

## **Cognitive functioning and social networking sites addiction – a review**

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### **Summary**

Nowadays social networking sites are commonly available and used by people in different age groups. These are used especially to communicate with other users but sometimes it turns into addiction, when people overuse it. This phenomenon belongs to so-called behavioral addiction which, only recently, has been described in scientific literature. It is crucial to differentiate when using social networking sites is normal and when it goes beyond the social norms. The article depicts the data concerning the spread of the social networking sites addiction phenomenon, its theoretical models and the possibility to identify it on the basis of diagnostic criteria offered by scientists. The main topic of this article is to discuss cognitive function in this specific kind of addiction. Researchers related this to personal, social and emotional spheres until now. However, it seems that cognitive processing, especially cognitive control and executive functions have a crucial role in explaining social media addiction mechanisms. Additionally, an understanding of these mechanisms can contribute to developing more appropriate forms both in terms of prevention and therapy.

**Key words:** social networking sites addiction, executive functions, cognitive functioning

### **Introduction**

The development of the Internet contributed to the creation of social networking sites (SNS), which have become integral part of people's life. Thanks to them human communication is possible no matter what time or place it is for the participants. It can be seen mainly among young people, who move some of their social interactions from real to virtual world [1, 2]. Facebook is nowadays the most popular portal among all

the social networking sites. It only gives place to Messenger, which is considered to be the best mobile application (enabling access to a social networking site from a mobile device). However, now, Messenger is a part of Facebook consortium [3–5]. The popularity of Facebook can be derived from many possibilities it gives to its users. However, more and more parents and teenagers are seeking assistance from specialists (psychologists, psychotherapists and psychiatrists) because of overusing the Internet, including social networking sites [6], and there are data indicating the occurrence of addiction to this type of sites.

So far, all the research has focused on personal, social and emotional factors associated with SNS addiction [7–10]. Whereas, there is not much research concerning the cognitive functioning of people habitually using SNS, especially Facebook. Therefore, the aim of this work is to depict this phenomenon in the context of cognitive functions. This work focuses mainly on executive functions and self-control as the elements of cognitive system associated with human behavior. Executive functions are defined as the ability of cognitive system to control and regulate cognitive processes and human behavior [11]. Whereas, self-control is depicted as the ability to control one's own behavior regardless of outside influence, intrinsic or learned automatisms and physiological impulses [12].

In the first part of the article the data on the habitual use of SNS spreading among Polish population will be depicted. In the further parts, diagnostic criteria approaches and theoretical models associated with cognitive sphere will be discussed. The research review will be made on the connection between cognitive function, measured using behavioral, neurophysiological and psychological methods, and the SNS addiction. Thanks to understanding the ways of cognitive functioning of people using SNS habitually we get to know behavioral addiction reasons, mechanisms and effects better. The article also supplies Polish language literature which lacks a comprehensive coverage of this topic.

### **Epidemiology**

In Polish literature, there are few articles on epidemiology of SNS addiction. Research conducted using the Polish adaptation of the *Bergen Facebook Addiction Scale* (BFAS) and the *Facebook Intensity Scale* among young adults suggests that 27.21% of the respondents are addicted to Facebook [8]. Whereas, low level of Facebook addiction was observed among 65.92% of the respondents. On the other hand, Czernski and Gonciarz [13] used their own translation of the BFAS to depict that 3.73–5.97% of the respondents are addicted to Facebook. Similar findings were obtained by Kulak-Bejda et al. [14], who pointed out that 5% of young adults manifest Facebook addiction. Rębisz and Sikora [2] showed that 3.3% of upper secondary students are addicted to

Facebook. It is hard to explicitly specify whether or not gender has anything to do with SNS addiction. Some findings suggest that women are more prone to overusing SNS [5]. SNS functions are more interesting for them than for men [15]. However, this relation is not confirmed by all the research [8].

Summing up, empirical data depict that overusing Facebook concerns mainly teenagers and young adults. On the basis of different research, the percentage of addicted people from given age groups ranges from 3.3% [2] to even 27.21% [8]. Some data suggest that women are more prone to Facebook addiction. It cannot be ruled out that in Poland this problem may become more and more common, as the number of Internet users in all age groups is increasing every year (GUS statistical results in the years 2013–2017). Simultaneously the popularity of social networking sites, including Facebook, is increasing [3].

### **Proposals for social networking addiction criteria**

SNS addiction cannot be observed in ICD-10 or DSM-IV mental disorders classification. American Psychiatric Association also did not include it in DSM-5 classification, giving insufficient number of empirical research results as the reason [16]. Meanwhile, the problem can be observed among Internet users. It seems that mainly young people are at risk [17]. It should be mentioned that the criteria for gaming addiction were first introduced in DSM-5 and ICD-11. Until then, they were based on working definitions and criteria that were scientifically revised, which later developed the official criteria. Similarly, the definition and criteria of social networking addiction are currently under discussion in scientific publications [18–20]. Consequently, the currently functioning definitions and proposals of social network addiction criteria in the scientific literature are presented below.

According to Andreassen and Pallesen [21], SNS addiction involves constant preoccupation with social media and lack of control over the time spent on them, which makes people function worse in other important spheres of life. Whereas according to Kuss and Griffiths [9], SNS is characterized by addiction symptoms similar to psychoactive substance addiction or other behavioral addictions. Therefore, due to the lack of specific criteria, they postulated that SNS addiction should be treated according to the same criteria, as in the case of dependence syndrome in ICD-10 or drug dependence syndrome in DSM-IV. In this context [22], the problematic use of social media can be determined by such symptoms as: mood changes, total preoccupation with social media, high tolerance (i.e., spending more and more time on social media), withdrawal symptoms (i.e., negative feelings like irritability, anxiety caused by limited use of SNS), conflicts (i.e., impersonal problems), withdrawal (i.e., lack of social media makes people feel stressed, anxious or irritated) and returning to overusing SNS after a period of abstinence.

Similarly, Kotyśko et al. [1] offered the following criteria of SNS addiction based on DSM-IV-TR classification: (1) growth of tolerance, meaning the need to spend more and more time on social media to achieve the same level of contentment; (2) withdrawal symptoms, that is a worsening of a state of mind, when one stops using social media, including anxiety, depression or irritability; (3) using social media for a longer time than it was planned; (4) the loss of control over time spent on social media and failure when attempting to limit or stop using it; (5) taking action to find more time to use social media and submit all activities to it; (6) reduction and abandonment of activities in social, professional and recreational spheres because of using portals; (7) using portals despite of problems.

The results of the research conducted so far suggest a positive correlation between Internet addiction and time spent on using social media, and between addiction to social media and time spent on the Internet [19]. According to CBOS [23], 64.5% of Internet users from at-risk group report their daily or almost daily activity on social media, whereas among other Internet users this percentage is 23.8%. Similarly, Warzecha [5] indicates that the percentage of respondents spending over 3.5 hours on social media is considerably higher among youth, addicted and prone to addiction to SNS. A positive correlation was observed between the time spent online and a level of addiction to Facebook [8].

Therefore, some researchers present SNS addiction as a subcategory to Internet addiction [24]. However, it is stated that SNS addiction is different from other types of Internet addiction [25]. Moreover, the attention is directed to the fact that SNS addiction itself can be related to a specific online service (e.g., Facebook, Twitter). What is more, a mobile phone addiction, nomophobia (an obsessive fear of not having a phone), fear of missing out, (the fear of not being a part of the entertainment) can be a part of SNS addiction [19]. According to a variety of studies, SNS addiction is correlated with high stress level, fear and depression and causes lower results at school, what influences life satisfaction in a negative way [26]. Therefore, despite the lack of presence in the international ICD and DSM classification, SNS addiction is a crucial issue in the sphere of child and adolescent psychology and psychiatry.

In this article, the definition of social networking addiction developed by Andreasen and Pallesen [21] based on the Griffiths' concept [22, 27] has been applied. The reason for using this definition is the widespread use of instruments to assess social media addiction (*Bergen Social Media Addiction Scale*) and Facebook addiction (*Bergen Facebook Addiction Scale*) based on the criteria proposed by Griffiths [22, 27]. Additionally, many authors refer directly or indirectly to the Griffiths' concept when defining social media addiction [21, 28].

### Selected theoretical models of SNS addiction

The appearance and development of SNS addiction can be explained on the basis of theoretical models available in the literature. Turel and Serenko [29] draw attention to some models: (1) cognitive behavioral model [30]; (2) socio-cognitive model of unregulated use of media [31]. It is worth to add the model developed by Brand et al. [32–34] to the above-mentioned theories.

According to cognitive behavioral model [30], some form of psychopathology (e.g., depression, social anxiety, substance abuse) is necessary to make addiction appear. Such Internet users find the benefits of using the Internet for themselves. These benefits intensify some behavior and lead to the continuation of online activity. The appearance and maintenance of SNS addiction is associated mainly with the individuals maladaptive cognition, related to thinking about oneself as well as thinking about the world. Addicts can be prone to rumination resulting in a continual thinking of and discussing problems associated with the use of social media. The addiction also involves negative thinking, low self-esteem and the lack of self-confidence. The addicts can be prone to overgeneralization of their individual experience which results in making general assumptions about the world (e.g., that they are respected only on social media; only there they are treated well; nobody loves them in real life). All these cognitive distortions appear automatically and unconsciously, immediately after a person is exposed to the stimulus associated with the Internet (including social media).

According to Davis [30], we can distinguish two types of Internet addiction. The first one, a specific pathological Internet use concerns people addicted to specific areas of the Internet, e.g., pornography, gambling, social networking sites). The second one, a generalized pathological Internet use consists in general use of the Internet, spending time online pointlessly, on chats, chatting apps, emails. Generalized Internet use can be associated with the lack of social support, feeling of alienation and solitude. Obsessive thinking of the Internet, lower stimulus control, inability to hinder the use of the Internet, feeling that the Internet is our only “friend”, inability to feel pleasure from offline activities, deepening of social isolation, turning to virtual relations are all the symptoms of addiction. These symptoms lead to strengthening of maladaptive behavior patterns, based on the vicious circle mechanism [30].

Brand et al. [32], based on the Davis' concept [30], developed an initial model, which described in more detail the differences between specific and generalized Internet addiction. In the process of further work, Brand et al. [33] presented a model of Interaction of Person-Affect-Cognition-Execution (I-PACE) in the formation of specific Internet dependence. The authors point out that specific Internet addiction is

a consequence of neurobiological and psychological predisposing factors. They also take into account that these factors may contribute to the subjective perception of the situation related to the use of a specific application and determine the affective and cognitive reactions in contact with that application. They also take into account that these factors may contribute to the subjective perception of the situation related to the use of a particular application and determine the affective and cognitive reactions in contact with that application. Additionally, Brand et al. [33] point to the moderating role of, among others, coping styles, cognitive biases and the reduction of effectiveness of cognitive control. According to this model, the user using social networking sites feels the pleasure of achieving certain goals, which may lead to more frequent use of SNS. Additionally, the user becomes more sensitive to any social networking application stimuli (e.g., specific application design, application-specific signals). These factors may increase the frequency of SNS use. Additionally, deficits in the ability to inhibit the response to social networking re-use can be an additional factor in the development of SNS addiction.

It should also be noted that Brand et al. [34] in the new version of the model indicate that it can be successfully extrapolated not only to addictions related to Internet use, but also to other addictive behaviors. In the new version of the model [34], the authors pay more attention to the triggers associated with the use of the medium and the moderating role of cognitive control in the user's response to these factors. Additionally, Brand et al. [34] indicate that as the addictive use of the medium develops, triggers (e.g., the sound of an incoming message in a social networking application) may contribute to reducing an individual's ability to inhibit the reaction associated with starting to use the medium.

According to socio-cognitive model of unregulated use of media [31], SNS addiction can be derived from the deficits in self-regulation. It should be highlighted that the ability to self-regulation may be reduced, i.a., by depression. The greater the sense of agency in the Internet (including knowledge about the Internet) and the higher expectations of one's online activity and its effects, the stronger Internet use compulsive habits, including social networking sites [31]

### **The research on cognitive functioning of people addicted to SNS**

The given concepts of SNS addiction indicate the importance of cognitive factors on the one side, and mechanisms associated with a compulsive behavior on the other side. The question which cognitive system elements are the key features in SNS addiction still remains unanswered. In this respect, the higher order processes involving widely understood cognitive control seem to be crucial. The cognitive control is defined as aheteronomic set of mechanisms underlying the person's ability to set up behavioral

functions because of the superior purpose or the instructions on how to perform the task, to maintain the objectives of the action in the face of a distracting situation, and to suppress a habitual or impulsive reactions [35]. The notion of cognitive control is used interchangeably with executive function [see 36]. However, cognitive control is mainly associated with cognitive activities related to the maintenance of the objectives of the action [35]. In contrast, the concept of executive function refers to a set of cognitive processes aimed at the maintenance of this objective [cf. 37]. Among these processes we can distinguish: (a) inhibition of the response, (b) updating and monitoring of the information that is being received by the working memory, (c) switching between tasks and states. The processes can be used simultaneously to varying degrees depending on the performed task.

On the other hand, self-control is the ability to control one's own behavior regardless of any outside influence, intrinsic or learned automatisms and physiological impulses [12]. It is mainly associated with the ability to restrain from unnecessary or detrimental reactions, postpone gratification, control emotions, treat people with care, and adjust to a social context [38]. Self – control enables a person to change their cognitive and behavioral processes, which makes way to achieve the objectives against external signals and imposed schematic actions. [39].

The following review focuses on the given cognitive control processes and self-control in terms of cognitive functioning of people addicted to the Internet. Therefore, taking into consideration the above, the review of the literature from Polish and foreign scientific journals, published before January 2019, was made. The research on SNS addiction, in terms of its influence on cognitive functions, with particular reference to widely understood cognitive control and self-control, was sought. The materials published in Science Direct, EBSCO, Wiley, and Web of Science databases were used. The following key words were used: social networking sites addiction, Facebook addiction, Facebook intrusion, and were correlated with the following concepts: cognitive function, executive function, inhibition, switching, updating memory, cognitive control, and self-control.

The first graph depicts the summary of the records found in each database on each stage of the review. In the first stage, articles containing the key words mentioned above in any part (title, abstract, article body) were sought. At the preliminary selection stage, the articles in which key words appeared in the title or abstract were selected. At the preliminary analysis stage, the articles were reviewed and rejected when: (1) did not contain the results of empirical research, (2) despite containing key words, their content did not refer to the relationship between cognitive functioning and social networking sites addiction, (3) were repeated in several databases. Moreover, in the next step, two articles were rejected because of doubts about the reliability of the questionnaire methods used to measure the variable related to self-control. 9 articles,

dealing with social networking sites addiction problem and cognitive function in the aspect of questionnaire and behavioral studies and functional magnetic resonance imaging (fMRI), were selected for in-depth analysis. In order to make the review clear and systematized, only research concerning strictly social networking sites addiction, especially Facebook addiction, were selected.

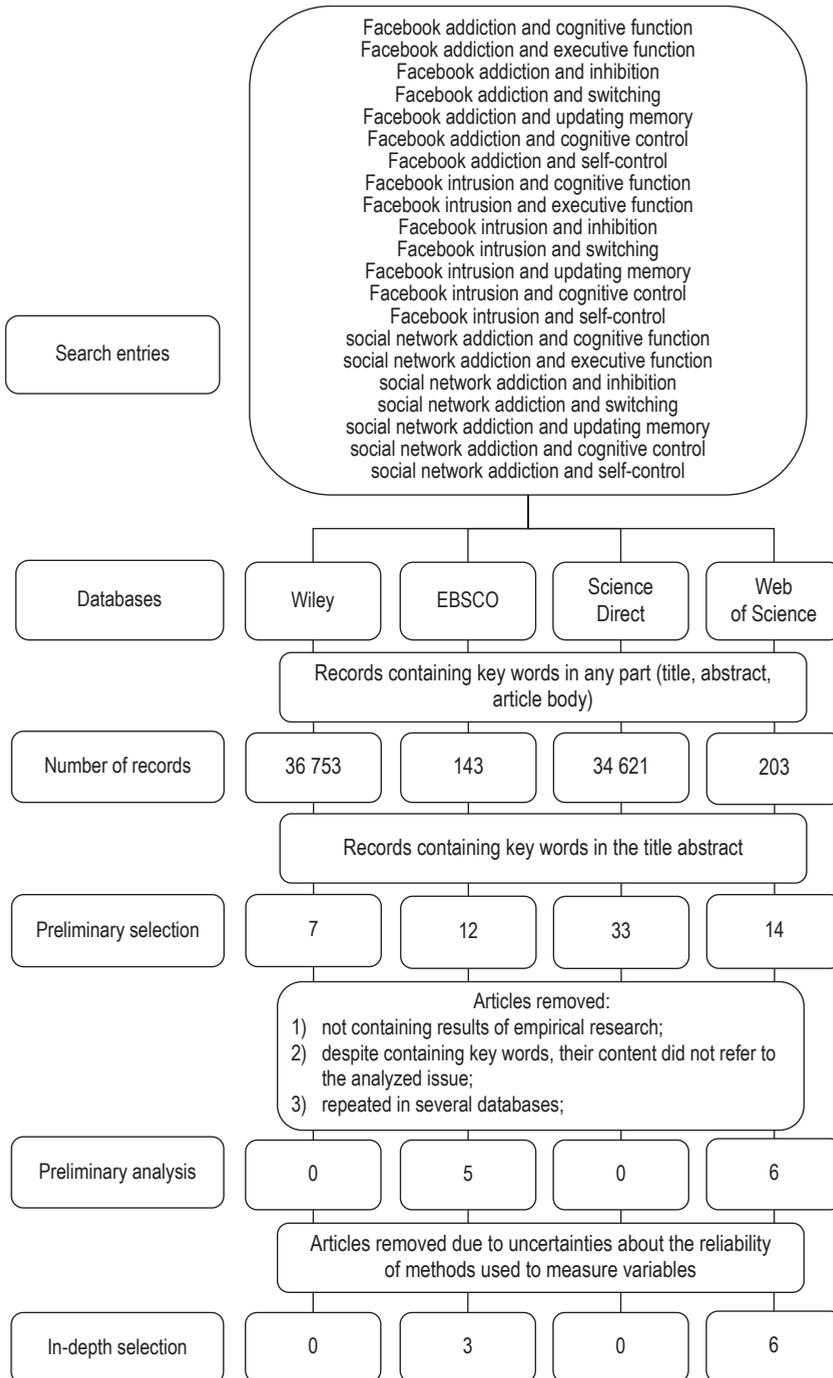


Figure. Graphic presentation of papers selection

Table 1. Summary of the research on cognitive functioning of people addicted to the SNS

No.	Research	Study groups	Type of the research	Task	Results
1.	[40]	Test subjects: N = 32 Age: M = 31.18 SD = 9.32	Beh./fMRI	Discounting Task	<p>The negative correlation between the level of social media addiction questionnaire results and the tolerance of prize receiving delay in case of discounting task was shown.</p> <p>The negative correlation between the grey matter volume in the area of the left and right posteriori insula and social media addiction questionnaire results was observed.</p> <p>It was proved that the level of the tolerance of prize receiving delay is a mediator between the grey matter volume in the area of the left and right posteriori insula and social media addiction questionnaire results.</p>
2.	[41]	Test subjects: N = 284 Age: M = 22.39 SD = 5.19	Quest.	Brief Self-Control Scale Action Control Scale	The negative correlation between Facebook addiction, self-control and focus on an action after failure was proved.

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3.	[42]	<p>Task 1: C = 44 Age: M = 28.59 SD = 9.80 SNSAD = 21</p> <p>Age: M = 24.24 SD = 3.24 GAD = 30</p> <p>Age: M = 27.07 SD = 7.73</p> <p>Task 2: C = 23 Age: M = 26.13 SD = 5.49 SNSAD = 12</p> <p>Age: M = 23.92 SD = 3.34 GAD = 13</p> <p>Age: M = 27.15 SD = 7.39</p>	<p>Task 1: Beh.</p> <p>Task 2: Beh./fMRI</p>	<p>Task 1: Go/NoGo task with affective stimuli</p> <p>Task 2: Stroop test with affective stimuli in the form of words</p>	<p>Task 1: No difference was observed in the examined groups in Go/NoGo task and affective stimuli.</p> <p>Task 2: In the group of computer games addicts (GAD), it was observed that there is much longer time of reaction in Stroop task in the situation of exposure to the words associated with social anxiety, in comparison with exposure to positive and negative words.</p> <p>Lower activity was observed in the area of left middle and superior temporal gyrus during exposure to words associated with social anxiety in the group of computer games addicts, in comparison to the group of SNS addicts (SNSAD)</p>
4.	[43]	<p>N = 25 Age: M = 24.12 SD = 6.15 C = 25 Age: M = 29.80 SD = 10.90</p>	fMRI	Rest activity	<p>Lower grey matter volume in the area of amygdala and right ventral striatum was observed among SNS addicts.</p> <p>Negative correlation between the results of the questionnaire measuring the severity of SNS addiction symptoms and the grey matter volume in the area of amygdala and right ventral striatum was observed.</p> <p>There was no difference between groups in the grey matter volume of in prefrontal cortex.</p>

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5.	[44]	Test subjects: M = 20 Age: M = 20.30 SD = 2.25	fMRI	Rest activity	Higher results in the scale measuring SNS addiction are associated with the lower white matter integrity in the area of corpus callosum.
6.	[45]	Test subjects: N = 20 Age: M = 20.30 SD = 1.30	Beh./fMRI	Go/NoGo task with stimuli thematically associated with Facebook	<p>Higher amount of false alarms and longer time of reaction when a person was not to react to stimuli thematically associated with Facebook than in the case of a person who was not to react to stimuli thematically not associated with Facebook was observed.</p> <p>Positive correlation between the activity within the ventral striatum, in the case when a person was to react to stimuli thematically associated with Facebook, and the scale measuring Facebook addiction, was observed.</p> <p>No connection was shown between the result of the scale measuring Facebook addiction and the activity in the area of ventro medial prefrontal cortex, interior frontal gyrus and anterior cingulate cortex.</p>

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7	[46]	Test subjects: N = 20 M = 20.30 SD = lack of data	fMRI	Rest activity	Negative correlation between the grey matter volume in the area of amygdala and the result of the scale measuring SNS addiction was shown.  Positive correlation between the grey matter volume in the area of anterior cingulate and midcingulate gyrus and the result of the scale measuring SNS addiction was observed.
8	[47]	Test subjects: N = 71 Age: M = 23.7 SD = 3.8	Beh.	Iowa Gambling Task	Negative correlation between the result of the Iowa Gambling Task and level of Facebook addiction was shown.
9	[48]	SNSAD = 40 Age: M = 21.36 SD = 1.54 C = 40 Age: M = 20.90 SD = 1.65	Beh.	AX – Continuous Performance Task (AX-CPT)	Facebook addicts in comparison with people showing no symptoms of addiction (C): 1) had longer time of reaction in BX sequence 2) had lower results in proactive index.

SNSAD – social networking sites addicts; GAD – computer games addicts; IAD – Internet addicts; ESMU – Excess Social Media Use; RSM – risk group; C – control group; Quest. – questionnaire study; Beh. – behavioral research; EEG – electrophysiological research with EEG; fMRI – neuroimaging research with fMRI

## Conclusions

The results of the research carried out so far indicate that people who use social media habitually can display cognitive deficits. They can be related to the decision-making process [40, 47], dealing with appearing cognitive conflicts [48], self-control [41], and the process of inhibition [42, 45], in particular. However, it should be highlighted that the cognitive deficits, particularly in the case of inhibition, were observed mainly in the situation of exposition to the materials thematically associated with social media [42, 45].

Meshi et al. [47] proved that the higher level of Facebook addiction, the more risky decisions were taken by the people taking part in the *Iowa Gambling Task* [49]. This result may mean that people showing symptoms of compulsive use of this social networking site preferred immediate strengthening at the cost of negative consequences and, in the long run, unequivocally ignored negative consequences of their own choice [49]. Similar results were obtained in the research on people addicted to psychoactive substances and gambling. Moreover, it is indicated that the lower results of the *Iowa Gambling Task* may be caused by impulsivity [50]. The study conducted by Turel et al. [40] also depicts that there is a negative correlation between the results of the questionnaire measuring the level of addiction to social networking sites and the tolerance of gratification delay in the case of discounting task, which can support the hypothesis about the connection between the use of this type of social media and impulsivity. Additionally, Błachnio and Przepiórka [41] showed that habitual use of Facebook is associated with lower self-control. However, lower level of self-control can be associated with higher level of impulsivity [see 51].

Furthermore, Cudo et al. [48] proved that people manifesting symptoms of habitual use of Facebook demonstrated deeper involvement in reactive control than people who do not use Facebook habitually, which was indicated by longer reaction time in BX sequence in AX-CPT task. Reactive control is of a corrective character and is activated in case of the appearance of cognitive conflict. Its function is to activate proactive control or automatic schematic actions [52]. Proactive control aims at preventing cognitive conflicts from happening on the basis of contextual information, associated with, i.a., the objective of an action, maintained in the working memory. On the neuronal ground, reactive control is associated with the activity of the anterior cingulate gyrus [52]. It should be highlighted that the changes within the activity of the anterior cingulate gyrus were observed among people addicted to psychoactive substances, computer games, gambling, and people showing generalized addiction to the Internet [53]. It should be indicated that the changes can be related to the deficits in the area of the motor reaction inhibition as well as to the emotional reaction inhibition [54].

However, it should be highlighted that in the research on SNS addiction the direct relationship between the level of the anterior cingulate gyrus activity and the level of Facebook addiction has not been shown [45]. Only positive correlation has been observed between the grey matter volume in the anterior cingulate and midcingulate gyrus and the result on a scale measuring social media addiction [46]. This result is contrary to the previous observation, indicating the decrease in the grey matter volume in this particular areas of the brain in people addicted to psychoactive substances [55]. According to the authors [46], the greater the grey matter volume in the anterior cingulate and midcingulate gyrus, can be associated with adaptation and compensation mechanisms due to the higher amygdala activity. It should be pointed out that the amygdala is responsible for, i.a., the processing of anxiety stimuli and the anxiety reactions conditioning [56]. Moreover, it was pointed out that higher grey matter volume in the anterior cingulate gyrus can correlate with a higher level of impulsivity [57].

Therefore, the research carried out so far can show the importance of impulsiveness as one of the mechanisms associated with the habitual use of SNS. However, at least two mechanisms associated with impulsive behavior of addicted people can be distinguished [58]. The first one is related to strong reactions to rewarding (e.g., associated with a subject of addiction) as well as aversive stimuli, which because of their strength, cannot be inhibited by the cognitive control system. This mechanism is related to disorders in the function of subcortical structures within the reward system. The second one is related to deficits in cognitive control, which can lead to insufficient reaction of inhibition directed to the subject of addiction. This mechanism, in turn, is related to disorders in the function of the prefrontal cortex [cf. 59].

Based on the research conducted so far, it can be assumed that among people using SNS habitually, the mechanism involving impulsiveness is dominant. Namely, the abnormal neurobiological processes can be observed among this people, mainly in the striatum [45], left middle and superior temporal gyrus [42], as well as anatomical alterations related to the lower gray matter volume in the amygdala [46], insula [40] and ventral striatum [43]. Moreover, lower white matter integrity within the corpus callosum was observed [44]. Whereas, the relationship between SNS addiction and activity within the ventromedial part of the prefrontal cortex and the inferior frontal gyrus has not been proved [45]. The difference in the grey matter volume in the prefrontal cortex between people habitually using SNS and people who do not show this type of behavior has not been observed [43].

The results may show alterations in neuronal function in the area related, among others, to the reward system. They may, presumably, lead to inadequate reward and fear stimuli reactivity. It was also proved that the level of the need to use SNS was higher after presentation of the clues thematically related to it than after presenta-

tion of neutral clues [60]. Moreover, people displaying symptoms of compulsive Facebook use evaluated stimuli related to Facebook as more positive, stimulating and motivating [48]. It should be highlighted that, contrary to the research on people addicted to psychoactive substances [55], the relationship between the activity within the prefrontal cortex and habitual use of SNS has not been observed [43, 45]. This can suggest that people habitually using social media and those who do not show this kind of behavior are similar in terms of the general ability to control the inhibition of reaction. Only presentation of the materials thematically related to the social media, which lead to a strong affective reaction, can make inhibition of reaction insufficient [42, 45]. Turel and Qahri-Saremi [61] also prove that there is a strong relationship between cognitive-emotional preoccupation with the use of SNS and severity of compulsive Facebook use.

Summing up, the recent research results can prove that there are cognitive function deficits associated with inhibition of reaction in people habitually using social media. The attention should be drawn to the fact that they are more visible when exposed to the stimuli related to the subject of addiction [42, 45]. Based on the research results, we can assume that neuronal mechanism of this kind of cognitive function is associated with subcortical structure function disorders, component of, i.a., the reward system [43, 45, 46]. It may lead to a strong and inadequate affective reaction to stimuli related to social media [48, 60] that cannot be stopped by the cognitive control system. Therefore, impulsive actions can dominate in the behavior of people habitually using social media, especially in case of exposure to social media or stimuli related to it. These assumptions are consistent with the model proposed by Brand et al. [34], which indicates the triggers associated with the specificity of the medium (e.g., application design, specific sounds, specific symbolism) that may contribute to reducing the ability of an individual to control their own behavior. Brand et al. [34] argued that with the development of addictive use of the medium, cognitive control deficits might occur in contact with contextual stimuli related to the object of addictive behavior. Additionally, taking into account the model proposed by Brand et al. [34], it can be assumed that users experiencing a greater gratification from using social networking sites may also have more difficulty in inhibiting their reaction to the use of SNS. This may probably increase the probability of developing addictive use of social networking sites.

It is also important to pay attention to possible limitations related to the generalization of the results. In most studies the authors focused on generalized SNS addiction [40, 42–44, 46], while some of the studies were focused on Facebook addiction [41, 45, 47, 48]. Despite the fact that Facebook is the most widely used SNS [3–5], caution should be exercised when generalizing results on the relationship between social networking sites addiction and cognitive functioning on Facebook addicted users. In

this context, further research is also needed that could clearly show the similarities and differences between users of different social networking sites (i.e., Twitter, Instagram, Facebook, Telegram, etc.) showing addiction to these sites. Additionally, an important issue that requires further research is whether the use of social networking sites can contribute to deficits in cognitive functioning, or whether addictive use of social networking sites is representative for people with certain deficits in cognitive functioning?

### References

1. Kotyśko M, Izdebski P, Michalak M, Andryszak P, Pluto-Prądyńska A. *Nadmierne korzystanie z sieci społecznościowych*. Alcohol. Drug Addict. 2014; 27(2): 177–194.
2. Rębisz S, Sikora I. *Skala uzależnienia od Facebooka wśród uczniów szkół ponadgimnazjalnych województwa podkarpackiego*. Edukacja – Technika – Informatyka 2018; 25(3): 251–259.
3. Gemius/PBI Polskie Badania Internetu. *Wyniki badania Gemius/PBI za październik 2018*. Gemius Polska, 2018. <https://www.gemius.pl/wszystkie-artykuly-aktualnosci/wyniki-badania-gemiuspbi-za-pazdziernik-2018.html> (retrieved: 10.11.2019).
4. Szymański G, Kowalczyk A. *Facebook realnym zagrożeniem współczesnego społeczeństwa*. Zeszyty Naukowe. Studia Informatica/Uniwersytet Szczeciński 2013; 33: 157–166.
5. Warzecha K. *Portale społecznościowe formą rozrywki i komunikacji współczesnej młodzieży – analiza statystyczna*. Studia Ekonomiczne 2017; 318: 84–107.
6. Sz wajca K, Drath W, Gond ek K, Kasprzak P, Kuszykiewicz A, Ramus K et al. *Nowy pacjent, stare problemy? Kontekst diagnozowania uzależnienia od Internetu*. Psychiatr. i Psychol. Klin. 2014; 14(2): 145–149.
7. Andreassen CS. *Online social network site addiction: A comprehensive review*. Curr. Addict. Rep. 2015; 2(2): 175–184.
8. Błachnio A, Przepiórka A. *Personality and positive orientation in Internet and Facebook addiction. An empirical report from Poland*. Comput. Hum. Behav. 2016; 59: 230–236.
9. Kuss DJ, Griffiths MD. *Online social networking and addiction – A review of the psychological literature*. Int. J. Environ. Res. Public Health. 2011; 8(9): 3528–3552.
10. Atroszko PA, Balcerowska JM, Bereznowski P, Biernatowska A, Pallesen S, Andreassen CS. *Facebook addiction among Polish undergraduate students: Validity of measurement and relationship with personality and well-being*. Comput. Hum. Behav. 2018; 85: 329–338.
11. Nęcka E, Orzechowski J, Szymura B. *Psychologia poznawcza*. Warsaw: Polish Scientific Publishers PWN; 2006.
12. Baumeister RF, Tierney J. *Sila woli. Odkryjmy na nowo to, co w człowieku najpotężniejsze*. Poznan: Media Rodzina; 2013.

13. Czerski WM, Gonciarz E. *Ryzyko uzależnienia studentów od mediów społecznościowych na przykładzie Facebooka*. Lubelski Rocznik Pedagogiczny 2018; 36(4): 133–152.
14. Kulak-Bejda A, Waszkiewicz N, Kulak P, Bejda G. *Risk of addiction to Facebook among Medical University students in Białystok, Poland*. Progress in Health Sciences. 2016; 6(2): 14–20.
15. CBOS. *Raport Korzystanie z Internetu*. Warszawa, 2017. [https://www.cbos.pl/SPISKOM.POL/2017/K\\_049\\_17.PDF](https://www.cbos.pl/SPISKOM.POL/2017/K_049_17.PDF) (retrieved: 12.01.2019).
16. Müller KW, Dreier M, Beutel ME, Duven E, Giralt S, Wölfling K. *A hidden type of internet addiction? Intense and addictive use of social networking sites in adolescents*. Comput. Hum. Behav. 2016; 55(Part A): 172–177.
17. Echeburúa E, Corral de P. *Addiction to new technologies and to online social networking in young people: A new challenge*. Adicciones. 2010; 22(2): 91–95.
18. Carbonell X, Panova T. *A critical consideration of social networking sites' addiction potential*. Addict. Res. Theory. 2017; 25(1): 48–57.
19. Kuss D, Griffiths M. *Social networking sites and addiction: Ten lessons learned*. Int. J. Environ. Res. Public Health. 2017; 14(3): 311.
20. Dalvi-Esfahani M, Niknafs A, Kuss DJ, Nilashi M, Afrough S. *Social media addiction: Applying the DEMATEL approach*. Telemat. Inform. 2019; 43: 101250.
21. Andreassen SC, Pallesen S. *Social network site addiction-an overview*. Curr. Pharm. Des. 2014; 20(25): 4053–4061.
22. Griffiths MD. *A 'components' model of addiction within a biopsychosocial framework*. J. Subst. Use. 2005; 10(4): 191–197.
23. CBOS. *Raport Oszacowanie rozpowszechnienia wybranych uzależnień behawioralnych oraz analiza korelacji pomiędzy występowaniem uzależnień behawioralnych a używaniem substancji psychoaktywnych*. Warsaw, 2015. <https://www.kbpn.gov.pl/portal?id=4476033> (retrieved: 12.01.2019).
24. Karaiskos D, Tzavellas E, Balta G, Paparrigopoulos T. *P02-232-Social network addiction: a new clinical disorder?* Eur. Psychiatry. 2010; 25(Suppl 1): 855.
25. Pontes HM. *Investigating the differential effects of social networking site addiction and Internet gaming disorder on psychological health*. J. Behav. Addict. 2017; 6(4): 601–610.
26. Kuss D, Griffiths MD, Karila L, Billieux J. *Internet addiction: A systematic review of epidemiological research for the last decade*. Curr. Pharm. Des. 2014; 20(25): 4026–4052.
27. Griffiths MD. *The evolution of the 'components model of addiction' and the need for a confirmatory approach in conceptualizing behavioral addictions*. Düşünen Adam. 2019; 3(32): 179–184.
28. Brailovskaia J, Margraf J. *Facebook Addiction Disorder (FAD) among German students – A longitudinal approach*. PLoS ONE. 2017; 12(12): e0189719.
29. Turel O, Serenko A. *The benefits and dangers of enjoyment with social networking websites*. Eur. J. Inf. Syst. 2012; 21(5): 512–528.

30. Davis RA. *A cognitive-behavioral model of pathological Internet use*. *Comput. Hum. Behav.* 2001; 17(2): 187–195.
31. LaRose R, Lin CA, Eastin MS. *Unregulated Internet usage: Addiction, habit, or deficient selfregulation?* *Media Psychol.* 2003; 5(3): 225–253.
32. Brand M, Young KS, Laier C. *Prefrontal control and Internet addiction: A theoretical model and review of neuropsychological and neuroimaging findings*. *Front. Hum. Neurosci.* 2014; 8: 375.
33. 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*. *Neurosci. Biobehav. Rev.* 2016; 71: 252–266.
34. 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*. *Neurosci. Biobehav. Rev.* 2019; 104: 1–10.
35. Miller EK, Cohen JD. *An integrative theory of prefrontal cortex function*. *Annu. Rev. Neurosci.* 2001; 24: 167–202.
36. Goldstein S, Naglieri JA, Princiotta D, Otero TM. *Introduction: A history of executive functioning as a theoretical and clinical construct*. In: Goldstein S, Naglieri JA, editors. *Handbook of executive functioning*. New York: Springer; 2014. P. 3–12.
37. Miyake A, Friedman NP. *The nature and organization of individual differences in executive functions: Four general conclusions*. *Curr. Dir. Psychol. Sci.* 2012; 21(1): 8–14.
38. Nęcka E. *Self-Control Scale AS-36: Construction and validation study*. *Pol. Psychol. Bull.* 2015; 46(3): 488–497.
39. Chuderski A. *Samokontrola: własności, funkcje, mechanizmy i ograniczenia*. *Studia z Kognitywistyki i Filozofii Umysłu* 2010; 4(1): 27–51.
40. Turel O, He Q, Brevers D, Bechara A. *Delay discounting mediates the association between posterior insular cortex volume and social media addiction symptoms*. *Cogn. Affect. Behav. Neurosci.* 2018; 18(4): 694–704.
41. Błachnio A, Przepiorka A. *Dysfunction of self-regulation and self-control in Facebook addiction*. *Psychiatr. Q* 2016; 87(3): 493–500.
42. Dieter J, Hoffmann S, Mier D, Reinhard I, Beutel M, Vollstädt-Klein S et al. *The role of emotional inhibitory control in specific internet addiction—an fMRI study*. *Behav. Brain Res.* 2017; 324: 1–14.
43. He Q, Turel O, Brevers D, Bechara A. *Excess social media use in normal populations is associated with amygdala-striatal but not with prefrontal morphology*. *Psychiatry Res. Neuroimaging* 2017; 269: 31–35.
44. He Q, Turel O, Bechara A. *Association of excessive social media use with abnormal white matter integrity of the corpus callosum*. *Psychiatry Res. Neuroimaging* 2018; 278: 42–47.

45. Turel O, He Q, Xue G, Xiao L, Bechara A. *Examination of neural systems sub-serving Facebook "addiction"*. Psychol. Rep. 2014; 115(3): 675–695.
46. He Q, Turel O, Bechara A. *Brain anatomy alterations associated with Social Networking Site (SNS) addiction*. Sci. Rep. 2017; 7: 45064.
47. Meshi D, Elizarova A, Bender A, Verdejo-Garcia A. *Excessive social media users demonstrate impaired decision making in the Iowa Gambling Task*. J. Behav. Addict. 2019; 8(1): 169–173.
48. Cudo A, Kopiś N, Francuz P, Błachnio A, Przepiórka A, Torój M. *The impact of Facebook use and Facebook intrusion on cognitive control: Effect in proactive and reactive control*. Adv. Cogn. Psychol. 2019; 15(1): 63–74.
49. Jaracz M, Borkowska A. *Iowa Gambling Task – narzędzie do oceny podejmowania decyzji*. Psychiatr. Pol. 2012; 46(3): 461–472.
50. Upton DJ, Bishara AJ, Ahn WY, Stout JC. *Propensity for risk taking and trait impulsivity in the Iowa Gambling Task*. Pers. Individ. Differ. 2011; 50(4): 492–495.
51. Cudo A, Torój M, Demczuk, M, Francuz P. *Dysfunction of self-control in Facebook addiction: Impulsivity is the key*. Psychiatr. Q. 2020; 91(1): 91–101.
52. Chiew KS, Braver TS. *Context processing and control in the human brain: From gating models to dual mechanisms*. In: Egner T, editor. *The Wiley handbook of cognitive control*. Chichester, England: John Wiley & Sons; 2017. P. 143–166.
53. Luijten M, Machielsen MW, Veltman DJ, Hester R, Haan de L, Franken IH. *Systematic review of ERP and fMRI studies investigating inhibitory control and error processing in people with substance dependence and behavioural addictions*. J. Psychiatry Neurosci. 2014; 39(3): 149–169.
54. Jaracz M, Borkowska A. *Podejmowanie decyzji w świetle badań neurobiologicznych i teorii psychologicznych*. Psychiatria 2010; 7(2): 68–73.
55. Goldstein RZ, Volkow ND. *Dysfunction of the prefrontal cortex in addiction: Neuroimaging findings and clinical implications*. Nat. Rev. Neurosci. 2011; 12(11): 652–669.
56. Milivojevic V, Fox HC, Sinha R. *Neural mechanisms associated with stress-induced drug craving*. In: Wilson SJ, editor. *The Wiley handbook on the cognitive neuroscience of addiction*. Chichester, England: John Wiley & Sons; 2015. P. 240–265.
57. Cho SS, Pellecchia G, Aminian K, Ray N, Segura B, Obeso I et al. *Morphometric correlation of impulsivity in medial prefrontal cortex*. Brain Topogr. 2013; 26(3): 479–487.
58. Bechara A. *Risky business: Emotion, decision-making, and addiction*. J. Gambl. Stud. 2003; 19(1): 23–51.
59. Gola M. *Neuralne mechanizmy zachowań nałogowych*. In: Habrat B, editor. *Zaburzenia uprawiania hazardu i inne tak zwane nałogi behawioralne*. Warsaw: Institute of Psychiatry and Neurology; 2016. P. 54–70.
60. Wegmann E, Stodt B, Brand M. *Cue-induced craving in Internet-communication disorder using visual and auditory cues in a cue-reactivity paradigm*. Addict. Res. Theory 2018; 26(4): 306–314.

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61. Turel O, Qahri-Saremi H. *Problematic use of social networking sites: Antecedents and consequence from a dual-system theory perspective*. J. Manag. Inf. Syst. 2016; 33(4): 1087-116.

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