurocognitive mechanisms of gambling disorder (GD), problematic pornography use (PPU) and binge-eating disorder (BED), focusing specifically on decision-making processes.

Recent findings: GD, PPU and BED have been associated with decision-making impairments both under risk and ambiguity. Features such as intelligence, emotions, social variables, cognitive distortions, comorbidities, or arousal may condition decision-making processes in these individuals.

Summary: Impairments in decision-making seem to be a shared transdiagnostic feature of these disorders We also hypothesized the EG relative to the NEG group would demonstrate weaker relationships between problem-gambling severity and health/functioning measures (e.g., substance use) and gambling behaviors (e.g., more time spent gambling) given that EG would account for

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Human and animal rights

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some of the variance in the relationships between ARPG and these measures. However, there is varying support for the degree to which different features may affect decision-making. Therefore, the study of decision-making processes can provide crucial evidence for understanding addictions and other disorders with addiction-like symptomatology.

Keywords

addictive behaviors; decision-making; delay discounting; gambling disorder; problematic pornography use; binge-eating disorder

1. INTRODUCTION

Behavioral addictions and eating disorders (EDs) are significant public health concerns worldwide (1). Increases in gambling opportunities (with legalization of online gambling in many jurisdictions), the increased availability and affordability of pornographic materials, and the instantiation of eating habits strongly associated with more sedentary lifestyles and accessibility of high-calorie palatable foods, have impacted addictive behaviors and disorders (especially gambling disorder (GD) and problematic pornography use (PPU)) and EDs (especially binge-eating disorder (BED)) (2–4).

Common mechanisms underlying substance-use disorders (SUDs such as alcohol, cocaine and opioids) and addictive or maladaptative disorders or behaviors (such as GD and problematic pornography use (PPU)) have been suggested (5–9). Shared underpinnings between addictions and EDs have also been described, mainly including top-down cognitive-control (10–12) and bottom-up reward-processing (13,14) alterations. Individuals with these disorders often show impaired cognitive control and disadvantageous decision-making (12,15–17). Deficits in decision-making processes and goal-directed learning have been found across multiple disorders; thus, they could be considered clinically relevant transdiagnostic features (18–20). More specifically, it has been suggested that these processes are found in individuals with behavioral addictions (e.g., in dual-process and other models of addictions) (21–24).

Regarding the addiction model, GD has been studied in greater depth, and has even been classified in the category “Substance-Related and Addictive Disorders” of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (1). However, in the case of BED and especially PPU, the existing literature is limited, particularly in neurocognition and neuroscience. Understanding of neurocognitive mechanisms underlying these psychiatric disorders has been slower, and fewer neurobiological models have been proposed, and those that have been cite decision-making as relevant (23,25,26).

Recent studies have suggested a biopsychosocial explanatory model of BED, where different factors (such as a genetic susceptibility to food reward, chronic stress and specific features of highly processed foods with high level of fats and sugars) would promote a behavioral pattern of dysfunctional intake and alterations in dopamine levels, facilitating the learning of erroneous eating behaviors (27). Therefore, some authors claim that the intake of certain high-calorie food and addictive drugs produce similar neural responses, linked to reward pathways modulated by dopamine (28,29) and could contribute to develop an addiction (30).

Similar neurobiological features have been identified between BED and GD (31,32), such as diminished ventral striatal activity during anticipatory phases of reward processing, which may be considered a biomarker associated with addictive processes (33). BED has also shown similarities with food addiction, such as diminished control over consumption, excessive and continued consumption patterns despite negative consequences, and difficulties reducing the frequency or quantity of consumption (34–36).

There is considerable debate whether PPU and compulsive sexual behaviors (CSBs) more generally should be considered as a behavioral addiction (37,38). CSB disorder (CSBD) has recently been incorporated in the eleventh revision of the International Classification of Diseases (ICD-11) as an impulse-control disorder (39). Similarities between CSBD and addictions have been described, and impaired control, persistent use despite adverse consequences and tendencies to engage in risky decisions may be shared features (37,40). While some authors have contended that based on similarities in behavioral neuroscientific and other features -such as the possible involvement of the reward system and the prefrontal-striatal circuits in cognitive control over motivational brain circuitry- that CSBD and PPU should be classified as addictive disorders (41), the addictive nature of sexually explicit materials remains debated.

The addiction model requires more data about possible transdiagnostic clinical features. A lack of consensus regarding this theoretical framework has hindered BED and especially PPU becoming a more substantial part of clinical debate. Therefore, the present review attempts to provide a comprehensive and critical overview of neurocognitive mechanisms, focusing specifically on decision-making processes (42).

2. DECISION-MAKING IN GD, PPU AND BED

The DSM-5 establishes six neurocognitive domains that have been studied in the field of addictions and EDs: complex attention, social cognition, learning and memory, language, perceptual-motor function and executive function (1,43). Among them, special interest has been given to executive functioning, delving into planning, cognitive flexibility, inhibition, responding to feedback and decision-making (44–46).

The specific conceptualization of the decision-making construct is controversial and has led to heterogeneous definitions, limiting the generalization of results. Decisions, even those linked with a potentially addictive behavior, result from a competition between different possible actions for behavioral expression (47). Instrumental behaviors may be less sensitive to contingency manipulations over time, if they turn into addictive behaviors (47). Therefore, decision-making may be understood as a complex set of processes that promotes the choice of the most optimal behavior, contemplating the possible alternatives (48). Decision-making may involve both habitual or “automatic” and deliberate processes (49). The former are typically quicker and more effortless, while top-down executive-control processes are typically goal-dependent, slower and effortful (50). Executive-control processes may allow individuals to avoid distracting information from the environment and to suppress actions or habits (50,51). However, the impairment of these executive-control processes may lead to activation of habitual processes in guiding behavior (50).

Distinctions have been made regarding decision-making under objective and ambiguous risk conditions (52,53). In decision-making under objective risk, measured with tasks such as the Columbia Card Task (54) and the Probability-Associated Gambling Task (52), individuals have information on probabilities and explicit rules associated with each option. Therefore, decision-making processes may involve considerable reasoning. However, decisions under ambiguity are missing information about probabilities or possible associated consequences. Therefore, emotional experiences may contribute considerably in analyses of possible punishments or rewards linked with each option. They are often more uncertain, may be perceived as more aversive (55), and are associated with intuitive processes. Decisions under ambiguity are commonly assessed using the Iowa Gambling Task (IGT), where decisions can result in immediate and high rewards that are associated to greater losses in the long term. The IGT involves learning as well. Poor performance on the IGT typically involves greater sensitivity to immediate rewards, without learning from or contemplating probable losses (44). Therefore, the findings on decision-making under ambiguity included in the present review used the IGT as the main assessment tool.

Impulsivity and decision-making are related, and some studies intermingle delay-discounting and decision-making processes. Delay discounting is related to choice impulsivity (56) and refers to the tendency to select smaller-immediate rewards over larger-later rewards (56,57). While delay-discounting tasks involve decision-making, they involve sequential selection of one of two rewards of differing magnitudes separated in time. Individuals with high levels of choice impulsivity show greater tendencies not to consider the longer-term consequences of their decisions and to focus on shorter-term rewards (58).

The present review focuses on decision-making in 3 conditions: GD, PPU and BED. Precise boundaries between the constructs of decision-making and choice impulsivity are not entirely distinct. In this review, we will review decision-making under ambiguity as measured by the IGT and decision-making under more defined contingencies as measured by delay-discounting tasks. We have tabulated main findings (Table 1).

2.1. Decision-making and GD

Decision-making processes that underpin gambling share similarities with those underlying day-to-day choices (59). They may be conceptualized as cost/benefit decisions, based on choosing between risking losing things of value and obtaining greater rewards (59). In general, individuals usually prefer to gamble in risky than in ambiguous ways, since in decision-making processes, ambiguity is often perceived as more aversive than risk (55). However, individual differences in personalities or tendencies (e.g. punishment insensitivity and sensation-seeking) and cognitive factors (e.g. reversal learning inflexibility) may influence decision-making in individuals with GD (60). Moreover, although specific influences of variables such as age, sex, or educational level have not often been directly linked to decision-making deficits in GD (58), features including intelligence, emotions, social variables, cognitive distortions, cognitive processing, comorbidities, length of abstinence, or arousal may also condition decision-making (50,55,58,61,62).

Social and emotional factors are usually integrated into decision-making processes. In a recent study evaluating decision-making processes in poker players, it was observed that

when participants experienced anger, they made mathematically poorer decisions (61). Moreover, the social nature of some forms of gambling, and more specifically the social identity of some people who gamble (e.g., on poker), may have a significant moderating influence on the expression of emotions and decision-making processes (61).

In assessing the specific role of arousal in risk and ambiguity decision-making, notable differences have been observed. In the case of decisions under risk, arousal is usually closely associated with the choice of safer options, when the risk is high and the probability of winning is low, thus decreasing gambling behavior (55). However, in the case of decisions under ambiguity, arousal may present a qualitatively different nature, and is often associated with increased gambling (55). Therefore, arousal may condition the perception of value in decisions involving greater or lesser degrees of uncertainty (55).

Individuals with gambling problems often wager large amounts and exhibit difficulties ceasing betting, and control and appetitive centers may contribute to decisions to gamble. Cognitive training that includes response inhibition may alter the amounts wagered, as well as stopping behaviors that may generalize beyond gambling (50).

Decision-making processes in the context of GD may also involve erroneous beliefs and cognitive distortions that may promote overconfidence in the ability to predict and control wins and losses, the denial of luck and chance, and generate high expectancies of winning (63–66). Sex differences in cognitive distortions have been reported (67), with females showing more magical thinking and procrastination and procrastination mediating the association between magical thinking and GD. The gender-related difference may explain tendencies for women to rely more on luck than on skill during gambling (67).

Overactivation of motivational and valuation networks has been reported in GD, with individuals presenting greater risk-seeking and a focus on immediate rewards (68,69). Both tendencies may influence decision-making and delay discounting (68–70). Specifically, links between risk-seeking and delay discounting were driven by GD status, and factors specific to the disorder, such as illusion of control, may contribute (68). Other studies have also highlighted the relevance of factors such as age in the association between delay discounting and GD, with younger individuals showing relationships between forms of impulsivity (71).

Laboratory-based decision-making studies have shown that individuals with GD exhibit decision-making impairments both under risk and ambiguity. They typically perform more poorly than comparison subjects on the IGT (although not always (72)), preferring short-term rewards, even if they are not profitable in the long term, evidencing insensitivity to the future consequences of their gambling behavior (73–76). In spite of making more disadvantageous choices, individuals with GD often learn from feedback more slowly than do comparison subjects (77,78). Disadvantageous decision-making on the IGT may relate to loss-chasing behaviors (74). Some authors have found that the relationship between IGT performance and GD severity is mediated by loss chasing, the tendency to continue to bet in attempts to recover previous losses (74). Others have reported that disadvantageous decision-making may involve diminished striatal signaling during reward and loss prospect and may operate across individuals with and without GD (72). In adolescents, a correlation

between disadvantageous decision-making and problem gambling was observed (64). Disadvantageous decision-making on the IGT was linked to interpretative biases, a cognitive distortion characterized by tendencies to associate losses with bad luck and gains with personal skill. Both factors, along with alcohol consumption, were powerful predictors of problem-gambling severity in adolescents.

Although most studies of decision-making in GD have focused on the outcomes derived from decisional processes, individual differences in habitual response patterns may also contribute (79). Decision-making styles are related to cognitive styles, and rational, intuitive, dependent, avoidant and spontaneous styles have been described (80,81). Problem-gambling severity has been positively related to spontaneous decision-making styles and negatively to rational decision-making styles in adolescents (79). Therefore, problematic gambling may be associated with non-rational and non-adaptive decision-making tendencies.

Together, these findings suggest that decision-making is an important consideration in GD. However, it is necessary not to operationalize risky decision-making patterns as a feature of GD solely, since it could represent an intermediate phenotype present across pathologies (59).

2.2. Decision-making and PPU

A specific role of arousal on decision-making under risk and ambiguity has rarely been studied in PPU (82,83). Sexual arousal may influence motivational drives toward sexual gratification; thus, responses to sexual context cues, such as pornography or other sexual arousing stimuli, are important to consider in decision-making (84).

Experimental studies of sexual decision making have been conducted (85), including when inducing sexual arousal by presenting images with sexual content (86). A modified version of the IGT included neutral and sexual pictures. When sexual images were associated with disadvantageous alternatives, decision-making performance was worse than when they were associated with advantageous alternatives, especially for individuals who were more sexually aroused. A preference in decision-making for images with sexual content may be associated with drives to receive and maintain gratification. Therefore, sexual stimuli may act as distractors, leading individuals, especially those who are more sexually aroused, to neglect feedback provided by the task during decision-making processes.

Sexual risk-taking when experiencing strong arousal may operate across genders. Sexual arousal may directly impact assessment of risky sexual situations and perceived advantages and disadvantages of chosen behaviors. Effects of “sexual myopia” may be similar to “alcohol myopia” and increase risk-taking (84). In one study (87), when sexual arousal was heightened, the effects of alcohol on risk behavior (in this case, intentions to have unprotected sex) were stronger.

When comparing individuals with recreational/occasion use of pornography and those with PPU, differences in impulsive choice were observed (88). These findings resonate with associations between impulsivity and severity of PPU described earlier (89). Longitudinal studies suggest that individuals are immediately rewarded by use of pornography, which

may predict steeper delayed discounting rate over time. Furthermore, effects of pornography use on decision-making may last longer than the duration of sexual arousal (17). These findings resonate with those proposing long-term effects of pornography on reward system (90). In addition, self-control training through non-use of pornography reduced delay discounting more so than other approaches, such as food abstinence (17).

In the case of problematic sexual behaviors, similarly to GD, it has been suggested that cognitive biases may contribute to decision-making in PPU, consistent with attentional impacts of erotic stimuli (91). Individuals who reported greater cybersex-addiction symptomatology showed approach/avoidance biases to erotic stimuli (92). A curvilinear relationship between PPU and approach-avoidance patterns was described (92). Impaired cognitive control has also been observed when individuals with cybersex addiction are faced with multi-tasking including pornographic and neutral stimuli (93). These findings were recently extended in male college students who used pornography; PPU was linked more to speed of approach than avoidance of erotic stimuli, with erotic stimuli being perceived as more positive and arousing (94). Similar findings have recently been reported in female college students (95). In a separate study, being sexually aroused and the desire to masturbate reduced self-confidence about the ability to avoid pornographic stimuli even in individuals whose pornography use is once or less per week (96). Some authors hypothesize that reward-related brain activations involved in PPU lead over time to a greater desire for increasingly new and extreme external sexual stimulation (97). However, others propose that it could be seen as a precondition rather than a consequence of PPU (97). Consequently, more research is needed to examine how decision-making relate to the onset or the maintenance of PPU.

Finally, when evaluating associations between sexual arousal and gambling in the general population, it has been observed that the incorporation of sexual stimuli reduced differences in arousal between gains and losses associated with gambling, when more arousal is usually observed towards losses. The presence of sexual stimuli could make losses associated with gambling be perceived as less salient (82).

2.3. Decision-making and BED

Making advantageous decisions when eating and evaluating possible long-term consequences is important due to the increasing availability of palatable food and rates of obesity worldwide (98,99). Employing advantageous decision-making processes is especially important in the case of BED, particularly with respect to bingeing (98).

Individuals with BED often report feeling unable to control their food intake (26). Individuals with BED may use more rigid decision-making strategies (16). Specifically, people with BED may demonstrate enhanced switching between choices leading to impaired behavioral adaptation, reflecting a bias towards exploratory decisions in the context of dynamic environments (16). Therefore, further investigation of decision-making in BED is important (16,100).

Regarding decision-making under risk, individuals with BED who were overweight or obese made more risky decisions relative than those without BED who were overweight or obese

as evidenced by performance on the game of dice task (GDT), which presents explicit probabilities and provides feedback to participants (98). Individuals with BED also showed greater risk-seeking under monetary reward anticipation (101). Thus, BED may involve impaired discrimination of reward values and tendencies to attribute more importance to subjective relative to objective probabilities (that is, when they perceive the likelihood of a probabalistic reward to be higher than the actual likelihood) (101,102).

When evaluating decision-making under ambiguity with the IGT, patients with BED obtain lower scores, showing a greater tendency to make disadvantageous decisions, compared to individuals without BED, and difficulties in processing feedback received after making decisions (103,104). When studying individuals with obesity with and without BED, both show similar task performance (102). In addition, BED severity correlates positively with the degree of impairment of decision-making processes (105).

With respect to delay discounting, individuals with BED versus those without tend to discount rewards more steeply (26,106). Furthermore, this tendency transcends domains, such as food, money, massages or sedentary activity (107). Higher levels of delay discounting have been observed in individuals with obesity, with and without BED. In the case of morbid obesity, higher delay discounting is observed if they also have BED, in comparison with individuals with non-BED obesity (102). Therefore, an association between BED, severity of obesity and impaired decision-making has been suggested (102). Some authors have stressed that in the case of BED, the subjective perception of impulsivity and difficulties in controlling behavior (self-reported impulsivity) may be more relevant than conscious decision-making processes (impulsive task performance) (108). Individuals' preferences for short-term rewards, discounting possible long-term consequences, may explain the occurrence of binge-eating episodes, associated with a sense of loss of control, even when individuals start to experience negative consequences, such as weight gain or feelings of guilt (109).

Despite these findings, studies assessing BED and decision-making are relatively scarce and heterogeneous (109), so they should be interpreted with caution. In addition, findings of impaired decision-making processes may be less applicable to adolescent populations with BED, as a recent meta-analysis of eating disorders suggests (110,111). The possibility exists that decision-making processes remain relatively intact in early stages of BED (111), although this too warrants more examination. Over time and during development, individuals with BED may develop maladaptive patterns of decision-making in response to rewarding food cues (111).

Binge-eating behaviors may be driven by multiple neurocognitive alterations associated with decision-making and impulsivity and compulsivity, as well as other neurocognitive domains (26). Some authors report, however, that in EDs, this impairment in decision-making processes may lessen when patients recover, with decision-making processes similar to non-affected individuals. Therefore, decision-making may be malleable and targeted in interventions for BED (112).

2.4. Limitations and future research

A current limitation in the field of neurocognition, and specifically in decision-making, is the existence of multiple tasks and models, which may hinder comparability of results across studies. More empirical studies are needed to understand the precise role for this neurocognitive domain in GD, PPU and BED. Differences in conceptualizations of decision-making may also limit the assessment of this construct. The division between decisions under risk and ambiguity is not addressed in all the studies, and multiple neuropsychological instruments have been used to assess both processes, which may overlap to some extent. Moreover, the direct comparison between these three clinical entities is challenging since the literature is focused on different factors which may affect decision-making. Therefore, future studies should also address these conceptualization and assessment limitations. Finally, it should be noted that laboratory findings may not translate to real-world contexts, and these should be assessed.

3. CONCLUSIONS

Understanding decision-making has important implications for the assessment and treatment of individuals with GD, PPU and BED. Similar alterations in decision-making under risk and ambiguity, as well as greater delay discounting, have been reported in GD, BED and PPU. These findings support a transdiagnostic feature that may be amenable to interventions for the disorders. However, there are relevant gaps in the decision-making literature across these three clinical conditions, and a direct comparison of these groups on decision-making may benefit from directly assessing specific constructs in parallel across the conditions.

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Conflict of interest

None of the authors have any conflicts of interest. Marc Potenza has consulted for Rivermend Health, Opiant Therapeutics, Game Day Data, Addiction Policy Forum, Idorisa Pharmaceuticals and AXA; has received research support from Mohegan Sun Casino and the National Center for Responsible Gaming; has participated in surveys, mailings or telephone consultations related to drug addiction, impulse-control disorders or other health topics; has consulted for and/or advised gambling, health and legal entities on issues related to impulse-control/addictive disorders; has provided clinical care in a problem gambling services program; has performed grant reviews for research-funding agencies; has edited journals and journal sections; has given academic lectures in grand rounds, CME events and other clinical or scientific venues; and has generated books or book chapters for publishers of mental health texts. Dr. Mestre-Bach reports grants from Fundación Ciudadanía y Valores, during the conduct of the study.

REFERENCES

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. 2013.
2. Duffy A, Dawson DL, das Nair R. Pornography Addiction in Adults: A Systematic Review of Definitions and Reported Impact. Journal of Sexual Medicine. 2016; 13(5): 760–777.
3. Chóliz M The challenge of online gambling: The effect of legalization on the increase in online gambling addiction. J Gambl Stud. 2016;32(2):749–56. [PubMed: 26058374]
4. Curtis GR, Coudriet JM, Sanzalone L, Mack NR, Stein LM, Hayes MR, et al. Short- and long-access palatable food self-administration results in different phenotypes of binge-type eating. Physiol Behav. 2019;212: 112700.
5. Love T, Laier C, Brand M, Hatch L, Hajela R. Neuroscience of internet pornography addiction: A review and update. Behavioral Sciences. 2015; 5(3): 388–433. [PubMed: 26393658]
6. Fauth-Bühler M, Mann K, Potenza MN. Pathological gambling: a review of the neurobiological evidence relevant for its classification as an addictive disorder. Addiction Biology. 2017; 22(4): 885–897. [PubMed: 26935000]
7. Gola M, Wordecha M, Sescousse G, Lew-Starowicz M, Kossowski B, Wypych M, et al. Can pornography be addictive? An fMRI study of men seeking treatment for problematic pornography use. Neuropsychopharmacology. 2017;42(10):2021–31. [PubMed: 28409565]
8. Leeman RF, Rowland BHP, Gebru NM, Potenza MN. Relationships among impulsive, addictive and sexual tendencies and behaviours: a systematic review of experimental and prospective studies in humans. Philos Trans R Soc Lond B Biol Sci. 2019;374(1766):20180129.
9. **Balodis IM, Potenza MN Common neurobiological and psychological underpinnings of gambling and substance-use disorders. Progress in Neuro-Psychopharmacology and Biological Psychiatry. 2020; 99: 109847.This study examines exhaustively decision-making and essential features of addictive disorders, comparing gambling disorder with substance-use disorders.
10. Balodis IM, Grilo CM, Potenza MN. Neurobiological features of binge eating disorder. CNS Spectrums. 2015; 20(6), 557–565. [PubMed: 26530404]
11. Maij DLR, Van De Wetering BJM, Franken IHA. Cognitive control in young adults with cannabis use disorder: An event-related brain potential study. J Psychopharmacol. 2017;31(8):1015–26. [PubMed: 28741423]
12. Steward T, Menchon JM, Jiménez-Murcia S, Soriano-Mas C, Fernandez-Aranda F. Neural Network Alterations Across Eating Disorders: A Narrative Review of fMRI Studies. Curr Neuropharmacol. 2017;16(8):1150–63.
13. Wang KS, Smith D V., Delgado MR. Using fMRI to study reward processing in humans: Past, present, and future. Journal of Neurophysiology. 2016; 115(3), 1664–1678. [PubMed: 26740530]
14. Bodell LP, Wildes JE, Goldschmidt AB, Lepage R, Keenan KE, Guyer AE, et al. Associations Between Neural Reward Processing and Binge Eating Among Adolescent Girls. J Adolesc Heal. 2018;62(1):107–13.
15. Weidacker K, Johnston SJ, Mullins PG, Boy F, Dymond S. Impulsive decision-making and gambling severity: The influence of γ-amino-butyric acid (GABA) and glutamate-glutamine (Glx). Eur Neuropsychopharmacol. 2020;32:36–46. [PubMed: 31901336]
16. Reiter AMF, Heinze HJ, Schlagenhauf F, Deserno L. Impaired Flexible Reward-Based Decision-Making in Binge Eating Disorder: Evidence from Computational Modeling and Functional Neuroimaging. Neuropsychopharmacology. 2017;42(3):628–37. [PubMed: 27301429]
17. Negash S, Sheppard NVN, Lambert NM, Fincham FD. Trading Later Rewards for Current Pleasure: Pornography Consumption and Delay Discounting. J Sex Res. 2016;53(6):689–700. [PubMed: 26305628]
18. Wyckmans F, Otto AR, Sebold M, Daw N, Bechara A, Saeremans M, et al. Reduced model-based decision-making in gambling disorder. Sci Rep. 2019;9(1).
19. Gu Y ting, Zhou C, Yang J, Zhang Q, Zhu G hui, Sun L, et al. A transdiagnostic comparison of affective decision-making in patients with schizophrenia, major depressive disorder, or bipolar disorder. PsyCh J. 2020; 9(2):199–209. [PubMed: 32077267]

20. Balogh KN, Mayes LC, Potenza MN. Risk-taking and decision-making in youth: Relationships to addiction vulnerability. J Behav Addict. 2013;2(1):1–9. [PubMed: 26166448]
21. Balodis IM, Potenza MN. Anticipatory reward processing in addicted populations: A focus on the monetary incentive delay task. Biological Psychiatry. 2015; 77(5): 434–444. [PubMed: 25481621]
22. Potenza MN. What integrated interdisciplinary and translational research may tell us about addiction. Addiction. 2010; 105(5), 792. [PubMed: 20402969]
23. Brand M, Wegmann E, Stark R, Müller A, Wölfling K, Robbins TW, 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. Neuroscience and Biobehavioral Reviews. 2019.
24. Antons S, Brand M, Potenza M. Neurobiology of cue-reactivity, craving, and inhibitory control in non-substance addictive behaviors. J Neurol Sci. 2020; 116952.
25. Brand M, Young KS, Laier C, Wölfling K, Potenza MN. Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. Neuroscience and Biobehavioral Reviews. 2016; 71:252–266. [PubMed: 27590829]
26. Kessler RM, Hutson PH, Herman BK, Potenza MN. The neurobiological basis of binge-eating disorder. Neuroscience and Biobehavioral Reviews. 2016; 63: 223–238. [PubMed: 26850211]
27. Treasure J, Leslie M, Chami R, Fernández-Aranda F. Are trans diagnostic models of eating disorders fit for purpose? A consideration of the evidence for food addiction. European Eating Disorders Review. 2018; 26(2), 83–91. [PubMed: 29341400]
28. Leslie M, Turton R, Burgess E, Nazar BP, Treasure J. Testing the addictive appetite model of binge eating: The importance of craving, coping, and reward enhancement. Eur Eat Disord Rev. 2018;26(6):541–50. [PubMed: 29971860]
29. Volkow ND, Wang GJ, Tomasi D, Baler RD. Obesity and addiction: Neurobiological overlaps. Obesity Reviews. 2013; 14(1):2–18. [PubMed: 23016694]
30. Hebebranda J, Albayraka Ö, Adanb R, Antel J, Dieguezc C, De Jongb J, et al. “Eating addiction”, rather than “food addiction”, better captures addictive-like eating behavior. Neuroscience and Biobehavioral Reviews. 2014; 47:295–306. [PubMed: 25205078]
31. Balodis IM, Kober H, Worhunsky PD, Stevens MC, Pearlson GD, Potenza MN. Diminished frontostriatal activity during processing of monetary rewards and losses in pathological gambling. Biol Psychiatry. 2012;71(8):749–57. [PubMed: 22336565]
32. Balodis IM, Kober H, Worhunsky PD, White MA, Stevens MC, Pearlson GD, et al. Monetary reward processing in obese individuals with and without binge eating disorder. Biol Psychiatry. 2013;73(9):877–86. [PubMed: 23462319]
33. Potenza MN. Non-substance addictive behaviors in the context of DSM-5. Addictive Behaviors. 2014;39(1).
34. Gearhardt A, White M, Potenza M. Binge eating disorder and food addiction. Current Drug Abuse Reviews. 2011; 4(3): 201–207. [PubMed: 21999695]
35. Burrows T, Kay-Lambkin F, Pursey K, Skinner J, Dayas C. Food addiction and associations with mental health symptoms: a systematic review with meta-analysis. Journal of Human Nutrition and Dietetics. 2018; 31(4), 544–572. [PubMed: 29368800]
36. Mestre-Bach G, Jiménez-Murcia S, Fernández-Aranda F, Potenza MN. Addressing controversies surrounding food addiction Compulsive Eating Behavior and Food Addiction: Emerging Pathological Constructs. 2019 (pp. 419–448). Academic Press.
37. **de Alarcón R, de la Iglesia J, Casado N, Montejo A Online Porn Addiction: What We Know and What We Don’t—A Systematic Review. J Clin Med. 2019;8(1):91.This article summarizes the studies about online problematic pornography use and outline areas of further research.
38. Duffy A, Dawson DL, das Nair R. Pornography Addiction in Adults: A Systematic Review of Definitions and Reported Impact. Journal of Sexual Medicine. 2016;13(5):760–777.
39. World Health Organization. ICD-11. 2018.
40. Kraus SW, Voon V, Potenza MN. Should compulsive sexual behavior be considered an addiction? Addiction. 2016;111(12):2097–106. [PubMed: 26893127]

41. Stark R, Klucken T, Potenza MN, Brand M, Strahler J. A Current Understanding of the Behavioral Neuroscience of Compulsive Sexual Behavior Disorder and Problematic Pornography Use. Curr Behav Neurosci Reports. 2018;5(4):218–31.
42. Potenza MN. The importance of animal models of decision making, gambling, and related behaviors: Implications for translational research in addiction. Neuropsychopharmacology. 2009; 34(13):2623–2624. [PubMed: 19901921]
43. Sachdev PS, Blacker D, Blazer DG, Ganguli M, Jeste DV., Paulsen JS, et al. Classifying neurocognitive disorders: The DSM-5 approach. Nature Reviews Neurology. 2014; 10(11):634. [PubMed: 25266297]
44. **Koffarnus MN, Kaplan BA Clinical models of decision making in addiction. Pharmacology Biochemistry and Behavior. 2018; 164:71–83.This study provides a thorough description of the assessment of decision-making in addiction.
45. Soyata AZ, Aksu S, Woods AJ, İşçen P, Saçar KT, Karamürsel S. Effect of transcranial direct current stimulation on decision making and cognitive flexibility in gambling disorder. Eur Arch Psychiatry Clin Neurosci. 2019;269(3):275–84. [PubMed: 30367243]
46. Spechler PA, Chaarani B, Hudson KE, Potter A, Foxe JJ, Garavan H. Response inhibition and addiction medicine: from use to abstinence In Progress in brain research (Vol. 223, pp. 143–164). Elsevier. [PubMed: 26806775]
47. Perales JC, King DL, Navas JF, Schimmenti A, Sescousse G, Starcevic V, et al. Learning to lose control: A process-based account of behavioral addiction. Neuroscience and Biobehavioral Reviews. 2020; 108:771–780. [PubMed: 31846653]
48. Bechara A Decision making, impulse control and loss of willpower to resist drugs: A neurocognitive perspective. Nature Neuroscience. 2005; 8(11):1458–1463. [PubMed: 16251988]
49. Kahneman D A Perspective on Judgment and Choice: Mapping Bounded Rationality. American Psychologist. 2003; 58(9):697.
50. Stevens T, Brevers D, Chambers CD, Lavric A, McLaren IPL, Mertens M, et al. How does response inhibition influence decision making when gambling? J Exp Psychol Appl. 2015;21(1):15–36. [PubMed: 25559481]
51. Logan GD, Gordon RD. Executive control of visual attention in dual-task situations. Psychol Rev. 2001;108(2):393–434. [PubMed: 11381835]
52. Schiebener J, Brand M. Decision Making Under Objective Risk Conditions–a Review of Cognitive and Emotional Correlates, Strategies, Feedback Processing, and External Influences. Neuropsychology Review. 2015; 25(2):171–198. [PubMed: 25894847]
53. Liebherr M, Schiebener J, Averbeck H, Brand M. Decision making under ambiguity and objective risk in higher age - A review on cognitive and emotional contributions. Frontiers in Psychology. 2017; 8: 2128. [PubMed: 29270145]
54. Figner B, Mackinlay RJ, Wilkening F, Weber EU. Affective and Deliberative Processes in Risky Choice: Age Differences in Risk Taking in the Columbia Card Task. J Exp Psychol Learn Mem Cogn. 2009;35(3):709–30. [PubMed: 19379045]
55. FeldmanHall O, Glimcher P, Baker AL, Phelps EA. Emotion and decision-making under uncertainty: Physiological arousal predicts increased gambling during ambiguity but not risk. J Exp Psychol Gen. 2016;145(10):1255–62. [PubMed: 27690508]
56. Hamilton KR, Mitchell MR, Wing VC, Balodis IM, Bickel WK, Fillmore M, et al. Choice impulsivity: Definitions, measurement issues, and clinical implications. Personal Disord Theory, Res Treat. 2015;6(2):182–98.
57. Fineberg NA, Potenza MN, Chamberlain SR, Berlin HA, Menzies L, Bechara A, et al. Probing compulsive and impulsive behaviors, from animal models to endophenotypes: A narrative review. Neuropsychopharmacology. 2010; 35(3), 591–604. [PubMed: 19940844]
58. Kovács I, Richman MJ, Janka Z, Maraz A, Andó B. Decision making measured by the Iowa Gambling Task in alcohol use disorder and gambling disorder: a systematic review and meta-analysis. Drug and Alcohol Dependence. 2017; 181:152–161. [PubMed: 29055269]
59. Winstanley CA, Clark L. Translational models of gambling-related decision making In: Current Topics in Behavioral Neurosciences. 2016 (pp. 93–120). Springer, Cham.

60. Navas JF, Torres A, Vilar R, Verdejo-García A, Catena A, Perales JC. Nonmonetary decision-making indices discriminate between different behavioral components of gambling. J Gambl Stud. 2014;31(4):1545–60.
61. Laakasuo M, Palomäki J, Salmela M. Emotional and social factors influence poker decision making accuracy. J Gambl Stud. 2015;31(3):933–47. [PubMed: 24633674]
62. Krmpotich T, Mikulich-Gilbertson S, Sakai J, Thompson L, Banich MT, Tanabe J. Impaired decision-making, higher impulsivity, and drug severity in substance dependence and pathological gambling. J Addict Med. 2015;9(4):273–80. [PubMed: 25918968]
63. Fortune EE, Goodie AS. Cognitive distortions as a component and treatment focus of pathological gambling: A review. Psychology of Addictive Behaviors. 2012; 26(2):298. [PubMed: 22121918]
64. Ciccarelli M, Griffiths MD, Nigro G, Cosenza M. Decision-making, cognitive distortions and alcohol use in adolescent problem and non-problem gamblers: An experimental study. J Gambl Stud. 2016;32(4):1203–13. [PubMed: 26894884]
65. Potenza MN. The neural bases of cognitive processes in gambling disorder. Trends in Cognitive Sciences. 2014; 18(8):429–438. [PubMed: 24961632]
66. Potenza MN, Balodis IM, Derevensky J, Grant JE, Petry NM, Verdejo-Garcia A, et al. Gambling disorder. Nat Rev Dis Prim. 2019.
67. Passanisi A, Craparo G, Pace U. Magical thinking and decision-making strategies among late adolescent regular gamblers: A mediation model. J Adolesc. 2017;59:51–8. [PubMed: 28582650]
68. Kräplin A, Dshemuchadse M, Behrendt S, Scherbaum S, Goschke T, Bühringer G. Dysfunctional decision-making in pathological gambling: Pattern specificity and the role of impulsivity. Psychiatry Res. 2014;215(3):675–82. [PubMed: 24434041]
69. Achab S, Karila L, Khazaal Y. Pathological Gambling: Update on Decision Making and Neuro-functional Studies in Clinical Samples. Curr Pharm Des. 2014;20(25):4000–11. [PubMed: 24001289]
70. Wulff DU, van den Bos W. Modeling Choices in Delay Discounting. Psychological Science. 2018; 29(11): 1890–1894. [PubMed: 28548880]
71. Steward T, Mestre-Bach G, Fernández-Aranda F, Granero R, Perales JC, Navas JF, et al. Delay discounting and impulsivity traits in young and older gambling disorder patients. Addict Behav. 2017;71:96–103. [PubMed: 28288442]
72. Balodis IM, Linnet J, Arshad F, Worhunsky PD, Stevens MC, Pearlson GD, et al. Relating neural processing of reward and loss prospect to risky decision-making in individuals with and without gambling disorder. Int Gambl Stud. 2018;18(2):269–85. [PubMed: 31485192]
73. Mallorquí-Bagué N, Fagundo AB, Jimenez-Murcia S, De La Torre R, Baños RM, Botella C, et al. Decision making impairment: A shared vulnerability in obesity, gambling disorder and substance use disorders? PLoS One. 2016;11(9).
74. Nigro G, Ciccarelli M, Cosenza M. The illusion of handy wins: Problem gambling, chasing, and affective decision-making. J Affect Disord. 2018;225:256–9. [PubMed: 28841489]
75. Wiehler A, Peters J. Reward-based decision making in pathological gambling: The roles of risk and delay. Neuroscience Research. 2015; 90:3–14. [PubMed: 25269860]
76. Cavedini P, Riboldi G, Keller R, D'Annucci A, Bellodi L. Frontal lobe dysfunction in pathological gambling patients. Biol Psychiatry. 2002;51(4):334–41. [PubMed: 11958785]
77. Goudriaan AE, Oosterlaan J, De Beurs E, Van Den Brink W. Decision making in pathological gambling: A comparison between pathological gamblers, alcohol dependents, persons with Tourette syndrome, and normal controls. Cognitive Brain Research. 2005; 23(1): 137–151. [PubMed: 15795140]
78. Ledgerwood DM, Orr ES, Kaploun KA, Milosevic A, Frisch GR, Rupcich N, et al. Executive Function in Pathological Gamblers and Healthy Controls. J Gambl Stud. 2012;28(1):89–103. [PubMed: 21253846]
79. *Cosenza M, Ciccarelli M, Nigro G Decision-making styles, negative affectivity, and cognitive distortions in adolescent gambling. J Gambl Stud. 2019;35(2):517–31. [PubMed: 29959691] This study assessed the role of decision-making styles in gambling disorder and its association with cognitive distortions, and negative affectivity.

80. Phillips WJ, Fletcher JM, Marks ADG, Hine DW. Thinking styles and decision making: A meta-analysis. Psychol Bull. 2016;142(3):260–90. [PubMed: 26436538]
81. Scott SG, Bruce RA. Decision-Making Style: The Development and Assessment of a New Measure. Educ Psychol Meas. 1995;55(5):818–31.
82. Lui M, Hsu M. Viewing sexual images is associated with reduced physiological arousal response to gambling loss. PLoS One. 2018;13(4).
83. Kowalewska E, Grubbs JB, Potenza MN, Gola M, Draps M, Kraus SW. Neurocognitive Mechanisms in Compulsive Sexual Behavior Disorder. Curr Sex Heal Reports. 2018;10(4):255–64.
84. Skakoon-Sparling S, Cramer KM, Shuper PA. The Impact of Sexual Arousal on Sexual Risk-Taking and Decision-Making in Men and Women. Arch Sex Behav. 2016;45(1):33–42. [PubMed: 26310879]
85. Woolf-King SE, Maisto S, Carey M, Vanable P. Selection of film clips and development of a video for the investigation of sexual decision making among men who have sex with men. J Sex Res. 2010;47(6):589–97. [PubMed: 19760530]
86. Laier C, Pawlikowski M, Brand M. Sexual picture processing interferes with decision-making under ambiguity. Arch Sex Behav. 2014;43(3):473–82. [PubMed: 23733155]
87. Scott-Sheldon LAJ, Carey KB, Cunningham K, Johnson BT, Carey MP. Alcohol Use Predicts Sexual Decision-Making: A Systematic Review and Meta-Analysis of the Experimental Literature. AIDS Behav. 2016;20:19–39.
88. 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):223–33. [PubMed: 31120316]
89. Antons S, Brand M. Trait and state impulsivity in males with tendency towards Internet-pornography-use disorder. Addict Behav. 2018;79:171–7. [PubMed: 29291508]
90. Hilton DL. Pornography addiction – a supranormal stimulus considered in the context of neuroplasticity. Socioaffective Neurosci Psychol. 2013;3(1):20767.
91. Mechelmans DJ, Irvine M, Banca P, Porter L, Mitchell S, Mole TB, et al. Enhanced attentional bias towards sexually explicit cues in individuals with and without compulsive sexual behaviours. PLoS One. 2014;9(8).
92. Snagowski J, Brand M. Symptoms of cybersex addiction can be linked to both approaching and avoiding pornographic stimuli: Results from an analog sample of regular cybersex users. Front Psychol. 2015;6.
93. Schiebener L, Laier C, Brand M. Getting stuck with pornography? Overuse or neglect of cybersex cues in a multitasking situation is related to symptoms of cybersex addiction. J Behav Addict. 2015;4(1):14–21. [PubMed: 25786495]
94. *Sklenarik S, Potenza MN, Gola M, Kor A, Kraus SW, Astur RS Approach bias for erotic stimuli in heterosexual male college students who use pornography. J Behav Addict. 2019;8(2):234–41. [PubMed: 31257916] This study assessed a possible approach bias for erotic stimuli using an approach-avoidance task.
95. Sklenarik S, Potenza MN, Gola M, Astur RS. Approach bias for erotic stimuli among heterosexual female college students who use pornography. Addict Behav. 2020;108.
96. Kraus SW, Rosenberg H, Martino S, Nich C, Potenza MN. The development and initial evaluation of the pornography-use avoidance self-efficacy scale. J Behav Addict. 2017;6(3):354–63. [PubMed: 28889754]
97. Kühn S, Gallinat J. Brain structure and functional connectivity associated with pornography consumption the brain on porn. JAMA Psychiatry. 2014;71(7):827–34. [PubMed: 24871202]
98. Svaldi J, Brand M, Tuschen-Caffier B. Decision-making impairments in women with binge eating disorder. Appetite. 2010;54(1):84–92. [PubMed: 19782708]
99. World Health Organization (WHO). “Obesity and overweight.” 2017.
100. Voon V, Derbyshire K, Rück C, Irvine MA, Worbe Y, Enander J, et al. Disorders of compulsivity: A common bias towards learning habits. Mol Psychiatry. 2015;20(3):345–52. [PubMed: 24840709]

101. Voon V, Morris LS, Irvine MA, Ruck C, Worbe Y, Derbyshire K, et al. Risk-taking in disorders of natural and drug rewards: Neural correlates and effects of probability, valence, and magnitude. Neuropsychopharmacology. 2015;40(4):804–12. [PubMed: 25270821]
102. Voon V Cognitive biases in binge eating disorder: The hijacking of decision making. Vol. 20, CNS Spectrums 2015 p. 566–73.
103. Aloi M, Rania M, Caroleo M, Bruni A, Palmieri A, Cauteruccio MA, et al. Decision making, central coherence and set-shifting: A comparison between Binge Eating Disorder, Anorexia Nervosa and Healthy Controls. BMC Psychiatry. 2015;15(1):1–10. [PubMed: 25609320]
104. Córdova ME, Schiavon CC, Busnello FM, Reppold CT. Nutritional and Neuropsychological Profile of the Executive Functions on Binge Eating Disorder in Obese Adults. Nutr Hosp. 2017.
105. Danner UN, Ouwehand C, Van Haastert NL, Hornsveld H, De Ridder DTD. Decision-making impairments in women with binge eating disorder in comparison with obese and normal weight women. Eur Eat Disord Rev. 2012;20(1):e56–e62. [PubMed: 21308871]
106. Steward T, Mestre-Bach G, Vintró-Alcaraz C, Agüera Z, Jiménez-Murcia S, Granero R, et al. Delay Discounting of Reward and Impulsivity in Eating Disorders: From Anorexia Nervosa to Binge Eating Disorder. Eur Eat Disord Rev. 2017;25(6):601–6. [PubMed: 29057603]
107. Manwaring JL, Green L, Myerson J, Strube MJ, Wilfley DE. Discounting of various types of rewards by women with and without binge eating disorder: Evidence for general rather than specific differences. Psychological Record. 2011; 1(4):561–582.
108. Bartholdy S, Rennalls S, Danby H, Jacques C, Campbell IC, Schmidt U, et al. Temporal Discounting and the Tendency to Delay Gratification across the Eating Disorder Spectrum. Eur Eat Disord Rev. 2017;25(5):344–50. [PubMed: 28345215]
109. Manasse SM, Forman EM, Ruocco AC, Butryn ML, Juarascio AS, Fitzpatrick KK. Do executive functioning deficits underpin binge eating disorder? A comparison of overweight women with and without binge eating pathology. Int J Eat Disord. 2015;48(6):677–83. [PubMed: 25644028]
110. Kittel R, Schmidt R, Hilbert A. Executive functions in adolescents with binge-eating disorder and obesity. Int J Eat Disord. 2017;50(8):933–41. [PubMed: 28407284]
111. Wu M, Brockmeyer T, Hartmann M, Skunde M, Herzog W, Friederich HC. Reward-related decision making in eating and weight disorders: A systematic review and meta-analysis of the evidence from neuropsychological studies. Neuroscience and Biobehavioral Reviews. 2016; 61:177–196. [PubMed: 26698021]
112. Guillaume S, Gorwood P, Jollant F, Van Den Eynde F, Courtet P, Richard-Devantoy S. Impaired decision-making in symptomatic anorexia and bulimia nervosa patients: A meta-analysis. Psychological Medicine. 2015; 45(16):3377–3391. [PubMed: 26497047]

Table 1.

Summary of the main studies

Clinical entities	Reference	Diagnostic and comparison groups	Task/construct to assess decision-making	Main findings
GD	Stevens et al. (2015)	24 gamblers with a gambling problem, 24 frequent gamblers without a gambling problem and a matched HC group with participants who did not gamble	Task involved the probability of winning decreased as the amount increased, without the exact probabilities being revealed.	Participants with problematic gambling did not adjust their gambling strategies when the probability of losing larger amounts was higher.
	Balodis et al. (2018)	28 participants with GD and 28 HCs	MIDT and IGT	Both groups showed no significant differences in out-of-scanner IGT performance.
	Mallorquí-Bagué et al. (2016)	178 patients with GD, 113 patients with obesity, 106 patients with substance use disorders and 194 HCs	IGT	The three clinical groups showed disadvantageous decision-making in comparison with the HC group.
	Nigro et al. (2018)	104 regular VLT players who reported gambling once a week or more	IGT	The higher the SOGS scores, the more disadvantageous the decision-making performance.
	Goudriaan (2005)	48 participants with GD, 46 participants with alcohol dependence, 47 participants with Tourette syndrome and 49 HCs	IGT	The GD and AD groups showed disadvantageous decision-making processes. The GD group showed differences in feedback processing in comparison with HCs.
	Ledgerwood (2011)	45 participants with GD and 45 HCs	IGT	The GD group showed disadvantageous decision-making.
	Navas et al. (2014)	77 college students	The dynamic decision-making was measured by a probabilistic reversal learning task based on the PROB task.	Individual differences in personalities or tendencies (e.g. punishment insensitivity and sensation-seeking) and cognitive factors (e.g. reversal learning inflexibility) may influence decision-making.
	Krmpotich et al. (2015)	96 substance-dependent participants divided into 2 groups depending on whether they met criteria for GD (n = 26) or not (n = 70)	Modified IGT	The group with GD performed disadvantageously on decision-making.
	Kräplin et al. (2014)	19 participants with GD and 19 matched HCs	CGT and DDP	The GD group showed a higher immediate reward focus.
	Cosenza et al. (2019)	425 adolescents	GDMS	The spontaneous decision-making style predicted problem-gambling severity
	Cavedini et al. (2002)	20 patients with GD and 40 HCs	IGT	Significant differences were found in IGT performance between groups
	Ciccarelli (2016)	104 male adolescents divided in problem and non-problem gamblers	IGT	Participants with problem gambling showed disadvantageous decision-making.
PPU	Mechelmans et al. (2014)	22 participants with CSB and 44 HCs	Dot probe task (attentional bias to sexually explicit clues)	Enhanced attentional bias to explicit cues may be related to an early orienting attentional response.
	Snagowski et al. (2015)	123 heterosexual males	Modified version of the AAT with pornographic pictures	Individuals who reported greater cybersex-addiction symptomatology showed approach/avoidance biases to erotic stimuli.

Clinical entities	Reference	Diagnostic and comparison groups	Task/construct to assess decision-making	Main findings
	Schiebener et al. (2015)	104 male participants	Multitasking – Balanced Switching Task porn (BSTporn)	Less balanced performance was related to a higher tendency towards cybersex problematic behavior.
	Sklenarik et al. (2019)	72 male undergraduate students	Modified version of the AAT utilized by Wiers et al. (2011)	The approach bias for erotic stimuli significantly correlated with pornography- use measures.
	Kraus et al. (2017)	229 male pornography users who sought or considered seeking professional help for their pornography use	PASS	Lower hypersexuality was related with higher confidence to avoid using pornography.
	Antons et al. (2019)	1,498 heterosexual males with recreational-occasional use (n = 333), recreational-frequent use (n = 394), and poorly regulated use (n = 225) of internet pornography	MCQ	Participants with poorly regulated pornography use showed the highest scores for delay discounting.
	Sklenarik et al. (2020)	121 female undergraduates	AAT with erotic and neutral stimuli	Participants showed an approach bias for erotic stimuli in comparison to neutral stimuli, and the approach bias was positively correlated with PPUS scores.
BED	Reiter et al. (2016)	22 patients with BED and 22 HCs	Reward-guided decision-making task	Decision-making in BED was characterized by a bias towards exploratory decisions during behavioral adaptation in a dynamic environment.
	Svaldi et al. (2010)	17 women with BED and 18 overweight HCs	GDT	Participants with BED made risky decisions significantly more often than HCs. Moreover, they showed less capacities to utilization of feedback processing.
	Voon et al. (2015)	30 abstinent subjects with alcohol dependence, 30 participants with obesity and BED, 30 HCs with obesity and without BED, and 23 abstinent methamphetamine-dependent subjects	Task where participants chose between a risky and a sure choice,	Participants with BED showed greater risk-taking, similar to substance-use disorders, and impaired discrimination of subjective value.
	Aloi et al. (2015)	45 participants with AN, 45 with BED, and 45 HCs	IGT	BED participants were characterized by more disadvantageous decision-making and cognitive flexibility in comparison with participants with AN.
	Córdova et al. (2017)	36 participants with obesity were divided into two groups, with and without signs of BED	IGT	Participants with signs of BED obtained lowest IGT scores.
	Danner et al. (2011)	20 patients with BED, 21 obese women without BED and 34 HC women	IGT	The BED and obese groups performed more disadvantageously on the IGT. An association between IGT performance and BED severity was found.
	Bartholdy et al. (2017)	66 women with an ED and 28 HCs	DGI and hypothetical monetary temporal discounting task	Poorer self-reported inhibitory control was found in the BN and BED groups compared with the AN and the HC groups. Symptom severity correlated with poorer self-reported inhibitory control across the EDs.
	Manasse et al. (2014)	Overweight women with (n=31) and without (n=43) full or subthreshold BED	DDT	Participants with BED displayed significantly poorer performance on tasks of problem-solving and inhibitory control, and showed higher prioritization of immediate versus delayed rewards.
	Kittel et al. (2017)	22 adolescents with BED and individually matched 22 adolescents with obesity, and 22 with normal weight	IGT	The three groups did not differ on measures of decision-making.

GD: gambling disorder; PPU: problematic pornography use; BED: binge-eating disorder; AN: anorexia nervosa; BN: bulimia nervosa; HC: healthy control; ED: eating disorder; CSB: compulsive sexual behavior; IGT: Iowa gambling task; MIDT: monetary incentive delay task; SOGS: South Oaks Gambling Screen; AAT: Approach-Avoidance-Task; PASS: Pornography-Use Avoidance Self-Efficacy Scale; GDT: game of dice task; DGI: Delaying Gratification Inventory; DDT: Delayed Discounting Task; CGT: Cambridge Gambling Task; DDP: Delay discounting paradigm; MCQ: Monetary Choice Questionnaire; PPUS: Problematic Pornography Use Scale.