



# Cognitive Correlates in Gaming Disorder and Social Networks Use Disorder: a Comparison

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## Abstract

**Purpose of Review** This overview aims at summarizing studies, which investigated cognitive correlates of gaming disorder and of a problematic use of social networks by using behavioral experimental paradigms and brain imaging techniques.

**Recent Findings** Based on theoretical models, inhibition/inhibitory control, attentional bias, executive functions, decision-making, and working memory capabilities have been identified as cognitive components, which are assumed to play a crucial role in the development and maintenance of an addictive behavior. A systematic search shows that various studies have already examined the involvement of different cognitive components in both types of potential addictive behaviors. However, the number of studies addressing cognitive correlates of social networks use disorder is very much lower compared with gaming disorder, even if there is a positive trend in terms of new publications in recent years.

**Summary** Cognitive correlates have been frequently investigated in gaming disorder, as in many other disorders due to substance use or addictive behaviors. Studies on cognitive aspects involved in a problematic social networks use are still rare, but they are needed in order to further show if this phenomenon may also deserve a classification as addictive disorder. Interactions between different cognitive and affective processes are still understudied in both gaming disorder and problematic social networks use.

**Keywords** Pathological gaming · Social networking sites · Executive functions · Inhibitory control · Decision-making · Attentional bias

## Introduction

The inclusion of gaming disorder as disorder due to addictive behaviors in the ICD-11 by the World Health Organization in 2019 as well as in the fifth edition of the Diagnostic and Statistical Manual (DSM-5) illustrates the clinical and societal relevance of this addiction-like, pathological behavior [1–3]. In 2013 in the DSM-5, this pathological behavior is described as internet gaming disorder, which requires further research [3].

Six years later in the ICD-11, gaming disorder is defined as a pattern of persistent gaming behavior, which may occur predominantly online or offline. Symptoms of this disorder are based on the definition of disorders due to substance use and include three key components such as impaired control over gaming, increasing priority given to gaming, and continuation or escalation of gaming despite the experiences of negative consequences in personal, family, social, educational, occupational, or other areas of functioning [2]. In addition to gaming disorder, gambling disorder was also included in the classification system with a similar definition; both disorders could be called as potential role models for other potential disorders due to addictive behaviors. Young [4] as well as Davis [5] have outlined that besides gaming and gambling disorder, other specified potential addictive internet-use patterns should be taken into account when considering pathological online behavior. Currently, several researchers discuss the excessive, uncontrolled use of online pornography, online buying-shopping disorder, as well as the problematic use of social networks, social media, social networking sites (SNS), or other online communication applications as candidates of disorders due to addictive behaviors [6–11].

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The widespread use of smartphones, changes in the communication behavior in general, the popularity of communication apps, but also the design of those apps [12–14] are assumed to be associated with dysfunctional use patterns of social networks and might play an important role in addiction research as well. Many different applications contain different features and main focuses (e.g., importance of direct messages via WhatsApp, uploading of pictures via Instagram, uploading and creation of videos via TikTok); however, all these applications have in common that the main idea is to be connected to other users, to exchange information, and to be entertained [15, 16]. The following definition is used frequently in research on problematic use of social networks: “*being overly concerned about SNSs, driven by a strong motivation to log on to or use SNSs, and to devote so much time and effort to SNSs that it impairs other social activities, studies/job, interpersonal relationships, and/or psychological health and wellbeing*” [17, p. 4054]. In addition, we prefer the term problematic use of social networks or social networks use disorder, which is based on the definition of gaming disorder in the classification systems ICD-11 and DSM-5 and focuses on the communicative, social exchange without highlighting a specific application or device while using social networks [11, 18]. To understand whether comparable mechanisms are relevant for the problematic use of social networks and comparable communication applications, as for other addiction-like disorders such as gaming disorders, it is necessary to use the same theoretical assumptions and to identify the relevance of key mechanisms. Gaming disorder is chosen as the comparative disorder based on the empirical findings and the inclusion as disorder due to addictive behaviors in ICD-11 and DSM-5. In the current overview, the following research questions will be addressed: Which cognitive correlates have been investigated as relevant mechanisms involved in the development and maintenance of gaming disorder and social networks use disorder? How do the findings or number of studies for gaming disorder and social networks use disorder differ?

## Theoretical Approaches Addressing the Development and Maintenance of an Addictive Behavior

When discussing problematic behavior as potential behavioral addiction, it is important to avoid overpathologizing of everyday-life behaviors [19–21]. Consequently, we argue that only those behaviors, which are associated with functional impairment in daily life, should be considered as a potential problematic behavior. In addition, to consider a problematic behavior as belonging to addictive behaviors, it is important that theoretical approaches and models, which describe relevant mechanisms of the development and maintenance of an addictive behavior including substance abuse as well as

behavioral addictions, explain the potential problematic behavior appropriately. Theoretical models, which describe addictive behaviors, are, for example, the Dual Process Theory [22], the Impaired Response Inhibition and Salience Attribution model [23], and the Incentive Sensitization Theory [24, 25] as well as the reward deficiency theory [26].

There are also first approaches focusing on behavioral addictions or gaming disorder specifically. The model by Davis [5] was one of the first theoretical underpinnings describing the mechanisms of an addictive use of the internet. Comparable with other theories, Davis illustrates that besides predisposing factors, such as psychopathology or subjectively perceived social integration in daily life, especially maladaptive cognitions and reinforcing mechanisms play a crucial role in the developmental process. In line with this, the cognitive-behavioral model of gaming disorder by Dong and Potenza [27] describes the interaction of person’s predisposing factors and cognitive components as mechanisms of an addictive gaming behavior. The authors outline that the motivational drive, the anticipation of stress reduction, reward sensitivity, as well as their interaction with inhibitory control, and (impairments in) decision-making behavior could lead to the urge to play online games and subsequently to gaming behavior. The manifestation of this behavior through the experience of gratification, craving, reduced inhibitory control, and specific expectancies towards playing games could result in a dysfunctional behavior, whereas it is shown repeatedly despite negative consequences [27]. The current version of the I-PACE (Interaction of Person-Affect-Cognition-Execution) model by Brand et al. [28] also highlights the interaction of predisposing factors (e.g., psychopathology, personality, genetics, specific needs, and motives) with affective and cognitive mechanisms as well as further executive functions and the experiences of gratification and compensation. In the addiction process, a person’s core characteristics likely affect the perception of external and internal triggers (e.g., abnormal mood, stress perception, confrontation with specific behavior-related cues) leading to specific affective and cognitive responses. These responses include higher attentional biases towards specific cues, stress, or abnormal mood as well as the experience of cue reactivity and craving. The confrontation with specific cues or the experience of cue reactivity and craving could lead to the decision to behave in a specific way, which is affected by general executive functions, inhibitory control, and in later stages of the addiction process by potential stimuli-specific reduction of inhibitory control. The specific behavior, such as playing games, could result in the experience of gratification and compensation (e.g., fulfillment of specific needs, compensation of certain deficits), which again results in reward experiences, which may change specific coping styles and therefore may enhance the risk to behave in the specific way repeatedly [28]. Consistent with the core hypotheses summarized in the I-PACE model, the

tripartite model of gaming disorder by Wei et al. [29] includes three main components as follows: (1) the impulsive system, which is associated with fast, automatic, unconscious, and habitual behaviors; (2) the reflective system, which is often associated with prefrontal cortex functions and top-down control of behaviors; and (3) the interoceptive awareness system, which is associated with craving experiences. The authors suggest an imbalance between these systems leading to a dysfunctional decision-making behavior based on a hyperactivity of the impulsive system, a hypoactivity of the reflective system, and the reinforcement of the impulsive as well as the limitation of the reflective system through the interoceptive system [29].

All these theoretical approaches describe key processes of the development and maintenance of addictive behaviors including gaming disorder. We consider these theoretical considerations as appropriate to spell out clear research questions and hypotheses and to examine systematically the current empirical evidence that exists for specific addictive behaviors. The common key hypotheses across all the aforementioned theoretical approaches are that (1) impulsive, affective factors are involved as motivators in the addictive behaviors, (2) reflective, cognitive functions may represent potential top-down control of the behavior, and (3) the imbalance between these processes may represent the diminished control over the behaviors and increasing urges and desires, which may result in the symptoms of disorders due to addictive behaviors. The main cognitive constructs of these theoretical approaches are as follows: inhibition and inhibitory control, attentional bias, executive functions, decision-making behavior, and working memory. In the following section, we will compare the evidence of empirical studies in gaming disorder compared with (the potential) social networks use disorder.

## Methods

We would like to give an overview regarding the amount of peer-reviewed articles, which address the relevance of cognitive correlates such as inhibition/inhibitory control, attentional bias, executive functions, decision-making, and working memory in gaming disorder and social networks use disorder. We systematically conducted a review of original publications using the database PubMed during January 13, 2020 and February 25, 2020. Terms to search for papers about gaming disorder included “gaming disorder” and “pathological gaming” AND (as Boolean operator) “inhibition,” “inhibitory control,” “attentional bias,” “executive function,” “decision-making,” or “working memory.” To search for papers about social networks use disorder, the same terms addressing the cognitive components were used. However, since social networks use disorder is not an official terminology or classification, we used the terms “problematic social network use,”

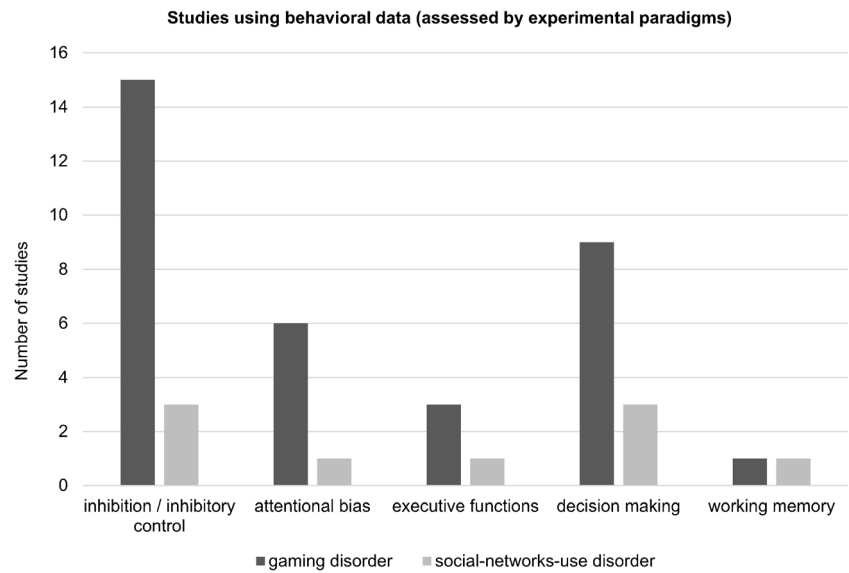
“problematic SNS use,” “social networks use disorder,” “pathological social networks use,” “Facebook addiction,” “social networking sites addiction,” “social networks addiction,” “social media addiction,” “SNS addiction,” “smartphone use disorder,” “smartphone addiction,” and “problematic smartphone use” to identify studies, which investigate the problematic use of social networks. We decided to include empirical studies within the last 10 years, since it is a new research field and we would like to highlight the development of publications over a longer period of time. In addition, during this period, the inclusion of the gaming disorder in the DSM-5 was also taken into account and we considered the development around these years to be extremely relevant. Nevertheless, the choice of terms used (e.g., gaming disorder instead of video game addiction) underlines that there was still a focus on the current research results in the recent years. Each study’s title and abstract were screened, and afterwards, full text of potentially relevant studies were retrieved and examined for eligibility. Regarding the eligibility, we decided to choose only those studies, which clearly illustrate the relevance of the cognitive correlates mentioned in a problematic use of games or social networks. In more details, we only focused on the cognitive correlates assessed by experimental paradigms and/or brain imaging data and excluded studies, which address affective components such as cue reactivity, craving, and the reward system solely. Only original empirical studies have been included in the analysis. Systematic reviews and meta-analyses were not included.

## Empirical Investigations of Cognitive Functions in Gaming Disorder and Social Networks Use Disorder

For gaming disorder, we were shown 192 results, of which 71 studies could be identified as relevant in terms of the criteria mentioned above. For social networks use disorder, 12 out of 211 results were identified as relevant. With 192, respectively 211 results in total, we cannot rule out multiple responses because individual studies have addressed several components. Positively validated results were then assigned to the different cognitive correlates. A further differentiation was made here: Studies were identified that (1) rely exclusively on behavioral data using experimental, neuropsychological paradigms, (2) relate behavioral data from experimental paradigms to brain imaging data, and (3) are based exclusively on brain imaging data, where the focus had to be on brain regions associated with these cognitive correlates. The results of this clustering are shown in Fig. 1, Fig. 2, and Fig. 3.

Figure 1 shows the results of studies using behavioral data assessed by experimental paradigms (e.g., Stroop Task, Stop-Signal-Task, Go/NoGo paradigm, Iowa Gambling Task, Game of Dice Task). The results are differentiated on the

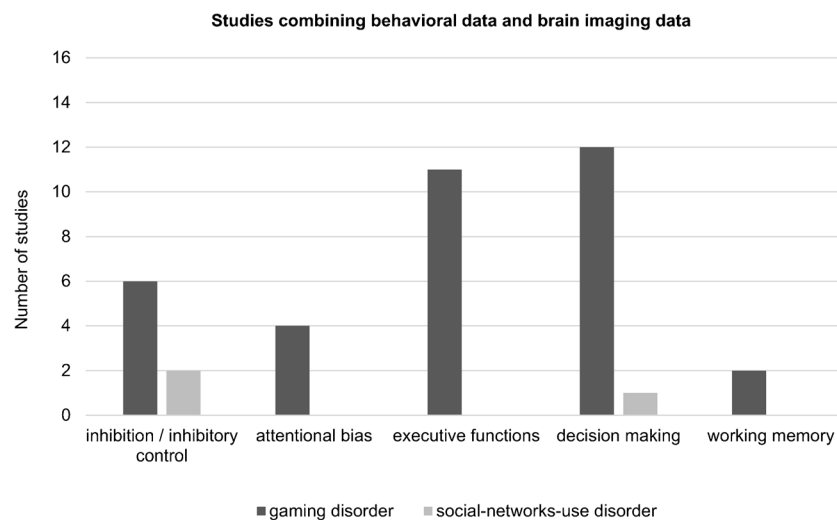
**Fig. 1** The figure illustrates the number of articles, which were found, addressing at least one of the constructs mentioned in gaming disorder and/or social networks use disorder. These studies used different experimental paradigms to investigate the relevance of those cognitive components. No further neurophysiological assessments were used. Some studies investigated the relevance of more than one cognitive component in the problematic use of gaming or social networks; therefore, the number of studies for the respective components cannot be summed up in order to get an impression of the total number



one hand in the different types of usage (gaming vs. social networks use) and on the other hand in the different cognitive correlates. It also illustrates that there is already an increasing number of studies investigating gaming disorder and occasionally social networks use disorder. In both cases, however, the focus seems to be obviously on examining inhibition/inhibitory control [e.g., 30, 31–35] and decision-making [e.g., 36, 37–43], as well as attentional bias in gaming disorder [e.g., 44, 45, 46]. One study assessed attentional bias in problematic social networks use [47]. Studies on the recording of general executive functions and working memory have only been available to a limited extent to date [e.g., 48–50]. Studies, which combined behavioral data and brain imaging data, are shown in Fig. 2. Again, it is highlighted that there are

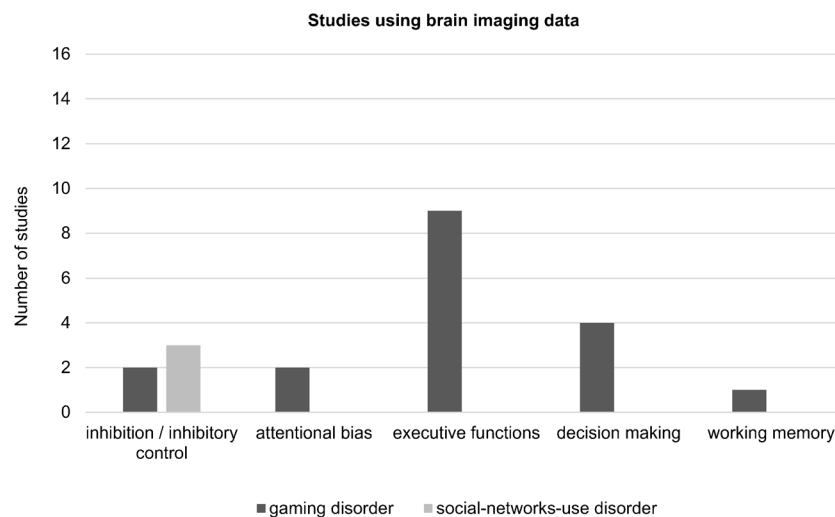
already several studies addressing the relevance of inhibition/inhibitory control [e.g., 51, 52], executive functions [e.g., 53], and decision-making [e.g., 54, 55] in gaming disorder.

For social networks use disorder, there are at least three studies, which illustrate the relationship between behavioral data and brain imaging data for inhibition/inhibitory control [56, 57] and decision-making [58]. In addition, there are only three other studies on the relationship between specific brain regions related to inhibition/inhibitory control and the problematic use of social networks shown in Fig. 3 [59, 60, 61]. For a better understanding of gaming disorder, the broader diversification of studies for the detection of relevant brain regions related to inhibition/inhibitory control, attentional bias, decision-making, and working memory would also be



**Fig. 2** The figure illustrates the number of articles, which were found, addressing at least one of the constructs mentioned in gaming disorder and/or social networks use disorder. These studies were brain imaging studies, which combine the brain imaging data with further experimental paradigms. Some studies investigated the relevance of more than one

cognitive component in the problematic use of gaming or social networks; therefore, the number of studies for the respective components cannot be summed up in order to get an impression of the total number



**Fig. 3** The figure illustrates the number of articles, which were found, addressing at least one of the constructs mentioned in gaming disorder and/or social networks use disorder. These studies were brain imaging studies, which address brain areas related to at least one cognitive component. No further experimental paradigms were used. Some

studies investigated the relevance of more than one cognitive component in the problematic use of gaming or social networks; therefore, the number of studies for the respective components cannot be summed up in order to get an impression of the total number

desirable. Nevertheless, there is a significant number of studies on the relevance of executive functions and specific brain regions.

Wrapping up, the brief overview illustrates that there are studies, which emphasize the importance of different cognitive components in gaming disorder as well as in social networks use disorder. However, the number of studies significantly differs. This is noteworthy since the terms of the literature research for gaming disorder were chosen much more restrictively than for social networks use disorder. While only two terms were selected for gaming disorder, the search for empirical results of social networks use disorder was carried out much more generously. Despite this restrictive strategy, clear differences can be determined, which, due to the strictness, impressively illustrate how different research has progressed in both disorders. Furthermore, it is remarkable that there are different methodologies such as behavioral data, brain imaging data, as well as the combination of both. It should be noted that the scope of empirical evidence between the two disorders or problematic behaviors clearly differs as well. Perhaps it is important to take into account the chronological course of the publications and the associated history. Figure 4 shows the number of published articles in the past 10 years. Here, we have aggregated the studies which used experimental paradigms and/or brain imaging data as well as the studies on the different cognitive components. The course has two remarkable insights. Empirical evidence on gaming disorder and the importance of cognitive correlates started earlier compared with problematic use of social networks. This is not particularly surprising, since pathological gaming is being discussed as one of the first disorders due to addictive behaviors. Furthermore, the years around the inclusion of

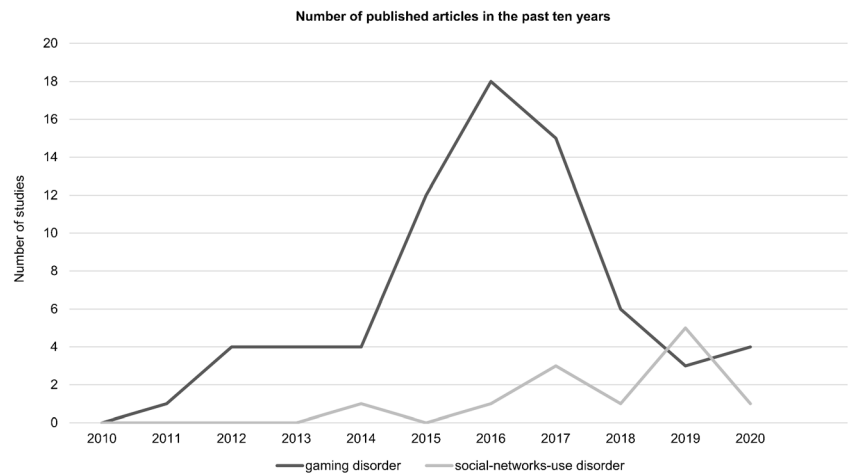
(internet) gaming disorder as a research diagnosis in the DSM-5 and before the inclusion in the ICD-11 seem to have been particularly productive. The other course also underlines that the importance of cognitive correlates for social networks use disorder increases. This is a promising development, which will result in further and new research questions for the future.

### Discussing the Publication Outcome and Future Perspectives of Gaming Disorder and Social Networks Use Disorder

A better understanding of the addiction process and its mechanisms for the development and maintenance of new disorders is essential when discussing these disorders and their clinical and societal relevance. Theoretical models as background for this approach are helpful in order to provide the first starting point and framework for research, and not to operate atheoretically or only exploratory. Models from substance use disorder and specific addictive behavior as mentioned above identified predisposing factors such as personality traits and psychopathology and also affective and cognitive components such as cue reactivity, craving, attentional bias, inhibitory control, executive functions, and decision-making as main factors of the development and maintenance of an addictive behavior [e.g., 28].

For gaming disorder, the empirical evidence of cognitive constructs seems to be stable, since the importance of cue reactivity and craving, as well as impairments in executive functions and specific inhibitory control and decision-making behavior are well demonstrated [e.g., 62]. The current

**Fig. 4** The figure shows the number of published articles on the relationship between the cognitive constructs mentioned and tendencies of a gaming disorder or social networks use disorder in the past 10 years. There is no differentiation between studies using experimental paradigms and/nor brain imaging data and brain imaging studies



findings include studies on a behavioral as well as on a neurophysiological level [e.g., 63, 64] and compare problematic and pathological users with healthy controls. However, it is remarkable that studies investigating the interaction of the different factors are widely lacking. For example, Yao et al. [65•] examined specific inhibitory control using a gaming-related Go/NoGo task, decision-making under risk and under ambiguity, and its relationship in gaming disorder. The results outline impairments in inhibitory control and decision-making under risk in individuals with gaming disorder as well as a close relationship between both constructs. Possible interaction effects as predictors of tendencies of a gaming disorder are missing. The study by Gilbertson et al. [41] illustrates the relevance of stress response on decision-making performance and its relation to gaming disorder. However, more studies investigating those interactions in gaming disorder are needed. This is also the case for social networks use disorder; Wegmann et al. [32] showed interaction effects of attentional impulsivity, (specific) inhibitory control, and executive functions as predictors of a problematic use of social networks. Again, more studies investigating those interactions in gaming disorder and social networks use disorder are needed. Impairments in general as well as specific inhibitory control are also demonstrated in behavioral and neuroimaging data. The empirical evidence for the involvement of further executive functions is lacking, and for decision-making behavior, it is mixed. However, the first cautious conclusion is allowed that apparently similar cognitive correlates have already been investigated in problematic social networks use. When taking the years of publication into account, it seems to be a development of more experimental, neuropsychological research addressing cognitive correlates of social networks use disorder. Considering the importance of cognitive correlates as well as affective responses in the theoretical models, it also means that (1) for a better understanding of mechanisms in problematic social networks use, more research on neuropsychological mechanisms as well as their interactions is needed, (2) for a

better understanding of the interplay of different cognitive correlates and further affective responses, gaming-disorder research should focus on the interplay of these components and should include predisposing factors as well, and (3) for a better comparison of both disorders, more research combining both types is essential. For example, the study by Dieter et al. [56•] compared individuals with gaming disorder, individuals with social networks use disorder, and healthy controls regarding emotional competence, social anxiety, and impulsivity using behavioral and brain imaging data. The results showed that individuals with gaming disorder and social networks use disorder showed higher impulsivity and reduced emotional competences compared with healthy controls. The direct comparison offers the opportunity to define convergent as well as divergent mechanisms [for further comparisons see also 66, 67]. If these approaches should be pursued in the future, corresponding conditions have to be created. For example, standardized diagnostic instruments and neuropsychological assessments for both gaming disorder and social networks use disorder are needed. With the inclusion of gaming disorder in the DSM-5, Griffiths et al. [68] already proposed a need for a unified approach to assess gaming disorder. The systematic review by King et al. [69] evaluated current assessment tools and the authors emphasize the need for a standard tool to identify maladaptive gaming behavior and gaming disorder, respectively. It should be discussed if those instruments could be modified for social networks use disorder or if specific tools are needed.

The striving for increased comparability and the identification of convergent mechanisms also leads to the research questions of what are unique features and divergent mechanisms of these disorders; what is the specific? It also results in the research questions, for example, (1) what role does attention processing play in the functional use of social networks when considering the constant availability of the smartphone and the associated impairments of attention [see 48, 70]? What does it mean for the examination of attention and other

executive functions in social networks use disorder compared with gaming disorder? (2) How significant are the (functional) impairments of executive functions, inhibitory control, and decision-making behavior in gaming disorder compared with social networks use disorder? These questions could be extended endlessly, whereby theoretical assumptions and the relevance of psychological distress, needs, motives, and expectancies, personality traits, and the experience of gratification and compensation should be integrated as well. This also results in the consideration that besides theoretical models, which are relevant for addictive behaviors in general such as the I-PACE model by Brand et al. [28], usage-specific theoretical assumptions such as the uses and gratification approach or the idea of fear-driven and reward-seeking behavior [16] could be important for a better understanding for specific characteristics of each disorders as well.

## Conclusion

Cognitive correlates such as inhibition/inhibitory control, attentional bias, executive functions, decision-making, and working memory have been frequently investigated in gaming disorder, as in many other disorders due to substance use or addictive behaviors. Studies on cognitive aspects involved in problematic social networks use are still rare, but they are needed in order to further show if this phenomenon may also deserve a classification as addictive disorder. Interactions between different cognitive and affective processes are still understudied in both gaming disorder and problematic social networks use.

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## Compliance with Ethical Standards

**Conflict of Interest** The author declares that there are no conflicts of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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