

The Impact of Social Media Use on Executive Function: Beneficial or Harmful?

Authors: Yajie Ma, Zhao Xin, He Xiangchun, Ren Liping, Zhao Xin, He Xiangchun

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Abstract

Current research on the impact of social media use on executive function remains controversial. Some studies have demonstrated that social media use promotes individuals' executive function, while others have found negative effects of social media use on executive function. Recent research suggests that social media use may exhibit an inverted U-shaped relationship with individuals' executive function levels, wherein moderate social media use represents the optimal level for promoting executive function. This is related to the moderating role of usage intensity. This article first introduces behavioral evidence regarding how social media use affects individuals' executive function, comprising three components: positive effects, negative effects, and the inverted U-shaped relationship. Second, it analyzes the moderating role of usage intensity in the inverted U-shaped relationship between social media use and executive function, attempting to elucidate the debate surrounding the advantages and disadvantages of social media use for executive function. Moderate-intensity social media use generates a social media flow experience, enabling individuals to filter out various distracting information and focus attention on useful information when confronted with complex information stimuli in social media. Target information is continuously stored and updated, and individuals' executive function (particularly the updating function) receives long-term and repeated training under such demands, ultimately leading to enhancement. Furthermore, the flow experience generated by social media use can serve as an intrinsic motivation for use. By increasing social network interactions and facilitating positive changes in interpersonal relationships, this provides individuals with continuous social rewards and emotional support, which can buffer the negative effects of excessive social media use on cognitive function to some extent and slow age-related executive function decline. However, high-intensity social media use causes individuals to worry about their performance on tasks, leading them to tend to maintain a broader attentional scope and be more susceptible to interference

from irrelevant information, whereas low-intensity social media use places individuals in a state lacking proactive motivation, reducing or even eliminating the psychological effort process of information processing, thereby both exerting negative effects on executive function. Future research in this field should explore the “dose-effect” of social media use on executive function. The positive effects of social media use on executive function may require a relatively long and continuous process of social media use. Can an optimal level of social media use be identified that maximizes the improvement of individuals’ executive function? Additionally, current research mainly focuses on the impact of social media use frequency on executive function in individuals’ daily lives, while lacking investigation into how different types of social media use affect the development of individual subcomponents of executive function. Future studies should further clarify the relationship between different types of social media use and subcomponents of executive function. Finally, the enhancing effects of social media use may be more pronounced in groups whose brain structures are in a period of change. Future research should combine behavioral and cognitive neuroscience methods to examine differences in brain region activation during executive function-specific tasks among social media users with different cognitive levels, thereby making research on the neural mechanisms of social media use affecting executive function more precise and comprehensive.

Full Text

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MA Yajie^{1, 2}, ZHAO Xin^{1, 2}, HE Xiangchun³, REN Liping^{1, 2}

¹ Key Laboratory of Behavioral and Mental Health, Gansu Province, Lanzhou 730070, China

² School of Psychology, Northwest Normal University, Lanzhou 730070, China

³ School of Educational Technology, Northwest Normal University, Lanzhou 730070, China

Abstract: The impact of social media use on executive function remains controversial, a discrepancy that appears to be moderated by usage intensity. Moderate-intensity social media use can generate social media flow experiences, focusing attention on target information while providing continuous social rewards and emotional support, thereby benefiting executive function. In contrast, both high- and low-intensity use may impair executive function. Future research should investigate the “dose-effect” relationship between social media use and executive function, examine how specific types of social media use affect executive function subcomponents, and consider individual differences in cognitive ability to further clarify the relationship between social media use and executive function development.

Keywords: social media, executive function, flow experience

1 Introduction

Social media refers to internet-based applications, particularly those built on Web 2.0 technologies, that enable users to construct social relationships and access information (Andreas & Michael, 2010). Social media use encompasses all activities conducted through these platforms, with researchers typically measuring usage through frequency, duration, intensity, and addictive patterns (Mieczkowski et al., 2020; Zhang et al., 2021). Studies have shown that social media use can help individuals develop positive self-concepts (Gentile et al., 2012), facilitate interpersonal communication (Torous & Keshavan, 2016), provide social support (Huang & Liu, 2017), and build social capital (Bucci et al., 2019). However, social media use also carries negative consequences, including increased depressive symptoms (Lin et al., 2016; Twenge & Campbell, 2019), decreased self-esteem (Sherlock & Wagstaff, 2019), sleep disturbances (van der Schuur et al., 2019), appearance anxiety (Vannucci et al., 2017), and body image concerns (Frost & Rickwood, 2017; Sherlock & Wagstaff, 2018). Additionally, social media use may degrade cognitive abilities, particularly executive function (EF) (Baumgartner et al., 2014; Parry & Roux, 2019).

Executive function refers to the goal-directed capacity to monitor and manage multiple cognitive processes (Miller & Cohen, 2001; Miyake et al., 2000), encompassing higher-order cognitive operations. Among these, three independent components have received considerable attention: switching (or shifting), updating, and inhibition. Recent research, however, suggests that social media use may benefit executive function. For instance, novice social media users showed significant improvements in updating and inhibition abilities after practice (Myhre et al., 2017; Quinn, 2018). Shin et al. (2020) proposed that the relationship between social media use and executive function may follow an inverted U-shape, with moderate use representing an optimal level for promoting executive function. Thus, the effects of social media use on executive function remain controversial. This paper systematically reviews current research on how social media use affects individual executive function, aiming to provide directions for future studies seeking to minimize negative impacts while promoting positive effects.

2.1 Positive Effects of Social Media Use on Executive Function

Research has demonstrated that social media use can enhance executive function. As social media becomes increasingly prevalent in personal, social, and work contexts, users have developed a habitual behavior pattern known as media multitasking—simultaneously processing two or more electronic or non-electronic media tasks (Brasel & Gips, 2011). Researchers typically quantify media multitasking using the Media Multitasking Index (MMI), calculated as:

$$MMI = \frac{\sum m_i \times h_i}{h_{total}}$$

where h_{total} represents the total time spent using all primary media, m_i denotes the number of other media typically used concurrently with a primary medium, and h_i indicates weekly usage time for each primary medium (Ophir et al., 2009). Due to limited cognitive resources, truly simultaneous processing of multiple media tasks is difficult; thus, media multitasking essentially involves rapid, automatic switching between multiple media tasks (Judd et al., 2011). Switching constitutes a subcomponent of executive function, defined as the ability to transition between mental operations, mental states, or different task rules (Miyake et al., 2000; Monsell, 2003). Studies have found that heavy media multitaskers (individuals who frequently engage in media multitasking) exhibit faster response times than light media multitaskers on the Eriksen Flanker task, Dot-Triangle task, and Digit Span task, demonstrating stronger switching and interference suppression abilities (Rogobete et al., 2020). Furthermore, greater media multitasking is associated with better cognitive control (Alzahabi & Becker, 2013; Elbe et al., 2019; Seddon et al., 2021). Researchers suggest that everyday media multitasking can serve as cognitive training, with intervention effects transferable to switching tasks or dual-task paradigms (Uncapher & Wagner, 2018). Heavy media multitaskers can better integrate multi-channel information in complex media environments (Lui & Wong, 2012) and have accumulated extensive experience switching between tasks. This rich experience enables them to rapidly readapt to new tasks or more completely suppress old ones, thereby reducing task-switching costs and facilitating better inter-task transitions (Rogobete et al., 2020).

Longitudinal studies training older adult novices to use Facebook have found significant improvements in updating and inhibitory control abilities post-training, suggesting that social media use may serve as an effective intervention for maintaining or enhancing executive function in older adults (Myhre et al., 2017; Quinn, 2018). Recent research indicates that social media use provides more stable social support for middle-aged and older adults, strengthening their internalized sense of self-efficacy and control, which can slow age-related executive function decline (Khoo & Yang, 2020).

2.2 Negative Effects of Social Media Use on Executive Function

Despite evidence of benefits, numerous studies have found that social media use impairs executive function (van der Schuur et al., 2019; Wiradhany & Nieuwenstein, 2017; Wiradhany & Koerts, 2019; Madore et al., 2020; Parry et al., 2020). Longitudinal research suggests that increasing social media use may displace activities crucial for cognitive development in young children, such as manipulative and imaginative play, potentially causing permanent negative effects on executive function development (Mcharg et al., 2020). A one-year follow-up study of

185 preschoolers found that, after controlling for covariates, children using applications for ≥ 30 minutes/day exhibited poorer inhibitory control than those using them for < 30 minutes/day (McNeill et al., 2019). Research on adolescents further demonstrates that higher media multitasking scores negatively correlate with executive function performance, including working memory, switching, and inhibition tasks (Baumgartner et al., 2014; Cain et al., 2016). Heavy media multitasking university students showed slower response times and lower accuracy than light multitaskers on the Eriksen Filter task, AX-CPT task, and 2-back/3-back tasks, struggling to maintain attention on current tasks and displaying more bottom-up attentional bias (Ophir et al., 2009). Magen (2017), using the Behavior Rating Inventory of Executive Function-Adult Version (BRIEF-A; Roth et al., 2013) with adults aged 18-36, found that frequent simultaneous media processing correlated with poorer executive function. Higher social media use frequency is associated with greater executive function difficulties (Zurcher et al., 2020), particularly in response inhibition (Murphy & Creux, 2021). Heavy media multitaskers also tend to rely more on intuitive response systems and prioritize immediate over delayed gratification (Schutten et al., 2017), suggesting that media multitasking may impair inhibitory control (Baumgartner & Wirad-hany, 2021).

2.3 Inverted U-Shaped Relationship Between Social Media Use and Executive Function

While most studies suggest a linear relationship between social media use and cognitive abilities (Ophir et al., 2009; Alzahabi & Becker, 2013; Ralph et al., 2017; Elbe et al., 2019; Zurcher et al., 2020; Murphy & Creux, 2021), some researchers propose an inverted U-shaped relationship, suggesting that social media use neither uniformly impairs nor enhances executive function, but rather exhibits an optimal critical point. Studies using n-back tasks have found that moderate media multitaskers outperform both heavy and light media multitaskers (Minear et al., 2013; Shin et al., 2020), with moderate media multitasking associated with optimal cognitive control (e.g., refreshing information in working memory, filtering distracting stimuli) (Cardoso-Leite et al., 2016). Heavy media multitaskers are more prone to attention lapses and difficulty focusing during n-back tasks, causing them to stop refreshing letters in short-term memory, resulting in poorer memory for letter sequences and weaker inhibitory control (Ralph & Smilek, 2017). Light media multitaskers perform worse than moderate multitaskers on executive function tasks, with no significant difference from heavy multitaskers (Cardoso-Leite et al., 2016). Researchers suggest this may be because light media multitasking associates with negative emotional states, reducing self-control and sense of achievement, thereby hindering executive function development (Sanbonmatsu et al., 2013).

3 Usage Intensity as a Moderator of the Relationship Between Social Media Use and Executive Function

The inverted U-shaped relationship between social media use and executive function suggests that moderate use may be optimal, potentially because moderate intensity elicits higher levels of social media flow compared to high or low intensity use (Katahira et al., 2018; Barros et al., 2018; Harmat et al., 2015; Keller & Bless, 2008; Keller et al., 2011; Yoshida et al., 2014). Social media flow refers to an optimal experience occurring when individuals become fully immersed in entertainment, information seeking, or social activities via smartphones and other digital tools, characterized by sustained focus and enjoyment during social media use (Leung, 2020). This construct is typically assessed across five dimensions: concentration, time distortion, presence, enjoyment, and curiosity (Kwak et al., 2014). At moderate usage intensity, social media flow represents a unique attentional state requiring no mental effort (Ullén et al., 2010), associated with high-level cognitive control and focused engagement (Katahira et al., 2018; Wu et al., 2013). This state enables individuals to filter distractions and concentrate on relevant information amid complex social media stimuli, with target information being continuously stored and updated. Under such demands, executive function—particularly the updating component—receives prolonged and repeated training, ultimately improving (Alloway et al., 2013). Additionally, flow experiences can serve as intrinsic motivation, increasing social network interactions and fostering positive interpersonal changes (Kwak et al., 2014), which provide continuous social rewards related to social connection and reputation enhancement (Meshi et al., 2015). Forming and maintaining social interactions engages neural systems associated with reward processing; receiving positive social feedback (e.g., likes, comments) activates brain regions involved in social reward, including the striatum and ventral tegmental area (Fareri, 2014; Ruff, 2014; Sherman et al., 2018). Consequently, when individuals use social media moderately as a tool to enhance social capital, it can protect executive function (Sanbonmatsu et al., 2013; Khoo & Yang, 2020; Baumgartner & Wiradhany, 2021), buffering against negative cognitive effects of overuse and slowing age-related executive decline (Myhre et al., 2017; Quinn, 2018; Glaser et al., 2018). Social media flow may also benefit executive function—particularly inhibition—by expanding and maintaining social relationships to obtain more emotional support (Zuelsdorff et al., 2019).

Thus, moderate-intensity social media use generates higher levels of social media flow, focusing attention on target information while providing continuous social rewards and emotional support, ultimately enhancing executive function.

Neurophysiological evidence supports this mechanism. Social media flow correlates with attention-related neural markers (Yoshida et al., 2014), with flow experiences during social media use associated with increased activation in the lateral frontal cortex (inferior frontal gyrus) and decreased activation in the medial prefrontal cortex (Ulrich et al., 2014; Yoshida et al., 2014). The lateral frontoparietal network typically mediates top-down attention and sustained

task focus (Corbetta & Schulman, 2002), whereas the medial frontal cortex is often implicated in mind-wandering and self-referential thought during tasks (Esterman et al., 2014). When self-control resources are depleted by concurrent media tasks, this top-down control deficit reduces prefrontal functional dominance, leading to executive function failures (Berkman & Miller-Ziegler, 2012) and impairing attentional control and self-regulation. Since attentional focus and distractor suppression are central to executive function (Farah, 2017), heavy media multitasking—involving processing large volumes of fragmented, dispersed information—causes individuals to worry about their task performance (Barros et al., 2018), creating attentional biases toward broader scope and parallel processing of multiple information streams, including irrelevant ones. This makes individuals more susceptible to interference (Ophir et al., 2009; Cain & Mitroff, 2011), preventing attentional focus on target information and negatively impacting executive function (Magen, 2017).

Conversely, low-intensity social media use associates with low sensation seeking (Chang, 2017), reducing social media flow and leaving individuals in a state lacking proactive motivation and enjoyment, with increased negative emotions (Lin et al., 2016; Brailovskaia et al., 2020; Dube et al., 2020). Since social media itself functions as an external information store, individuals process and store less information internally, diminishing or eliminating mental effort in information processing (Sparrow & Wegner, 2011) and reducing task engagement (Wu et al., 2013). People need only remember information cues rather than the information itself, with social media substituting for cognitive functions. Over time, cognitive abilities lose training opportunities, and individuals become unable to effectively store and process current information when disconnected from social media, resulting in insufficient information processing and negative effects on executive function (Kahn & Martinez, 2020).

Therefore, high-intensity social media use leads to performance concerns and broader attentional scope, increasing vulnerability to irrelevant information, while low-intensity use results in reduced motivation and diminished mental effort in information processing, both negatively affecting executive function.

In summary, the impact of social media use on executive function remains controversial, with usage intensity likely playing a moderating role. Several issues require further investigation.

First, future research should examine the “dose-effect” of social media use on executive function, including the independent and interactive effects of different measurement indicators (addiction, duration, frequency, intensity). Longitudinal research suggests that social media influences executive function development as a “trait” rather than a short-term “state” effect (McHarg, 2020), and that negative effects may be absent when usage duration and frequency remain moderate (McNeill et al., 2019). Thus, positive effects may require relatively long-term, sustained social media use (Khoo & Yang, 2020). Can an optimal usage level be identified that maximizes executive function benefits? Future studies should conduct more longitudinal research examining social media use

as a continuous variable affecting executive function.

Second, research should clarify relationships between different types of social media use and specific executive function subcomponents. Current studies primarily focus on how usage frequency affects everyday executive function (Cardoso-Leite et al., 2016; Khoo & Yang, 2020), with less investigation of how specific usage types influence individual subcomponent development. Research indicates that active social media use benefits cognitive development (Wang et al., 2014; Xie, 2014), whereas passive use harms it (Tandoc et al., 2015; Verduyn et al., 2015; Frison & Eggermont, 2015), possibly due to differences in purpose clarity. Additionally, as media multitasking is a highly self-selected habitual pattern (Seddon et al., 2021), how do individuals select efficient multitasking types based on attentional priorities and cognitive resources to avoid interference and maximize flow states that promote executive function? Future research should investigate specific effects of social media use types on executive function to provide recommendations for improving cognitive status.

Finally, future studies should examine individuals with different cognitive levels to clarify the relationship between social media use and executive function development. Executive function is closely linked to the prefrontal cortex (Gianaros et al., 2007), and associations between social media use and prefrontal function vary across age stages. Enhancement effects may be more pronounced in groups undergoing brain structural changes—preschool children in developmental stages and older adults in degenerative stages may benefit more than adults with relatively stable brain structures (Chan et al., 2016; McNeill et al., 2019; Myhre et al., 2017; Quinn, 2018; Huber et al., 2018; Khoo & Yang, 2020). While previous research shows that social media use alters neural pathways or brain response patterns (Meshi et al., 2015; Sherman et al., 2018; Kei et al., 2020), little is known about how cognitive level influences structural changes related to executive function. Therefore, future research should combine behavioral and neurocognitive methods to examine differences in brain activation during executive function tasks among social media users with varying cognitive levels, providing more precise and comprehensive understanding of the neural mechanisms underlying social media's effects on executive function.

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