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COMMENTARY

Mobile and non-mobile Internet Use Disorder: Specific risks and possible shared Pavlovian conditioning processes

Commentary on: How to overcome taxonomical problems in the study of Internet use disorders and what to do with "smartphone addiction"? (Montag et al., 2019)

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ABSTRACT

This commentary addresses a recent article by Montag et al. (2019) about the relevance of distinguishing between mobile and non-mobile Internet Use Disorder (IUD). In response to the review, we reflect on the clinical relevance of this distinction and, in parallel, we propose some Pavlovian conditioning processes as possible mechanisms underlying different IUDs. We believe that, from a clinical point of view, it is of fundamental importance assessing both specific "forms" of IUDs and the underlying mechanisms that would be shared across different IUDs, like multiple and parallel classes of Pavlovian responses and the influences of Internet cues on Internet-related addictive behaviors that may be influenced by the probability of obtaining Internet rewards.

KEYWORDS

Internet, classical conditioning, reward, gaming, addictive behaviors, cues

INTRODUCTION

The article, "How to overcome taxonomical problems in the study of Internet use disorders and what to do with "smartphone addiction"?" by Montag et al. (2019) describes the relevance of distinguishing between mobile and non-mobile Internet Use Disorders (IUDs) for a better understanding of individuals who (over-)use the Internet, in terms of risk factors and underlying mechanisms. We believe that, from a clinical point of view, it is of fundamental importance assessing both specific "forms" of IUD (i.e., predominantly mobile and predominantly non-mobile IUD) and the underlying mechanisms that may be shared across

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different IUDs, such as Pavlovian associative learning processes, as well as those that may be distinct.

CLINICAL RELEVANCE OF DISTINGUISHING BETWEEN MOBILE AND NON-MOBILE INTERNET USE DISORDER

Although data suggest that similarly to individuals with Substance Use Disorder (SUD), those with IUDs share some important symptoms and comorbidities; e.g., they are more likely to have symptoms associated with depression (e.g., Kitazawa et al., 2018), stress (e.g., Moretta & Buodo, 2018), and anxiety (e.g., Stavropoulos et al., 2017), loneliness (Moretta & Buodo, 2020), and obsessive-compulsive disorder (Carli et al., 2013), and to be characterized by low inhibitory control in an emotional context (Brand et al., 2019; Moretta, Sarlo, & Buodo, 2019). Additionally, some important differences have been highlighted (Montag, Wegmann, Sariyska, Demetrovics, & Brand, 2019). Some of these differences may be important to assess in clinical contexts given specific negative consequences on individuals' lives and health care systems. Although considering IUDs as psychopathological conditions is still under discussion, research has identified negative effects of using specific devices (e.g., smartphones) for accessing the Internet in problematic ways. Specifically, studies of smartphone-use-related accidents suggest that using the smartphone is frequently linked to increases driving distraction (Metz, Landau, & Just, 2014), driving mistakes (Young & Salmon, 2012), and the risk of accidents (Nemme & White, 2010). Younger people appear at greater risk than older people (O'Brien, Goodwin, & Foss, 2010; Wagner et al., 2019). While driving, young people with Smartphone Use Disorder (SmUD) exhibit difficulties refraining urge from using their smartphones, and consequentially this may lead to them taking their eyes off the road and their hands off the wheel to touch their screens (Kim, 2013; Luria, 2018).

Although the magnitude of the problem remains unclear, studies of smartphone use during ambulation have generated worrying findings, with smartphone use while walking increasing the risk of injury. Consequently, smartphone-related distracted ambulation has been reported as an emerging public health concern (Gary et al., 2018a, 2018b). In this context, younger individuals have been reported to be more at risk than older ones, with greater frequencies of self-reported smartphone-related distracted ambulation among younger pedestrians (Lennon, Oviedo-Trespalacios, & Matthews, 2017). Higher SmUD proneness in university students has been linked to higher accident rates when using a smartphone while walking (Kim, Min, Kim, & Min, 2017). Moreover, using a smartphone while walking increases the number of missed environmental stimuli, with higher smartphone-addiction proneness scores linked to higher number of missed environmental stimuli (Mourra et al., 2020). The authors also found gaming to be the most distracting smartphone-related activity, and the emotional arousal generated by the smartphone task to be a mediator.

From a clinical perspective, these studies corroborate the argumentation of Montag et al. (2019) by highlighting the importance of addressing both the specific content/application of IUDs and the IUD forms (i.e., predominantly mobile vs. predominantly non-mobile IUDs), since these seem to be characterized by specific behavioral usage patterns leading to specific potential risks (Ha, Jung, & Shin, 2020).

TOWARD A COMMUNALITY BETWEEN DIFFERENT IUDS: PAVLOVIAN CONDITIONING PROCESSES AND REWARD PROBABILITY

The study and clinical assessment of predominantly mobile and predominantly non-mobile specific IUDs (i.e., ones specifying the content of Internet use/online application) should go in parallel with the investigation of underlying common mechanisms of IUDs (Brand et al., 2019), given some similarities across IUDs and the importance of better conceptualizing and diagnosing IUDs.

A key feature of IUDs and new technologies-related addictive behaviors, which is often not shared with any other addictive behaviors, is the number of available visual (e.g., colored graphical app interfaces; advertisements; emoticons; visual notifications), auditory (e.g., the sounds of notifications, errors, warnings, messages, key press), and tactile cues (e.g., keys, touch screen, device temperature, device covers material) to which many individuals users are frequently exposed. This feature may help answering why some people compulsively search/"surf" online. It has been suggested that conditioned environmental cues may significantly influence online behavior by promoting early attentional bias to Internet rewards (e.g., sexual images, identification with the characters in games) and enhancing conditioning to such rewards (Ahn, Chung, & Kim, 2015; Banca et al., 2016; Vogel et al., 2018).

It may be hypothesized that Internet-related reflexive conditioned behaviors may be elicited by Pavlovian conditioned stimuli (CS; e.g., a Social Network sound-alert for a notification) that predict the subsequent delivery of significant outcomes (e.g., a positive feedback to an individual's web profile). Pavlovian conditioning has been proposed to involve parallel forms of associative learning including multiple types of Pavlovian responses (Cardinal, Parkinson, Hall, & Everitt, 2002). Some associations may be formed with affective/motivational aspects of outcomes, while others with sensory attributes of outcomes, thus resulting in multiple classes of Pavlovian response elicited in parallel by the same stimulus (Zhang et al., 2016). Interestingly, parallel Pavlovian responses may have different sensitivities to outcome devaluations in humans, with some responses persisting even when outcomes are no longer valued (Pool, Pauli, Kress, & O'Doherty, 2019). Considering both the number of online available cues to which individuals are often exposed and the multitude of Internet outcomes (that are characterized by subjective motivational/affective values

and several perceptual features), parallel forms of associative learning may contribute importantly to the maintenance of Internet-related Pavlovian responses. Future studies should explore this possibility. The extent to which these processes may contribute to goal-directed versus habitual behaviors and transitions between the two (e.g., via Pavlovian to intrumental transfer mechanisms (Everitt & Robbins, 2016)) warrants direct examination.

Interestingly, the influence of Internet cues on individuals' behaviors may be enhanced by the probability of obtaining a reward. Specifically, uncertainties related to deliveries of Internet rewards (e.g., receiving likes to photos, gaining real/virtual money, receiving desirable messages, winning auctions) may increase the influence of conditioned cues on individuals' online behaviors. In fact, the influence of environmental cues has been described to depend on probabilities of obtaining rewards; namely, when the chance of getting a reward is lower, individuals may be more influenced by cues associated with such rewards, and vice versa (Cartoni, Moretta, Puglisi-Allegra, Cabib, & Baldassarre, 2015). Given the large range of probabilities of obtaining Internet rewards and their associations with subjective perceptions of such probabilities (Sharp, Viswanathan, Lanyon, & Barton, 2012), future studies should examine whether the magnitude of the influence that conditioned Internet cues may have on individuals' online behaviors depend on the real and/or on the subjective probabilities of obtaining Internet-related rewards.

CONCLUSIONS

To overcome some conceptual problems that are mainly related to a reliable identification of severe generalized and specific forms of IUDs, identifying core mechanisms, contextual characteristics, and diagnostic criteria has become a priority. An integrative framework for understanding cognitive, affective, and behavioral problems should form the basis of clinical research and practice for any psychopathological condition. In the case of IUDs, this seems to be particularly true given specific risks that may be related to mobile vs. non-mobile IUDs and commonalities between different IUDs that may relate to possible parallel forms of associative learning that may underlie Internet-related addictive behaviors.

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