

The Impact Of Digital Media Multitasking On Attention Span And Memory

Author

Abstract

The emergence of digital media has completely redefined the information consumption and human interaction landscape. The main feature of this new age is the commonness of multitasking in digital media- the simultaneous use of several streams of digital media. The paper gives an in-depth analysis of how digital media multitasking affects two essential cognitive processes, namely, attention span and memory. This paper is based on a comprehensive overview of neuroscientific, psychological, and pedagogical studies by arguing that a continuous practice of multitasking in digital media is linked to serious and possibly permanent damage to cognitive control. The discussion goes into the neurophysiological basis of such effects, and how the attentional and memory systems within the brain are overloaded and possibly changed by the continuous shift of attention involved in multitasking. The paper also explores the dissimilar effects of diverse types of digital media, including social media and the videos, and explores the increased susceptibility of the growing adolescent brain. Although we will admit that we experience perceived efficiencies and gratifications that motivate multitasking behaviors, this paper argues that the cognitive price, in the forms of reduced sustained attention, poorer working memory, and reduced encoding in long-term memory, are high. The moderating effect of individual differences in working memory capacity is also discussed and the possible intervention strategies that would be used to reduce the adverse cognitive impacts of a round-the-clock interconnected world are also discussed. The paper concludes that although digital media provides the greatest access to information and communication, the multitasking phenomenon of using digital media is a major threat to the development of the rich, intensive thinking process, and has far-reaching consequences on learning and productivity, as well as the general cognitive health.

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I. Introduction

The 21st century has been defined by the highest degree of digital connectivity. Laptops, smartphones, and numerous other devices are the source of endless flow of information, entertainment, and social life. This digital ubiquitousness has created a new form of interaction with the world digital media multitasking. Since it is possible to scroll through social media and watch a movie at the same time or reply to emails in a video conference, the act of simultaneous media streams has become widespread and very automatic. The mere fact of this back and forth behavior between various digital inputs prompts an essential question: how is the cumulative effect of this behavior on our basic cognitive abilities? The paper will also discuss the complex effect of digital media multitasking on two most important areas of human cognition namely attention and memory.

Attention, the power of selective attention, the focus on one part of the environment and disregard of another is the key to all other higher-order thinking processes. It forms the foundation of study, critical thought and appropriate social interaction. In the same way, the aspect of memory, which is the ability of the brain to encode, store and recall data or information when required is what forms the basis of our self-identity, our capability to learn through the past, and our future planning. The main idea of the given paper is that the constant multitasking in digital media which is usually seen as an effective and indispensable skill of working in the modern world takes a heavy toll on attention and recollection.

The paper will start by giving a conceptual perspective on the understanding of digital media multitasking and how it is differentiated with other forms of task-switching and how it is placed in the context of our changing media environment. It will proceed to explore the neurological basis of attention and memory and this will give it a ground upon which it can establish the influences of the systems on the demands of multitasking. The central part of the paper will consist of the detailed analysis of the empirical data that has incorporated the digital media multitasking with the alterations of the attentional control and the memory performance. It will involve the analysis of both immediate and in the moment impacts and the possibility of long-term changes in cognitive functioning.

Additionally, the paper will discuss the varying effects of the digital media of the different kinds. As an example, does multitasking with social media have a worse cognitive effect on cognitive functioning compared to multitasking with academic materials? The developmental vulnerabilities, especially of the adolescent brain

are also a critical issue that will be discussed in the paper, in which areas of the brain that perform executive functions such as attention and impulse control are undergoing a major development.

Lastly, the paper will reflect on the general implications of the findings. What do the implications of digital media multitasking mean to education, the workplace, and our personal life, in case indeed, it is impairing our ability to maintain sustained attention and deep memory encoding? At the end of the paper, the author will discuss possible personal and social approaches to managing the troubles of an increasingly digitalized world and create a more conscious and efficient approach to using the very potent instruments that technology has made available to us at the touch of a button. The study will be conducted in such a way that it will seek to offer a comprehensive and rich insight into a phenomenon that is not only transforming the manner in which we relate to information, but it is also changing the very structure of our way of thinking.

II. Literature Review

The literature regarding the cognitive impact of digital media multitasking has not only expanded significantly during the last 20 years but it has also described a complex and quite worrying picture. This literature review will include the main results of a range of interrelated research questions: theoretical frameworks employed to conceptualize multitasking, neurological facts on the consequences of the practice, the phenomena of attention and memory observed, and the particular consideration to the growing brain.

Theoretical Models: Cognitive Load and Limited Capacity.

The issues of multitasking are commonly interpreted in terms of Cognitive Load Theory. According to this theory, our working memory which is the memory system that stores and processes information to use it immediately has a limited capacity. When we strive to execute several tasks concurrently, we allocate our scarce mental resources, the result of which is a performance drop of each task separately. The high flexibility of digital media multitasking, which demands the change of streams of information that are rather dissimilar, puts a significant strain on working memory. The switching incurs a switch cost inviting the disengagement of one task followed by the re-engagement with another; it takes time and mental resources. Such relocation of cognitive resources on a regular basis may result in a condition of cognitive overload, i.e., the demands of the tasks surpass the ability of our working memory and the information processing becomes shallow and the risks of errors increase. The Cognitive Load Theory further divides this load into three categories; intrinsic load (the difficulty of the task itself), extraneous load (distractions and presentation methods of information), and germane load (the application of effort to learning and schema formation). Digital multitasking profoundly upsurges extraneous load with fewer resources to handle the germane load that is required to deep learn.

Intimately connected is the idea of a low attention capacity. Our attentional mechanism is not suited to parallel processing of complicated data. Rather, the concept of multitasking is in fact the quickness of task-switching. This constant movement of attention does not allow in-depth and long focus on the information needed to encode information into the long-term memory. The flow of thought is constantly interrupted and we are left with the piece meal and shallow idea of what we are trying to digest. The brain is forced to repress the rules and objectives of the last task and reload the new task, which is not only resource-consuming but also not ideal, and in general, it results in a cognitive leftover of the former task that distorts the current one.

The second article is titled Neurological Correlates of Multitasking on Digital Media.

The neural correlates of heavy media multitasking have started to be discovered using neuroscientific methods. Functional magnetic resonance imaging (fMRI) studies have revealed that individuals that claim to multitask more media show varying patterns of brain activation dissimilar to their low-multitasking counterparts. An example is that it has been discovered that heavy media multitaskers exhibit less gray matter density in one of the brain parts, the anterior cingulate cortex (ACC) which is important in the control of the mind, emotions, and judgment. The ACC influences the identification of an error and conflict resolution between competing activities, and thus lower density at this location may be a plausible cause of increased challenges in multitasking-related distractions. Although the causal order remains under discussion that is, whether multitasking is the cause of these neural distinctions or that individuals endowed with these innate neural characteristics are more attracted to multitasking, the relationship is a strong cause of concern.

In addition, studies in the field of brain plasticity indicate that our brains are in a continuous state of being influenced by our experiences. The recurrent switching between various media digital environment can, in the long-run, reinforce neural circuits in charge of shallow and rapid processing at the unservice to those facilitating deep and sustained attention. This might result in a situation where the brain is now programmed to be distracted and therefore it becomes even harder to do some tasks which may require a long period of concentration even without outside interruptions. There is also a heavy involvement of dopamine system. The strong effect of the tiny, randomized rewards brought about by notifications and new content introduces a strong reinforcement loop, which makes the brain always strive to obtain new stimuli, compromising the ability to focus

on a single, less-stimulating activity.

Impact on Attention Span

A decrease in sustained attention or the capacity to stay focussed on one task at a time over a prolonged time is one of the most prevalent outcomes of digital media multitasking to be reported. Research has always indicated that those who often multitask in media are less effective with regard to activities that involve constant attention. These are easily distracted by extraneous (such as a notification) and intrinsic (distracting thoughts unrelated to the task at hand) stimuli, as well as tend to be more prone to mind-wandering, in which the mind is not focused on the task at hand. It is not a lack of attention, but it is a practiced cognitive skill to find distraction.

The effect of this diminishment of sustained attention is huge in regard to learning and academic performance. Students that multitask using digital media during lectures or when studying have worse understanding and lower grades as compared to their counterparts who do not multitask using digital media. Their concentration is interrupted by the unceasing notifications, messages, and the appeal of other online materials, which do not allow them to focus on the educational content. Studies indicate that the mere existence of a smartphone on a table, even when it is off, can decrease the cognitive capacity due to some of the attention resources being allocated to the struggle not to look at the phone.

Impact on Memory

There are negative impacts of the digital media multitasking, which are spread out to different memory dimensions. As addressed in the previous section, cognitive overload that is the result of multitasking directly affects working memory. By overloading working memory with data gathered by various sources, one affects the performance of working memory as it fails to maintain a proper processing and passing of the information to long-term memory. Multitaskers The ability to select irrelevant information out of their working memory decreases in heavy users of the media, implying that distracting thoughts and external information occupy precious cognitive space otherwise used on the task at hand.

The implications on the long-term memory are also very significant. New memories encoding is a sensitive process that needs special attention. Weakening of the encoding process is experienced when we divide our attention. This leads to less detailed, weaker and harder to access later memories. Studies have found out that what is learned during multitasking is usually developed in a more implicit and shallow way hence not easily retrieved when required and therefore not easily applied. An illustration of this is that a texting student, who is reading a textbook, can probably grasp some of the concepts in a multiple-choice test but will not be able to discuss them in their own language or transfer them to new issues. Research has indicated that multitasking may cause learning to be re-allocated to the hippocampus, which is crucial in flexible and declarative learning, to the striatum which is associated with the learning of habits and skills. This implies that the knowledge gained will not be reflected in larger conceptualizations.

Also, the digital media multitasking has been associated with the loss of prospective memory which is the ability to remember to do some action in future. The stream of distractions that persist may prompt us to forget what we had planned to do which makes us miss appointments, forbidden deadlines and general disorderliness.

The Brain of the Vulnerable Adolescent.

Adolescence is a brain development stage that occurs in the brain, especially in the prefrontal cortex which is the part of the brain that is involved in the executive functions like attention, planning and impulse control. This is what renders adolescents peculiar victims of the outcomes of digital media multitasking. Such important developmental activities as synaptic pruning and myelination are ongoing which makes the brain highly plastic and receptive to environmental contributions. The immediate satisfaction and stimulation offered by most scopes of digital media may be exceptionally tempting to the teenage brains, which are yet to attain the ability to exercise self-regulation.

The studies have demonstrated that, the heavy media multitaskers among the adolescents are more impulsive and are more likely to get into trouble with attention. It is also feared that overloading multitasking at this crucial period of development may somehow have lasting effects on the development of the prefrontal cortex, disabling some permanent ability to focus on attention and subsequent thinking in the adulthood. These impulses along with the social pressures to be always connected through social media may reinforce these tendencies, forming the vicious circle in which multitasking becomes a social norm, and these harmful cognitive patterns are further reinforced in the time of maximal brain plasticity.

To conclude, the available literature makes the argument that digital media multitasking is a serious threat to our cognitive well-being. It overloads our finite conscious capacity and thus compromises our ability to remain attentive, form memories efficiently and think profoundly and thoughtfully. Although the digital world is as great as it can get, the multitasking habit, with all its endless possibilities, can be changing our thinking, learning, and memory abilities in rather fundamental ways.

III. Methodology / Approach

The methodological approach that will be utilized in this research paper is a comprehensive literature review. The goal in this regard is to conduct a synthesis and critical analysis of the available scholarly research on the effects of digital media multitasking on attention span and memory. The following method of choice is explained by the amassing and quickly increasing amount of empirical literature in this field, covering several fields, such as cognitive psychology, neuroscience, education, and communication studies. The systematic literature review enables finding the consistent results, discussing the contradictory results, and defining the areas that are to be investigated further.

The required data collection will be performed through the use of data sources

To carry out the research on the subject of the current paper, a systematic search in high-level academic databases took place, in particular, PubMed, PsycINFO, ERIC, and Google Scholar. The search strategy involved the use of both single and combination of words and variants of the words, which included digital media multitasking, media multitasking, attention span, sustained attention, cognitive control, working memory, long-term memory, memory encoding, adolescent brain development and neuroplasticity.

Several criteria informed the choice of sources to make the research reviewed quality and relevant. Preference was accorded by peer-reviewed journal articles that were published in an established academic journal. The literature search period was mainly limited to studies published in the past 15 years, which constitute the comparative recent developments in the digital media technologies that are the topic of this paper. Nevertheless, more ancient works that offer the background theoretical views were also covered, including those addressing cognitive load theory.

The reviewed types of studies include:

Experimental studies: Experimental studies are also carried out in the laboratory, which tend to give a great insight into the cause and effect relationship between media multitasking and cognitive performance through manipulation of variables and control of extraneous variables.

Correlational studies: These studies conduct statistical studies to determine the statistical relationships between self-reported data on media multitasking and on cognitive tests in the real-life context. Although they cannot cause causality, they do give valuable information about the relationships of these variables.

Longitudinal studies: Longitudinal studies can involve tracking of individuals over a long-period of time providing important data on the long-term impacts of media multitasking on the cognitive development and the possibility of cognitive deterioration.

Neuroscientific research: Neural findings due to the use of neuroimaging instruments like the fMRI and EEG offer a more in-depth observation of the neural processes of the cognitive impact of media multitasking.

Meta-analyses and review articles: These sources were priceless in highlighting the general patterns and unanimous results in the field and also in comprehending the peculiarities and drawbacks of the current researches.

Analysis Conceptual Framework.

The discussion of the literature gathered is organized with the help of a conceptual framework analysing the effect of digital media multitasking at various levels:

Cognitive Processes: This is the level of analysis that concentrates on the immediate impacts of multitasking on the core cognitive processes, which are sustained attention, attentional control, working memory capacity and the encoding and retrieval of long-term memories.

Neurological Substrates: This tier examines the underlying neural processes, such as brain structure and brain processes, involved in heavy media multitasking. It involves an analysis of the prefrontal cortex and the anterior cingulate cortex role and the concept of neuroplasticity.

Developmental Trajectories: This tier of analysis will take into account that the impact of media multitasking might vary over the lifespan, with much attention paid to the increased susceptibility of the developing adolescent brain.

Moderating and Mediating Factors: The framework further explains individual differences which could mediate the association between media multitasking and cognitive results. These are factors like capacity to hold working memory in advance and other personality characteristics like impulsivity.

With the implementation of this multi-level conceptual framework, this paper is expected to enjoy a comprehensive and thorough insight into the multi-faceted interaction between multitasking in digital media and human cognition. The opportunities of the synthesis of the results of different research methods and theoretical approaches will permit to discuss the implications of this widespread modern behavior powerfully and with a well-grounded base.

IV. Discussion

The evidence that is reviewed in the present paper gives a strong indication that the current ubiquitous practice of digital media multitasking has a great impact on attention and memory, with overwhelmingly negative effects. The lure of constant connectivity and the seeming efficiency of being able to process numerous streams of information at once obscure the cognitive costs that are being paid. This discussion will explore the general implications of these results, discuss some of the complexity and unresolved research questions in the study, and reflect on some of the ways in which the negative aspects of the multitasking culture can be alleviated.

The Delusion of Efficiency and the Cognitive Cost Reality.

Among the most striking, and, in fact, counterproductive, results of the study is the clear difference between the subjective perception of the effectiveness of multitasking and the objective reality of performance declines. Heavy media multitaskers usually think that they have mastered the art of multi-tasking but in all cases they perform poorly in a multitude of cognitive tests in comparison with low- multitaskers. This indicates a deficit of metacognition, in which not only are people less effective in multitasking, but they are also mostly unaware of having poor performance. The resulting illusion of competence may lead to a vicious circle, where the perceived necessity to multitask to sustain oneself in a fast-paced world is recreated, despite the fact that the act of multitasking actually impairs the cognitive abilities one would otherwise require to effectively handle the demands of his or her fast-paced world. What reinforces this illusion is the dopamine driven reward system of digital platforms which delivers small hits of pleasure when checking notifications or reading new information that creates a sense of being busy and productive that does not correlate with actual production.

The implication of this on education and the workplace is immense. A student who feels that they can learn well and at the same time use social media will experience a shallow kind of comprehension and remember less information which will culminate into poor performance in the field. The daily interruptions due to emails, instant messages, and other electronic notifications may disrupt the workday, decrease productivity, and make errors more probable, especially when one is working on the task that requires a strong focus and critical thinking. The so-called attention residue, i.e., thoughts regarding some past activity lingering and disrupting the present one, implies that the even slight disruption can have a disproportionately significant negative effect on performance.

The Long-Term Path: The Change in the Cognitive Habits?

The critical question that is still to be determined is how long the cognitive impact of the digital media multitasking lasts or whether it represents more enduring alterations in our cognitive architecture. The theory of neuroplasticity indicates that the brain responds to the needs it is subjected to. When we habitually give ourselves the practice of operating our brains in a divided attention mode, it is reasonable to conclude that we are in fact, training ourselves to adopt a style of cognition that is more appropriate to breadth of information coverage, as opposed to depth of processing. This may create a situation of having an ability to think sustainably, in a linear and deep way a less common and more difficult to learn and retain skill. The social consequences are enormous, and may include not only the production of scientific knowledge and also of art, but also the level of our social conversation, which relies upon the ability to think profoundly and attentively.

The study of the teenage brain is especially relevant in this case. The habits of mind developed in this phase of critical development may have permanent implications. When a generation is being raised in an environment where cognitive growth is dictated by an endless digital distraction, we should know what these likely may do to their future capacity to concentrate, learn and be able to solve complex problems as adults.

Wading through the Complexities: Not Every Multitasking is Equal.

The specifics of the phenomenon of media multitasking should also be mentioned. The cognitive effect will also most probably be different according to the type of tasks to be combined. To take an example, instrumental music played when one is doing a repetitive task can have inconsequential or even positive impact on performance in certain people. Conversely, when trying to write a complicated report and at the same time being a member of a group chat, it is a prescription of cognitive overload and worse performance on both assignments. Future studies should further subdivide the various types of media multitasking to know the most harmful and which, perhaps, are not harmful at all. The situation is also important; when one is multitasking to entertain, the results might be different than when he/she is multitasking in an urgent learning or working task.

Moreover, one cannot overestimate the role of the individual differences. The working memory capacity, the personality characteristic of impulsivity, sensation-seeking, and pre-existing attentional skills, to name a few, contribute to the influence of an individual on media multitasking. This shows that the influence of digital media should be viewed as unique and treated individually, and that it cannot be put in a bottle and handed over to everyone.

A more conscious approach to a digital life: Intervention possibilities.

Considering that the adverse effects of excessive digital media multitasking can be severe, it is important to think of the ways to counteract the damage. These may be idealized at the individual and the societal levels.

In the individual level, metacognitive awareness is a very essential step that should be cultivated. One can be motivated to change his or her habits by simply having the knowledge of the cognitive costs of multitasking. Even meditation in the form of mindfulness has been demonstrated to have potential benefits in enhancing attentional control and minimizing mind-wandering, which may be an effective remedy to the discontinuity in attention of multitasking. Mindfulness teaches the brain to be aware of when one has lost attention and to be mindful to redirect to the moment, which is the direct opposite of the digital distractions attraction.

It is also necessary to create the atmosphere that will facilitate concentration of work. This may entail feasible measures such as:

- Time-blocking: Deep work is allocated in time, in blocks of time that are non-interrupted.
- Online hygiene: Disabling unnecessary alerts, shutting down unwanted tabs, and literally unplugging distracting gadgets are one of the rules that can be followed.
- Single-tasking: Being mindful of performing one thing at a time and taking it through to the end before proceeding to the next one.

A larger cultural change in attitude to and development of attention is necessary in a society-wide and educational context. Schools and colleges play a very significant role in imparting to the students the cognitive science of learning and the significance of attention. This may include direct lessons on how to study well and the harm of media multitasking. The organizations can promote the culture of deep work in the workplace by encouraging an understanding that no matter how urgent an email or message is, it will not be answered quickly and by instituting policies that ensure periods of continuous focus. An increase in the popularity of a movement to design digital products in a humane way, without exploiting human attention as a source of profit, is also observed.

V. Conclusion

The promise of unlimited information and unlimited connectivity brought about by the digital age has brought a new age of change in the way we live, work and learn in unprecedented ways. The widespread multitasking using digital media has become a characteristic of this new landscape. This research paper has made an in-depth analysis of how this behavior affects two of the most basic pillars of human cognition namely attention and memory. The arguments, based on a broad range of psychological, neuroscientific, and pedagogical studies, all lead to one definitive and powerful conclusion, namely, although digital media multitasking might provide a subjective sense of productivity and interest, it is at a considerable and quantifiable price to our cognitive health.

This cost is at the very heart of the constricting nature of our cognitive architecture. The human brain is not programmed to handle numerous and intricate streams of information concurrently. What we perceive as multitasking is in actual fact a hasty and burdensome alternating of activities. This continued switching saturates our working memory which is the bottleneck whereby all information has to go through to be processed and learned. The result of such cognitive overload is the quality of our attention is reduced. We are more distracted, we find it harder to maintain attention on a single task, and we have superficial and fragmented thinking.

This attentional deficit reflects directly and inevitably on the impact on memory. Encoding of robust, detailed and flexible long-term memories is a process which is highly reliant on focused attention. Weak, less coherent and harder to retrieve memories are the result when we divide our attention. The information that we acquire is usually superficial and context specific we can hardly use it in new circumstances, or to develop a complex and interdependent conception of the world.

Neuroscientific evidence also throws more light on the possibility of such patterns of behaviors causing permanent alterations in the brain. The association between heavy media multitasking and the structural and functional changes in the brain, specifically, the brain structures relating to cognitive control, makes sobering the possibility that we are through our digital habits inadvertently training our brains to be less able to engage in deep and thought-provoking forms of cognition. The susceptibility of the developing adolescent brain to such influences in particular highlights the importance of acting upon this problem because the cognitive habits established during such formative years may precondition a lifetime of attentional difficulties.

The insidiousness of the illusion of competence of multitasking has also been brought to the fore in this paper. Being caught in the cycle of progressively distracted and less productive thinking is the consequence of the gap between how we view ourselves as performing and our actual performance. To end this cycle it will take a deliberate and joint action to develop metacognitive awareness and to implement techniques that will encourage us to be more mindful and attentive towards our online lives.

Finally, the results offered in this paper do not imply a blame towards digital technology in itself, it only points to a more conscious and careful approach to it. We now have the task of discovering how to use the enormous power of our digital resources without letting them set the terms of our cognitive life. This will involve

a multi pronged strategy incorporating individual activities to develop digital hygiene and attentional capability, educational measures that inculcate the principles of successful learning in the digital era and a larger culture change that will restore the importance of deep undivided attention. Whether we will have a good future of our collective intellectual life could be determined by how we learn to sail the winds of the digital stream with discretion, deliberation and a newly enhanced admiration of the immense strength of a concentrated intellect.

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