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Social Media and Working Memory - A Review

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Abstract

Social media is a part of daily today life which is growing more and more widespread. Many individuals have mobile phones and often use social media. This review paper explores the impact of social media on working memory, a critical cognitive function. It discusses the widespread use of social media, its emotional influence, and its potential effects on cognitive processes. It highlights factors contributing to this complex relationship, including the type of engagement and platform design. Research indicates that using social media expands the possibility of becoming addicted. Excessive social media usage affects emotional well-being by strengthening negative feelings such as fear of missing out, melancholy, increased loneliness, anger, irritation, and anxiety. According to earlier research, the subject of whether using social media negatively affects our working memory has been raised. They cause numerous issues in our daily lives while they do the task. This literature review's data came from a comprehensive database search of relevant previously published articles. A total of 25 papers were extracted from databases of which 10 were found relevant and hence chosen to be part of this review. The review revealed that online social media has a high potential to affect the cognitive functioning 'working memory' of people who spend their time on online social media platforms. The paper proposes interventions such as cognitive training, mindfulness practices, and digital detox programs to counter potential negative effects. Overall, it emphasizes the need for ongoing interdisciplinary research to better understand and address the interaction between social media and cognitive functions.

Keywords: Attention, Cognitive Function, Memory, Social Media, Working Memory

1. Introduction

Online social media platforms have become more prominent online hobbies in recent years. Approximately 4.26 billion people worldwide used social media in 2021, and that number is expected to increase by nearly six billion in 2027[1].

Social media is becoming increasingly integrated into everyday life. Smartphone ownership and daily use of social media are widespread worldwide. Additional studies indicate that 72% of Americans and 43% of people worldwide own smartphones[2,3], while in excess of 71% of teenagers aged 13 to 17 routinely use Facebook. According to the data analyzed, 90% of smartphone owners accessed social media at least once every day.

A recent study Kircaburun, found that students of different ages, genders, and personalities use various sites to varying levels and for varying motives[4]. Particularly among younger people, now a moment when social media is seen as life itself, rather than merely a component of IT; during and even after the COVID-19 pandemic, this perception has increased dramatically[5].

Individuals are seen to be more joyful on the grounds that they are associated with additional individuals, which is the reason that, on account of virtual entertainment, individuals are more interconnected than at any other time. Facebook is the biggest online media platform worldwide[3]. Every online social media platform, according to[6,7] has the potential to significantly affect the emotions and relationships of adolescents who use it.

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The launch of MMM suggests that the time has come to promote an interdisciplinary approach to memory and media, one that draws on a variety of fields with a unique and necessary perspective on how various media and technology affect memory[8].

The writing on this unavoidable innovation is new and developing curiosity among scientists in the effect of such innovation on community general prosperity. Social media's impact on cognitive function[9], educational attainment[10], and Researchers, families, and health professionals are all interested in mental health, particularly among youths[11]. However, the majority of the research lacks scientific support and is founded on correlation and self-reporting studies[12].

Research has indicated that using social media can lead to addiction because checking one's phone or social media accounts gives one a "high," which activates the addiction area of the brain[13]. Over time, tech users' brain patterns can change. DSM does not include internet addiction, but its symptoms include emotional shutdown, withdrawal symptoms, and difficulty concentrating. As per another review from Harward College, self-divulgence via web-based entertainment organizing locales enacts the very part of the cerebrum that is actuated when dependent substances are consumed[14].

Excessive social media use increases the reaction to negative feelings such as FOMO, melancholy, loneliness, anxiety, decreased life satisfaction, lost time, anger, increased isolation, and a variety of others[15].

It's not clear how social media affects cognitive performance. Working memory has attracted the interest of academics as a cognitive ability that may be altered by the use of social media because it is one of the numerous predictors of academic accomplishment[16].

Mental execution can be influenced by various components, including non-mental ones like the near and dear condition or the close-to-home condition of the test-taker[17,18]. There is a significant association between emotional well-being and working memory function, and social media use and mental health have been linked in several research. The question is whether our working memory is harmed by social media use and access. Anxiety has been found to have a negative relationship between linguistic and visuospatial WM performance, along with n-back performance and the dynamic span measure[19]. According to the findings, working memory retrieval and transient anxiety have a negative relationship.

1.1 Working Memory

Working Memory (WM) is a principal mental capability. It is a system with constantly updated temporary memory storage of limited capacity[20,21]. Working memory is a structure in the brain with minimal processing,

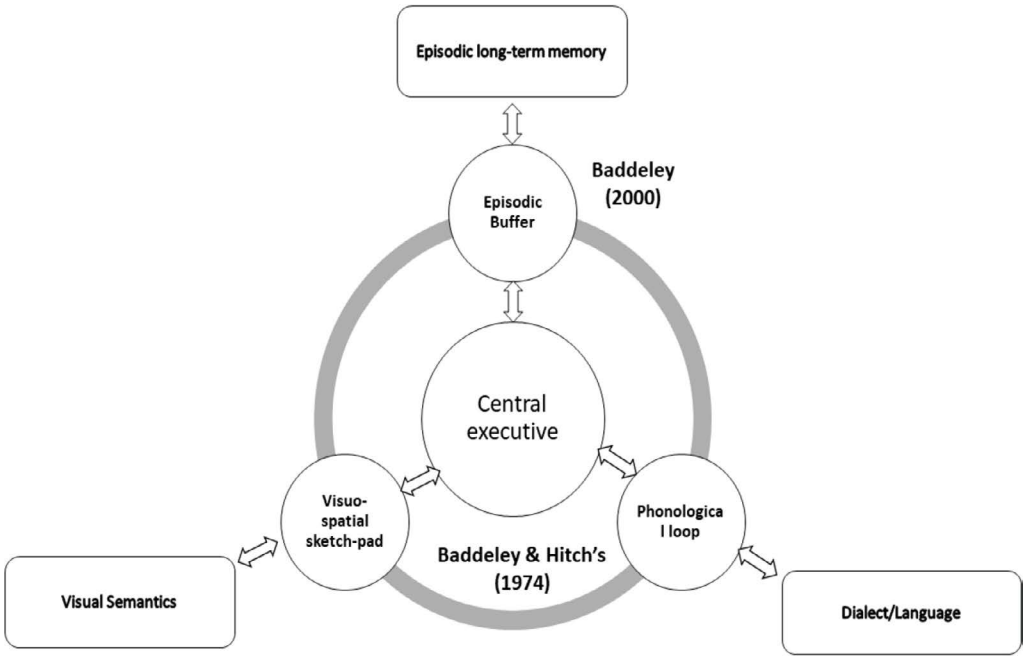

Figure 1. The multicomponent model of working memory.

and manipulation capabilities and temporarily stores information[22,21]. The central executive, which generates and modifies information, connects the phonological loop and the visuospatial sketchpad, two well-known temporary storage systems, in the conventional paradigm of working memory[23]. A component of storage known as the phonological loop is connected to the brief memory of parts of voices, sounds, and language before they fade. Additionally, it incorporates a portion of the recovery effort. The visual-spatial sketchpad is a capacity part that considers the capacity and control of data. It can convey information in either visual or verbal form to a spatial channel, making it easier to recall[20].

Baddeley added the episodic buffer component to the classic model in the year 2000, which integrates chunks of episodic and semantic information[21]. Figure 1 depicts these components and their interaction in the dynamics of working memory[24].

2. Literature Search

Numerous literature searches were carried out between the years 2010 and April 2022. Science Direct, PubMed, Google Scholar, were employed to conduct an electronic search of articles. The following keywords were used i.e., Social Media, Working Memory, Problematic social media use, and Memory performance. This meticulous approach yielded a total of 25 articles.

Following the initial search, a stringent selection process was implemented to ascertain the pertinence of the articles. A meticulous evaluation led to the identification of 10 articles that aligned closely with the predefined selection criteria. This rigorous process ensured the inclusion of only the most relevant and scientifically rigorous articles in the subsequent analysis. The summary of the utilized articles is given in Table 1.

2.1 Inclusion Criteria

- Studies included correlation studies, Randomized Controlled Trials (RCTs), and a survey.
- Only full-text versions of English articles are accessible.
- Human subjects were used in the research.
- In studies where working memory and cognitive/executive function was used as a dependent variable.
- Studies with participants who directly or indirectly connected with Social media.

2.2 Exclusion Criteria

- Research on populations that do not use any type of social media.

3. Result and Discussion

The present study is steered to determine whether the use of social media can affect either positively or negatively our cognitive process (working memory)

3.1 The Impact of Social Media Use on Working Memory

Social media use has been linked to decreased memory performance tenderness, according to several studies. Greater problematic social media usage and anxiety were found to be substantially related to worse memory retention[25]. Anxiety moderated the association between bad usage of social media and memory function, but not depression, stress, sleeplessness, or other mood problems. Inadequate memory performance and PSMU were clearly linked in this study[25].

Dependence on social media platforms, whether psychological or behavioural, may have major effects on people's everyday lives. Numerous studies have revealed that individuals' mental health and general well-being can suffer as a result of their social media use[26,27]. While scholars have sought to study how and why social media is problematic, they have yet to provide empirical or scientific evidence-based suggestions for proposing viable remedies to this problem.

Stieger and Wunderl looked at data from a large number of teenagers between the ages of 12 and 16; who took A battery of IQ psychological assessments regarding spatial perception, information processing, and practical arithmetic, and the results were compared to the time they spent on social media (The active and inactive average time spent every day, as well as the problematic usage of social media)[28].

Contrary to expectations, the verbal intelligence scores of passive social media users were marginally higher than those of active social media users[28]. In the same context, there is a difference between actively and passively using social media 'such as browsing, republishing messages, and considering the content[29,30]. Practical numeracy skills were lower in adolescents whose PSMU scores were higher or who used social media more frequently.

Table 1. Summary of literature review

Study	Participants	Methodology	Conclusion
Dagher *et al.*,[25]	466 community-dwelling participants from all Lebanese governorates were selected using a proportional random sample.	In this cross-sectional study, 466 residents from different Mohafazat communities were randomly selected and interviewed face-to-face. The study included participants over 18 years old, excluding those with dementia, and individuals who chose not to participate were not considered.	This research confirms that the wrong way at the wrong time of using social media as well as psychological disorders such as anxiety negatively affect memory function, as well as the fact that sadness, lack of sleep, and stress failed to influence the association between poor social media use and poor memory function.
Stieger and Wunderl[28]	The sample was made up primarily of adolescents from Lower Austria (N = 12,043), Austria. 49.1% are women).	Information from a large number of adolescents (ages 12 to 16; N > 12,000) took many psychometric assessments on subjects like intelligence, spatial perception, information processing, and practical numeracy.	This study found that more social media use and higher PSMU scores relate to weaker practical numeracy skills in adolescents, along with a decline in working memory due to web-based entertainment. Other cognitive abilities like knowledge, spatial insight, data handling, and language skills showed no significant link to social media use.
Murphy *et al.*,[38]	In exchange for a portion of their course credits, 100 first-year university students (28 men and 72 women, M = 25.14) ranging in age from 17 to 70 participated in the study.	Using MMI scores as a continuous variable, this study investigated the associations among media multitasking and performance on the WM (DOT), Response Inhibition (Spatial Stroop task), and together WM and Response Inhibition (Go or No-Go task via moderate and high cognitive load circumstances) measures.	The study's results show limited correlation between higher MMI scores and stronger working memory inhibition. Elevated MMI scores were tied to better performance in Go or No-Go test go trials. However, higher MMI scores were linked to lower task accuracy in certain situations of the Spatial Stroop task and specific conditions of the Go or No-Go task with varying cognitive loads.
Mayshak *et al.*,[47]	Eighty members matured somewhere in the range of 18 and 67 (M ¼ 29.39, SD ¼ 11.21 years)	Eighty individuals underwent initial mood and cognitive assessments, focusing on working memory and executive functioning. Following this, they were exposed to three positive emotional posts and one negative control post. Participants had the option to respond freely or indicate non-response. Afterward, they completed cognitive and emotional assessments once again.	Participants' Executive Function (EF), assessed through reaction time and incorrect target word detection, improved following exposure to an emotionally distressing post. Emotionally charged messages garnered stronger responses than control posts. Engagement with negative online social network posts was influenced by mood, executive function, and empathy traits.
Lara and Bokoch[54]	Amazon Mechanical Turk (MTurk) was used to recruit the most diverse sample possible. The ideal number of participants for the sample was ninety-nine. because of the low power and tiny sample size (= 0.70), only 80 US participants were recruited.	The online survey was divided into three sections: SONTUS, the Stroop test, the Corsi block test, and a demographics questionnaire to account for age, gender, racial and ethnic identification, as well as educational attainment.	This study showed that social media use had no discernible effects on these cognitive qualities of functioning.

Table 1 to be continued...			
Sharifian and Zahodne[57]	The sample included 217 younger adults (ages 20 to 39), 400 middle-aged adults (ages 40 to 59), and 165 older adults (ages 60 and up), all of whom were predominantly non-Hispanic white (84.70%).	Multilevel models were used to assess the effect of everyday social media use, age, and the connection between them on same-day and next-day memory failures in the Midlife in the United States Refresher cohort (n = 782, 25-75 years).	The study's model revealed that days with higher virtual social media use correlated with increased memory letdowns. Additionally, greater previous-day web-based entertainment consumption led to more significant memory disappointments the next day, even after accounting for earlier-day disappointments. Interestingly, age showed no influence on these patterns.
Spence *et al.*,[42]	A total of 45 undergraduates (36 women and 9 men) aged 18-24 participated in the study at a small humanities college in the United States.	This research studied how Instagram use during or after new information presentation impacts college students' short-term memory. Three groups (control, Instagram during, Instagram after) were tested.	According to the findings, compared to people who do not use their phones to scroll through social media, those who access Instagram with their smartphones while they are in class or with friends may have a lower capacity to retain the information that is presented to them.
Aharoney and Zion[31]	A convenience sample was used to select 64 participants, 24 of whom were men and 40 of whom were women. Their ages were from 12 to 17.	From the study sample, a control group and an experimental group, each consisting of 32 students, were randomly chosen. Researchers employed six surveys, including personal details, performance assessment questionnaire, and Working Memory Record from the Wechsler Intelligence Scale for Children, to gather data.	The key conclusions indicate that students' working memory performance is decreased when distracted by WhatsApp via smartphones. Students are also aware of how using WhatsApp makes it harder to complete assignments and reduces learning effectiveness.
Almorzouki *et al.*,[55]	118 Saudi Arabian undergraduate students, aged 19 to 28, made up the sample.	The sample carried out two WM tests; In one assessment, participants had to use social media before the test, and in the other, they had to paint online before the test. We additionally estimated grade point normal (GPA), constant online entertainment utilization (SMU), discouragement (PHQ-9), tension (Stray 7), and scattered virtual entertainment use (SMDS).	They found that, at least in a healthy adult population, working memory is resistant to social media use. The findings showed that the circumstances varied, with individuals who were at least mildly sad making more errors on the WM task after being confronted with social media for a short period of time.
Jones *et. al.*,[48]	160 Members (laborer)	160 participants conducted working memory tests on the pretest and posttest to gauge their performance at work. They were also randomly allocated to politically salient or politically neutral Facebook pages.	Even when sharing political views, exposure to political social media content impacts both workplace performance (cognitive domain) and coworker attitudes (social domain). Post-test results showed that participants exposed to politically charged content had lower working memory scores compared to those exposed to politically neutral content.

Due to the cross-sectional plan, it is unresolved whether young people with lower viable mathematical abilities are effectively looking for social media communication or another, more troubling direction; that is, people who spend more time on social media have fewer numeracy skills, such as a capacity to solve straightforward text-based math problems (such as establishing areas)[28].

The link between active social media usage and LTM was of tiny effect size and marginal importance, despite being in the expected direction (RF model's third least significant predictor), despite the fact that it decreases working memory in the short term[31]. In addition, there was no evidence that the intellect, spatial perception, information processing, technical comprehension, creativity, phonological awareness, and language of teenagers were significantly related to one another.

Media multitasking is a necessity in the digital age today. Research reveals that American adolescents dedicate around 7.5 hours per day to media consumption, with nearly a third of that time spent processing multiple forms of information simultaneously[32]. Additional studies highlight that Americans frequently juggle two or more media-related activities alongside studying, watching television, and staying updated with the news[33]. A survey conducted by the Pew Research Center indicates that 95% of teenagers have access to mobile phones, and 45% of them admit to using the internet "constantly"[34]. This demonstrates the prevalence and importance of media multitasking in modern society.

Scientists are curious about this rise in media multitasking. In addition, there has been an enhancement in the amount of research in the past few years that focuses on the consequences of multitasking with media on human performance[35-37].

Murphy and colleagues have demonstrated similar results in 2021[38]. Murphy *et al.,* explored the link between media multitasking and Executive Functions (EFs) like inhibition and Working Memory (WM)[38]. After adjusting for factors like age and IQ, they found a slight connection between higher media multitasking and stronger WM. Those with higher media multitasking scores performed better in the Go trial, indicating faster processing. Poorer inhibition task performance was associated with increased media multitasking, particularly in specific conditions. This highlights the intricate relationship between media multitasking and cognitive functions[38].

In addition, a number of studies (such as Ophir *et al.,*) demonstrate a link between it and poor performance[35,39]. However, a number of studies appear to suggest the opposite[40,41], while others show absolutely no association[39].

Spence *et al.,* studied how social media, particularly Instagram, affects college students' short-term memory[42]. They found that students who used Instagram and were exposed to new information had lower short-term memory recall accuracy compared to non-users (71.56 vs. 80.89 %). However, the ability to recall a story after hearing it remained similar between the two groups. The study showed no link between memory and the number of subjects on Instagram accounts, nor did the variety of topics in Instagram feeds affect memory. This suggests that using Instagram on phones during classes or group settings might hinder information recall compared to abstaining from such use[42].

Users of Social Media Technologies (SMTs) are profoundly affected emotionally. Clients oftentimes comment on what their temperament is meant for by the internet-based messages and cautions they get, as well as the updates and articles they see[43,44]. SMTs are widely accepted to have the ability to affect a person's emotional state. An "affective state" in this context refers to the likelihood that SMTs may have an influence on a range of affective states, including feelings and moods. SMT can maintain or elicit a particular mood, as well as elicit an emotional response. An emotional shift, in which one affective state changes into another, could cause this[45]. Working memory performance may be affected by emotional valence, arousal, and motivational variables all at once. Task significance, feeling type, working memory standards, and individual attributes may all impact Emotional influence on working memory[44,46].

Mayshak *et al.,* investigated the impact of negative social media content on free-text responses, Executive Function (EF), Working Memory (WM), and sentiment[47]. Participants exposed to negative messages experienced mood decline but improved executive function, evident in quicker responses and fewer incorrect word identifications. Responses to emotional messages were more emotive than control posts. Emotional response levels were influenced by trait empathy and mood, even after accounting for demographics. Mood, executive function, and empathy played roles in engaging with negative online social media content[47].

Jones and colleagues conducted research in 2021 to ascertain the effect of reading politically charged posts on social media on Work Effectiveness[48]. In their research, 160 members were haphazardly distributed to politically

remarkable and politically impartial Facebook pages and finished WM tests as a proportion of expert execution (at pretest and posttest). At the posttest, members who were politically prominent had lower working memory scores; the working memory scores of those in the politically neutral condition were unaffected.

App developers often wield control over online content delivery, tailoring it to captivate users' attention during internet and social media browsing[49]. This control hinders users' ability to limit their social media time, leading to distorted time perception[50]. The Zeigarnik effect highlights how our brains remain active on unfinished tasks, perpetuating scrolling on social networking sites due to endless engaging content, creating an unconscious drive to continue the activity[51,52]. Similarly, the Ovsiankina Effect compels users to resume interrupted tasks, as seen in social media's fast-paced interactions that encourage prolonged engagement for satisfying conclusions[53].

The behavioral patterns formed by social media are also connected to the cognitive function of the brain; a study has been conducted to better comprehend this. Lara and Bokoch hypothesized that persons who used social media often would have a reduced capacity to efficiently block inappropriate information and a better ability for working memory[54]. Surprisingly, the study found no significant correlation between information suppression, working memory performance, and social media usage. The study's outcomes did not yield substantial results.

With these considerations in mind, in a study by Almarzouki *et al.,* the relationship between compulsive social media use and educational outcomes was examined, focusing on Working Memory (WM) and accounting for depression, anxiety, and inappropriate use. Among moderately depressed adults, social media use predicted more errors compared to control conditions, though WM scores did not significantly differ[55]. Higher Social Media Disposition Scale (SMDS) scores correlated with prolonged social media use and increased depression, but WM performance and social media use did not predict Grade Point Average (GPA) scores.

In a review paper, Kuss and Griffiths reviewed how teens' constant social media use stems from a "need to belong" and a fear of missing out, along with motivations like voguery, cyberstalking, identity formation, and information seeking[56]. Virtual entertainment can become highly significant for some individuals, reminiscent of Maslow's hierarchy of needs. "Addictive" social media use can arise from positive outcome expectations and a lack of self-control during usage, as per[56].

Sharifian and Zahodne's study highlights that social media can aid memory offloading and strengthen social bonds, impacting day-to-day memory positively or negatively[57]. Age-related declines may exacerbate these effects in older adults. The study found a link between higher social media use and increased memory errors, with this relationship persisting across age groups. However, social interaction emerged as a protective factor for memory. This emphasizes the need to comprehend the implications of social media use[57].

Immediate expectations brought about by social media have resulted in societal pressures. A study on WhatsApp's instant messaging network, conducted by Pielot *et al.,* highlights that the "Last Seen" feature intensifies the anticipation of an immediate response[58]. This feature acts as an automated indicator of availability, suggesting when the sender expects the recipient to reply and, conversely when the recipient should respond to avoid straining the relationship.

The "Read Receipt" feature in WhatsApp, as studied by Blabst and Diefenbach, intensifies the pressure to respond quickly[59]. The double ticks indicate message viewing, leading senders to feel compelled to reply promptly. This mutual understanding of the feature's operation establishes social norms for response time[51], contributing to potential addiction and negative well-being impacts[59].

Aharony and Zion delve into the impact of WhatsApp on cognitive function and working memory[31]. Focusing on teens, their study reveals that interruptions caused by mobile instant messaging, particularly through WhatsApp, hinder working memory performance. The research highlights students' awareness of how WhatsApp usage complicates learning tasks and diminishes instructional effectiveness. Notably, their unique experiment directly examines the detrimental effects of WhatsApp disruptions on teenagers' working memory, shedding light on this novel digital platform's influence[31].

A comprehensive review centred on Adolescent and Child Working Memory Function[60]. Drawing from 19 papers sourced from PubMed, PsycINFO, and Google Scholar, the investigation explored the repercussions of excessive screen time on memory. The study underscores the diverse perspectives that existing research offers, while acknowledging that the influence of reduced screen time goes beyond memory, touching on areas such as attention

and potentially addictive behaviors, which have also been noted in various studies[60].

3.2 Interventions to Counter Social Media's Impact on Working Memory

The widespread use of social media has raised concerns about its potential negative effects on cognitive functions, particularly working memory, crucial for information processing and decision-making. Interventions to mitigate these effects include:

3.2.1 Neuroplasticity and Cognitive Training

Cognitive training shows the brain's adaptability. Studies by Green and Bavelier (2012) and Owen *et al.,* reveal that targeted activities can enhance working memory[61,62]. This suggests cognitive training interventions could counteract the potential negative effects of excessive social media use.

3.2.2 Mindfulness and Attention Regulation

Mindfulness practices enhance attention control and working memory. Jha *et al.,* found mindfulness training improved working memory and affective experience[63]. Mrazek *et al.,* demonstrated mindfulness training reduces mind wandering, supporting its potential as an intervention[64].

3.2.3 Digital Detox and Emotional Well-Being

Concerns about social media's impact on emotional well-being prompted studies. Wilmer, Sherman, and Chein linked mobile technology habits to cognitive functioning[65]. Hunt *et al.,* showed limiting social media reduced loneliness and depression[66]. Structured digital detox programs might improve emotional well-being and indirectly enhance working memory by reducing cognitive load from negative emotions.

4. Conclusion

The interaction between individuals and social media platforms has complex effects on cognitive functions, notably working memory. Different patterns of user engagement, both active (commenting, sharing) and passive (liking, viewing), influence cognitive processes. Excessive social media use is linked to reduced memory performance and increased anxiety, with potential impacts on emotional states. Interventions like cognitive training, mindfulness practices, and digital detox programs offer ways to counter these effects. However, the intricate nature of the relationship between social media and cognitive processes suggests the need for continued interdisciplinary research. Factors such as emotional influence, age-related differences, and the design of social media platforms contribute to the complexity of this relationship. As technology continues to evolve and shape our interactions, a deeper understanding of how social media affects cognitive functions will be crucial for developing effective interventions and fostering healthy digital habits.

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