



## Is compulsive internet use related to sensitivity to reward and punishment, and impulsivity?

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### ABSTRACT

Aim of the present study was to examine whether the personality correlates sensitivity to reward and to punishment, and impulsivity predict compulsive internet use (CIU). Furthermore, the predictive value of these personality correlates was compared to the predictive value of factors relating to psychosocial well-being. The results showed that particularly rash spontaneous impulsivity predicts CIU and that this personality factor is more important than psychosocial wellbeing factors. Sensitivity to reward, which is supposed to play a role in craving processes associated with substance abuse and eating disorders, could not be related to CIU. The data suggest that internet users who are characterized by an impulsive personality feature, are less able to control their use of the internet, which makes them more vulnerable to develop CIU.

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### 1. Introduction

From a behaviorist point of view, the internet can be seen as a giant web of individually tailored Skinner boxes where the behavior of its users is reinforced through classical and operant conditioning mechanisms. Through positive intermittent reinforcement, the behavior is gradually shaped and the user becomes increasingly skilled to find stimuli on the internet that suits and pleases him or her most. The behavior resembles, in this regard, short-odds continuous gambling practices. These conditioning mechanisms have been described as an explanation for compulsive online sexual behavior (Putnam, 2000) and compulsive online gaming (Yee, 2001), but may be applicable more generally to compulsive online behavior, because practically all internet users can find rewarding stimuli on the internet. The crux of compulsive internet use (or internet addiction, as it is sometimes referred to; a pattern of internet use characterized by loss of control, preoccupation, conflict, withdrawal symptoms, and use of the internet as a coping strategy (Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009) – see for a discussion e.g. Holden (2001), Mitchell (2000) and Orford (2005)), may even, in part, be found in the vast variety of rapidly achievable and instantly rewarding stimuli that

can be found online conveniently, anonymously, abundantly, and at no or low cost. Moreover, because the internet can be used continuously, it can also be used to escape from or cope with daily problems (see also Orford (2005), Cooper, McLoughlin, and Campbell (2000), Young, Griffin Shelley, Cooper, O'Mara, and Buchanan (2000), and Meerkerk, van den Eijnden, Vermulst, and Garretsen (submitted for publication) for a more detailed description of the unique factors that make the internet highly entrapping). Although these rewarding stimuli are ubiquitous on the internet and the majority of the population in industrialized countries has access to the internet (for example, in 2008 86% of the Dutch households had internet access; [www.cbs.nl](http://www.cbs.nl)), only a small minority of internet users appears to develop compulsive online behavior (Aboujaoude, Koran, Gamel, Large, & Serpe, 2006). Apparently, there are individual differences in the vulnerability to develop CIU.

The literature on CIU suggests that individual differences in the vulnerability to develop CIU can, at least in part, be explained by factors indicating low psychosocial wellbeing such as depression, low self-esteem, and loneliness (Caplan, 2002; Davis, Flett, & Besser, 2002; Meerkerk et al., submitted for publication; Whang, Lee, & Chang, 2003; Yang & Tung, 2007; Young & Rodgers, 1998b). The causal nature of the relationship between low psychosocial wellbeing and CIU, however, still needs further clarification (Davis, 2001; Meerkerk et al., submitted for publication).

In addition, individual differences in the vulnerability to develop CIU might be related to more or less stable personality features.

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Research into the relationship between personality and CIU is still relatively sparse (see also Meerkerk et al. (submitted for publication)), although some studies including a Big Five personality questionnaire (Danforth, 2003; Engelberg & Sjöberg, 2004) or the 16-Factor Personality Questionnaire (Yang, Choe, Baity, Lee, & Cho, 2005; Young & Rodgers, 1998a) showed that emotionally less stable personalities seem to be more vulnerable to develop CIU. Few researchers studied the relationship between CIU and other more or less stable personality features such as impulsivity; a trait often related to addictive behavior (Dawe, Gullo, & Loxton, 2004; Dawe & Loxton, 2004). Armstrong, Phillips, and Saling (2000) studied the relationship between CIU and sensation seeking, as measured by disinhibition, a sub-trait of impulsivity and closely related to extraversion. Armstrong and colleagues hypothesized a positive relation between disinhibition and CIU but disinhibition appeared not a good predictor of CIU. Lavin, Marvin, McLarney, Nola, and Scott (1999) even found compulsive internet users to score significantly lower on sensation seeking, a construct that also can be linked to impulsivity, and Petrie and Gunn (1998) found self-declared internet addicts to be more introverted which also invalidates the assumed relation between CIU and (sub-traits) of impulsivity. Yen and colleagues, on the other hand, studying the relationship between ADHD and CIU, did find a positive association between CIU and impulsivity (Yen, Yen, Chen, Tang, & Ko, 2009). In part, these differences in results may be explained in the diverse conceptual denotations of impulsivity (Leshem & Glicksohn, 2007; Potenza, 2007). Nevertheless, despite these contradictory results, several researchers have conceptualized CIU as an impulse control disorder (Davis, 2004; Davis et al., 2002; Morahan Martin, 2005; Shapira et al., 2003; Treuer, Fabian, & Furedi, 2001; Yellowlees & Marks, 2007; Young, 1998).

An unreclaimed theoretical perspective that may explain individual differences in the vulnerability to develop and maintain CIU is Gray's neuropsychological Reinforcement Sensitivity Theory of personality (RST) (Gray, 1987; Gray, 1991). As far as we know, this perspective has not yet received any attention in the literature on CIU, although it provides an interesting and promising viewpoint. In brief, Gray's original RST postulated anxiety and impulsivity as the two basic and independent biologically-based dimensions in motivation and personality. These dimensions reflect the functioning of two brain systems that regulate approach and withdrawal/avoidance behavior in response to environmental stimuli. The behavioral inhibition system (BIS) reacts in response to stimuli of punishment or termination of reward, and evokes feelings of fear (negative affect) and withdrawal/avoidance behavior. The behavioral activation (or approach) system (BAS) reacts in response to stimuli of reward or termination of punishment and evokes positive affect and approach behavior. According to RST, differences in personality reflect differences in the sensitivity to punishment and reward (BIS and BAS, respectively) (Corr, 2004; Dawe & Loxton, 2004).

Originally, Gray hypothesized that both sensitivity to punishment and sensitivity to reward (Gray labeled the latter "impulsivity") are one-dimensional traits. With regard to sensitivity to punishment there is considerable agreement (Franken & Muris, 2006b) that this is indeed a one-dimensional trait, characterized by fear and anxiety, and conceptually near to neuroticism (Jorm et al., 1999). Sensitivity to reward or impulsivity, on the other hand, seems to be at least bi-dimensional. Subsequent authors have made a distinction between reward sensitivity and impulsivity (Dawe & Loxton, 2004; Dawe et al., 2004; Franken & Muris, 2006b; Smillie & Jackson, 2006). Impulsivity, according to these authors, is related to rash and spontaneous behavior without thinking of risks or future consequences, and includes constructs such as novelty seeking, sensation seeking, behavioral undercontrol and disinhibition. Sensitivity to reward or drive, on the other

hand, does not necessarily imply rash and spontaneous behavior but is a more deliberate and goal-directed approach behavior. In short, there is consensus that sensitivity to punishment is a one-dimensional construct (conceptually near to neuroticism), but that impulsivity is at least bi-dimensional, pertaining to reward sensitivity or drive on the one hand, and rash spontaneous impulsivity on the other.

Various forms of addictive behavior have been related to impulsivity and reward sensitivity measures, notably alcohol and drug abuse (see for an overview Dawe et al. (2004)) and eating disorders (Loxton & Dawe, 2001). Dawe and Loxton (2004) argue that the two impulsivity-related components reward sensitivity or drive, and rash spontaneous impulsiveness should be considered in both the explanation of the development and the maintenance of addictive behavior. They hypothesize that "reward sensitivity/drive plays a role in cued-cravings and motivation to use drugs, but that rash spontaneous impulsiveness influences actual drug-taking behavior and the inability to discontinue use in light of negative consequences." (p. 347). The conjunction of heightened reward sensitivity and rash spontaneous impulsivity leads in this model to drug abuse and dependence (Dawe et al., 2004). Similarly, neurobiological studies reveal that an anomaly in the reward pathways of the brain can be related to addictive, compulsive or impulsive disorders comprising alcoholism, substance abuse, smoking, compulsive overeating and obesity, attention-deficit disorder, Tourette's syndrome and pathological gambling (Blum, Cull, Braverman, & Comings, 1996). In short, it is hypothesized that a deficiency in the limbic system of the brain, which is supposed to accommodate the reward system, makes the individual less able to experience reward from normal everyday activities, making the individual anhedonic and therefore more sensitive to the rewarding effects of drugs and other artificial highly rewarding stimuli (Volkow, Fowler, & Wang, 2002).

The model described above leads to several assumptions when applied to internet behavior and CIU. First, the internet offers an enormous variety of sometimes highly rewarding stimuli that can be obtained by simply clicking a button. Therefore, we expect that, compared to people low in sensitivity to reward, high sensitive individuals will engage more in reward-seeking behavior on the internet. Consequently, we expect a positive association between CIU and reward sensitivity (hypothesis 1). In addition, once online, it is easy to repetitively find rewarding stimuli and internet users can administer themselves endless arrays of individually-tailored rewarding stimuli. Because one of the most characteristic problems of people suffering from CIU is spending more time online than intended (i.e. they are unable to control the use of the internet), we also expect a positive association between CIU and impulsivity (hypothesis 2). Several studies have shown an association between CIU and the personality factor emotional stability or neuroticism (Danforth, 2003; Meerkerk et al., submitted for publication; Yang et al., 2005) and between CIU and factors indicating low psychosocial wellbeing (Caplan, 2002; Davis et al., 2002; Meerkerk et al., submitted for publication; Whang et al., 2003; Yang & Tung, 2007; Young & Rodgers, 1998b). Because psychosocial wellbeing is conceptually linked to neuroticism and emotional stability, and because sensitivity to punishment is related to neuroticism and emotional stability, we expect a positive association between sensitivity to punishment and CIU (hypothesis 3). Finally, the hypothesized associations may be moderated by the specific function for which the internet is used. Although the term CIU suggests an overuse of the internet in general, there is growing agreement that internet addicts are actually dependent on some rewarding aspects or functions of behavior associated with internet use (Davis, 2001; Meerkerk, van den Eijnden, & Garretsen, 2006; Yellowlees & Marks, 2007). That is, the addictive potential of the different applications varies. Studies addressing the

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