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A cognitive-behavioral model of Internet gaming disorder: Theoretical underpinnings and clinical implications

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Abstract

Cognitive contributions to the behaviors observed in substance and non-substance addictions have been investigated and characterized. Based on models of drug addictions and the extant literature on Internet gaming disorder (IGD), we propose a cognitive-behavioral model for conceptualizing IGD. The model focuses on three domains and their roles in addictive behaviors. The three domains include motivational drives related to reward-seeking and stress-reduction, behavioral control relating to executive inhibition, and decision-making that involves weighing the pros and cons of engaging in motivated behaviors. Based on this model, we propose how behavioral therapies might target these domains in the treatment of IGD.

Keywords

Internet gaming disorder; cognitive model; reward sensation; executive control; decision making

Background

Internet addiction disorder (IAD) or problematic Internet use has been proposed as a diagnostic entity and studied for more than a decade; however, there has been debate regarding a standardized definition for such a disorder. Although no formal diagnostic criteria for a psychiatric condition characterized by excessive and interfering patterns of Internet use were included in the fourth edition of the Diagnostic and Statistical Manual (DSM-IV) (Block, 2008, Shaw and Black, 2008, Liu et al., 2011), the DSM-5 committee considering substance-use and addictive disorders generated criteria for Internet gaming disorder (IGD), and this condition is included in the section of the DSM-5 containing

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Contributors

Guangheng Dong wrote the first draft of the manuscript, Marc Potenza revised and improved the manuscript. All authors contributed to and have approved the final manuscript.

Competing Interests

The authors declared that no competing interests exist.

disorders warranting additional study (American Psychiatric Association, 2013, Petry and O'Brien, 2013). Given this recent change in the DSM, we will refer to excessive Internet gaming, addictive Internet gaming, or pathological online gaming as IGD in the current manuscript, although we recognize that the term and diagnostic construct might differ and none have been systematically examined with respect to current criteria for IGD.

Unlike drug addiction or substance abuse, no chemical or substance intake is involved in IAD or IGD, although excessive Internet use may lead to physical dependence, similar to other addictions (Holden, 2001, Dong et al., 2013a). This observation suggests that people's online experiences may change brain structure and function, and related cognitive processes, in manners that may perpetuate Internet use (Holden, 2001, Weinstein and Lejoyeux, 2010, Dong et al., 2011b). Although it has been proposed that excessive Internet use may involve at least three subtypes relating to gaming, sexual preoccupations, and email/text messaging (Block, 2008), other subtypes may exist (e.g. relating to other types of behaviors (social networking) or motivations that may underlie Internet use, such as those relating to positive or negative reinforcements). While additional research is needed to identify clinically meaningful subgroups, a model that describes cognitive domains, their inter-relationships and how the domains might be targeted in treatment could be helpful in the study and research of IGD.

Unanswered questions exist regarding the precise features that may lead some individuals to use the Internet excessively or compulsively. IGD behaviors may be driven by experiences involving strong emotions. The frequent and repetitive engagement in such behaviors may alter brain structure and function underlying specific cognitive processes. In this paper, we propose a cognitive-behavioral model for IGD based on the extant literatures.

Although few trials have been conducted to test the efficacies and tolerabilities of medications in the treatment of IGD (Liu and Potenza, 2007, Flisher, 2010, Huang et al., 2010, Yau et al., 2012), IGD treatments might consider psychological or cognitive processes as potential targets for pharmacological or behavioral interventions (Huang et al., 2010). Based on the proposed cognitive-behavioral model, possible approaches for the treatment of IGD are discussed, with a focus on behavioral therapies.

A cognitive-behavioral model of IGD

A central component of addictions involves reward-seeking (Potenza, 2013). Reward-centric models have focused on pleasurable aspects of drug-taking with the notion that drugs may "hijack" brain reward circuits (Volkow and Li, 2004, Nestler, 2005). The incentive salience model of drug addiction proposes that "liking" a drug may be separated from "wanting" the drug (Berridge, 2007). A "reward deficiency syndrome" model posits that addicted individuals engage in addictive behaviors to compensate for hypo-functioning reward signals in the mesolimbic dopamine pathway (Blum et al., 2006). Negative-reinforcement models suggest that relief from aversive states (e.g., relating to stress) may drive participation in addictive behaviors. Motivation-focused models have proposed that addiction might be considered a disorder of misdirected motivation in which relatively greater priority is given to drug use (as opposed to other motivational behavioral domains

like occupational or familial) (Chambers et al., 2003, Kalivas and Volkow, 2005). These and other models (e.g., the impaired response inhibition salience attribution – IRISA (Goldstein and Volkow, 2011)) consider that diminished executive control over pro-motivational drives may contribute to decisions to engage in addictive behaviors.

Like in these models of drug addiction, we propose that motivational drives linked to reward-seeking contribute importantly to IGD and that diminished executive function/cognitive control over these motivational drives contribute to decision-making that leads to persistent engagement in Internet game-playing in IGD (Figure 1). In the figure, we also indicate possible areas which may be targeted with specific therapies (which are discussed later in the manuscript), although these possible relationships remain largely untested at this point. Nonetheless, the proposed model provides a theoretical basis for hypothesis testing in mechanistic studies and treatment development.

Reward and motivation in IGD

Given the role of reward processing in behavioral and drug addictions, investigators have examined aspects of reward sensitivity in IGD. Studies that have used guessing tasks have found that individuals with IGD show enhanced reward sensitivity and decreased loss sensitivity in mild (Dong et al., 2011a, Dong et al., 2012) and extreme (Dong et al., 2013a) winning and losing situations. Online behaviors may be perceived as rewarding through feelings of being in control and immediate achievement (Leung, 2004). Enhanced reward sensitivity in IGD may underlie desires to use the Internet and promote online game-playing for longer periods of time. In this manner, enhanced reward sensitivity and decreased loss sensitivity might contribute to the development of IGD (Dong et al., 2013b).

Executive control: Inhibition of cravings and limiting excessive Internet use

Executive systems are posited to promote cognitive and behavioral control over motivational drives and may enable individuals to inhibit desires and control the extent of participation in reward-seeking behaviors (Everitt et al., 2007, Goldstein and Volkow, 2011, Sofuoglu et al., 2013). These features may contribute importantly to IGD. Reduced response-inhibition and cognitive-control tendencies or abilities have been demonstrated in subjects with IGD (as compared to those without) using go/no-go (Dong et al., 2010), Stroop (Dong et al., 2011c) and switching (Dong et al., 2014) tasks, respectively. Such response tendencies appear influenced by Internet-gaming-related stimuli, with poorer performance seen in groups with IGD relative to those without in response to online-gaming stimuli as compared to control stimuli during performance of a game-shifting task (Zhou et al., 2012). These findings suggest a cognitive bias similar to that seen in other addictions (Potenza, 2014), as well as altered set-shifting tendencies that may relate importantly to compulsive aspects of addictions. Apparent set-shifting and cognitive-control deficits in IGD may relate to inefficient processing within neural circuitry underlying these processes, a notion consistent with findings relating these neural measures to Internet addiction severity (Dong et al., 2013c). Taken together, the existing findings suggest that neural processes underlying attention, response inhibition and behavioral flexibility in individuals with IGD relate importantly to IGD severity, although the extent to which these findings reflect predisposing

factors or neural functions that arise during phases of IGD development is not yet understood.

Decision-making: Weighing short-term pleasures and long-term negative consequences

Reduced cognitive capacity or willingness to avoid excessive behavioral engagement in pleasurable activities may contribute to the development of various clinical problems, including addictive disorders like gambling and substance-use disorders (Potenza et al., 2013). Studies suggest that individuals with IGD show enhanced regional brain activations when performing decision-making tasks (Dong et al., 2013b). Data also suggest that individuals with IGD show diminished consideration of experiential outcomes when making future decisions (Dong et al., 2013b). In making decisions between participating in immediately rewarding experiences (e.g., playing online) and long-term adverse consequences (e.g., using the time spent gaming instead to perform activities associated with longer term occupational success), individuals with IGD may show a “myopia for the future”, as has been described for drug addictions (Pawlikowski and Brand, 2011, Floros and Siomos, 2012, Bechara et al., 2002). As decision-making arguably acts as a final ‘check point’ before a behavior is enacted, future investigations should examine the extent to which decision-making deficits may predispose to the development of IGD or whether decision-making capacities may become impaired during the course of IGD.

Interactions among cognitive domains

Increased reward sensations during winning or pleasurable experiences may enhance desires to play online for individuals with IGD. Meanwhile, impairments in executive control capacities may lead to poor control over such desires, which may permit urges, desires or cravings to dominate and lead to excessive Internet use in IGD. Such imbalances may promote disadvantageous decision-making in IGD, leading to pursuit of short-term pleasures rather than long-term gains. Reward-seeking behaviors may be reinforced through short-term online experiences, and these may further disturb executive-control abilities, leading to a vicious cycle of addictive Internet use.

Clinical implications

Several categories of behavioral interventions have demonstrated efficacy in the treatment of gambling and/or drug addictions through randomized controlled trials (Potenza et al., 2011; Potenza et al., 2013): 1) brief and motivational interventions, which may alter decision-making processes to focus on more future-oriented goals (Burke et al., 2003); 2) contingency management, which provides immediate reinforcement to promote abstinence (Dutra et al., 2008); and, 3) cognitive behavioral therapies, which emphasize the development of cognitive strategies to countervail motivational drives for drugs and provides skills for managing situations that previously predisposed to drug use (Carroll and Onken, 2005). Additionally, other therapies that have preliminary support in targeting addictions and more established support in targeting domains that may promote engagement in addictive behaviors warrant consideration. For example, mindfulness-based therapies that

have more established support in stress reduction have demonstrated support in targeting drug addictions (Brewer et al., 2009, Brewer et al., 2010, Brewer et al., 2013, Witkiewitz et al., 2013), and this approach may be particularly helpful for individuals whose behaviors are driven by negative-reinforcement motivations.

Based on the proposed cognitive-behavioral model for IGD and the evidence-based treatments for drug addictions and stress reduction, potential effective treatment methods for IGD might target one or more of the following domains: (1) inhibition of desires to play games or otherwise engage excessively in Internet use; (2) strengthening of cognitive capacities to inhibit participation in Internet use; and (3) overcoming myopic decision-making by placing emphasis on longer-term goals rather than shorter-term pleasures. Below we consider behavioral therapeutic approaches used in drug addiction, their application to IGD, and how these cognitive domains may relate to the therapies. It should be noted that limited data from randomized clinical trials exist to determine the extent to which these therapies have support in the treatment of IGD, or how their active ingredients might operate in the treatment of IGD and with respect to the proposed model.

Cognitive behavioral therapy (CBT)

CBT is one of comparatively few empirically supported therapies that has been demonstrated to be effective across a range of substance-use disorders (Carroll et al., 2011, DeVito et al., 2012). Studies suggest that the putative “active ingredients” of CBT may exert their effects to strengthen the aspects of executive control over behaviors given that acquisition of these types of skills in CBT are associated with better long-term outcomes (Kiluk et al., 2010). CBT has been used in IGD treatment because it may help individuals with IGD improve their inhibitory control ability, recognize maladaptive cognitions, and employ more adaptive decision-making (Huang et al., 2010). However, unlike CBT for drug addictions, no studies have formally examined the efficacy of CBT for IGD, nor have manualized therapies undergone systematic assessment in randomized clinical trials. Future studies should focus on these endeavors, with initial efforts underway (Jager et al., 2012).

Cognitive enhancement therapy (CET)

As described above, IGD subjects often show cognitive disturbances relating to elevated impulsivity, impaired cognitive control and cognitive inflexibility. Thus, therapies that target these domains may be helpful in ameliorating symptoms of IGD. CET typically involves repeated practice of cognitive tasks involving problem-solving, response inhibition, visual tracking, and discrimination skills, with such practice occurring for several hours per week over a course of several months (Sofuoglu et al., 2013). Such training has resulted in significant improvement in impulsivity and delay discounting among stimulant users (Bickel et al., 2011), and similar strategies warrant consideration in targeting cognitive function in individuals with IGD.

Cognitive bias modification (CBM)

As individuals with IGD have been shown to demonstrate attentional biases towards Internet cues, therapies that target such biases might be efficacious in the treatment of IGD (Zhou et al., 2012). CBM specifically targets automatic/implicit processes, such as attention bias and

approach bias (Schoenmakers et al., 2010). As CBM has shown positive effects in the treatment of alcohol-use disorders and other 11 psychopathologies (Hakamata et al., 2010), its potential in treating IGD warrants investigation.

Mindfulness-based Stress Reduction (MBSR)

Stress has exhibited strong associations with IGD (Achab et al., 2011; Peltzer et al., 2014; Spada, 2013). As such, interventions like MBSR that target stress reduction may be helpful for IGD. As stress has been closely linked to addictions in women (Petry et al., 2005, Potenza et al., 2012), MBSR might be particularly helpful for females with IGD, although this hypothesis warrants direct examination.

Combined approaches

Preliminary treatment studies suggest that combinations of several psychotherapeutic strategies may be more effective than a single approach (Orzack et al., 2006, Shek et al., 2009). The psychotherapeutic approaches may include various methods (CBT, CBM, CET and/or MBSR) in various formats (group, individual, family therapy, and school-based intervention), with different strategies complementing aspects of the others. Additionally, combinations of behavioral and pharmacological therapies also warrant consideration and testing in randomized clinical trials.

Conclusions

Recent studies suggest neurocognitive differences in individuals with and without IGD. IGD shares multiple features with drug addictions including elevated impulsivity, cognitive inflexibility, and attentional biases. However, the extent to which these may represent pre-existing factors predisposing to IGD or factors that may develop following excessive Internet gaming, or perhaps a combination of both, is not yet known. Although data from studies of substance addictions suggest the last possibility (that both options may be relevant (Fineberg et al., 2014, Mitchell and Potenza, 2014)), direct examination of these possibilities with respect to IGD is necessary and may best be accomplished through longitudinal studies. As more data become available, the model may be refined over time. Nonetheless, existing findings suggest a theoretical model for IGD and specific cognitive domains that may be targeted with specific psychotherapies. Future studies should examine the efficacies of such psychotherapies in treating IGD and investigate specific cognitive functions that may improve with effective treatment.

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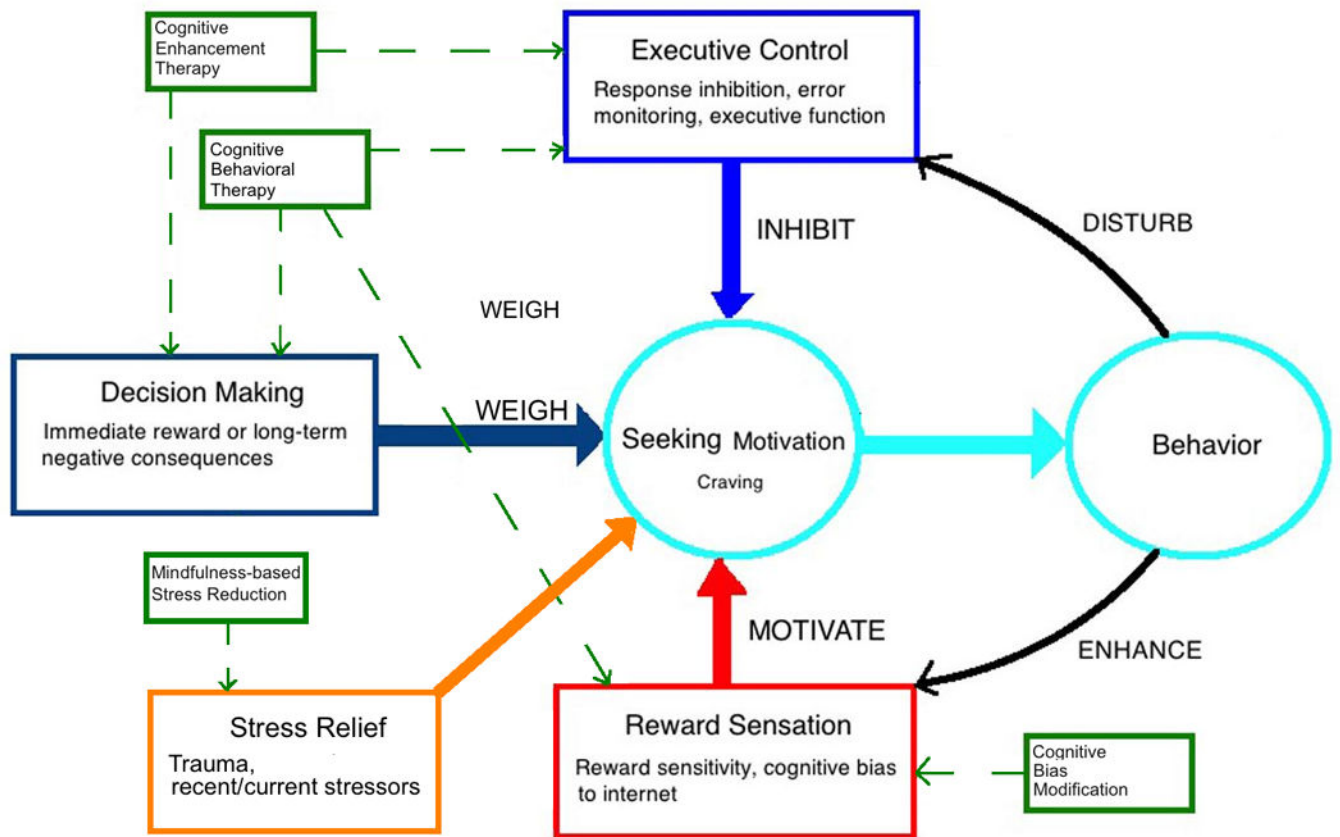


Figure 1. A cognitive-behavioral model of IGD

This figure shows proposed cognitive domains associated with IGD. The model focuses on three cognitive domains and their possible roles in addictive behaviors. The three domains include motivational drives related to reward-seeking and stress reduction, behavioral control relating to executive inhibition, and decision-making that weighs the consequences of engaging in motivated behaviors. Online gaming behaviors might further disturb executive control and reinforce rewarding online experiences, which may lead to a vicious cycle of addictive Internet game-playing. The contents framed in green boxes show potential psychological and cognitive treatments for IGD. Dashed lines indicate potential targets of intervention strategies, with further studies needed to investigate efficacies and possible mechanisms of actions.