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APPLIED PSYCHOLOGY | OPINION ARTICLE

Carpe diem instead of losing your social mind: Beyond digital addiction and why we all suffer from digital overuse

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Abstract: It is not too late, but about time to realize how damaging IT overuse can be. The present paper discusses why it is of tremendous importance to study the effect of the Internet, smartphone, and other new digital technologies on individuals' productivity and well-being. Besides its recognized addictive nature, it also becomes clear that such technology inevitably alters our natural social lives, which has, in our opinion, the potential to harm entire societies. In developed countries, we are more or less all using digital devices for communication purposes; we surf the Internet and we download apps on a daily basis. We present two lines of argument as to why the study of technological (over) use and its consequences is of tremendous importance. First, we outline under which circumstances use of smartphones and Internet can make us unproductive. Second, we anchor the (over)use of technologies in an affective neuroscience framework. Both these approaches to describing and understanding the consequences of digital technology use clearly show that many humans are already "overusing" technology. Therefore, we also provide some initial ideas on how to cut down technology use in order to live more satisfying and happier lives. Let us look into each other's eyes and begin to spend more quality time with our loved ones outside in nature instead of staring at digital devices.

Subjects: Behavioral Neuroscience; Mental Health; Psychological Science

Keywords: Internet addiction; smartphone addiction; primary emotional systems; well-being; affective neuroscience; productivity

1. Background and observations from everyday life
One needs not to be a trained psychologist to recognize a certain behavioral pattern in humans all around the globe. People stare at small technological devices at bus stations, in trains, bars, or even

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PUBLIC INTEREST STATEMENT
Smartphones and other digital devices play a crucial role in both business and private areas of everyday life. Mounting evidence demonstrates that a "too much" can exist with respect to the consumption of digital contents. The present opinion piece provides the reader with a short overview of current research in the context of smartphone usage and tries to define the point from where usage of digital devices comes with costs for our mental health. Of importance, the scope of this paper is different compared to most research conducted in the field because it deals with a perspective beyond addictive behavior. Potential changes in productivity and psychological well-being due to smartphone and Internet (over)usage are discussed.

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when having a romantic candlelight dinner. Due to smartphones and Internet, we stop communicating with our directly available environment and we stop experiencing the current moment. In general, we forget what life really is all about. To illustrate this: imagine yourself buying a very expensive concert ticket to see your favorite artist performing live—what will you likely be doing in the concert (along with a lot of other people)? Enjoying yourself? Singing along? Dancing? Wrong! Very likely, you will be fumbling with your smartphone to take shaky videos or pictures which are not really worth looking at ever again. Of course, the concert will not have any lasting impression on your brain then because you simply have not seen it, which, given your actual physical presence, seems rather odd. Instead of directly sensing and perceiving real-life action, you stare at a little digital screen providing you only with a glimpse of reality in two dimensions.

Due to our constant interaction with smartphones and the Internet, we lose the skill of finding beauty in the simple things in life: the sunset, the first days of spring, or the sound of the wind and freshness of the air when autumn comes. Unfortunately, we are increasingly becoming distracted by technology everywhere and at every given time point in our lives. The old Roman saying , "Carpe Diem" should be more in fashion than ever; we simply do not live it. Even worse is the fact that our social lives suffer significantly, ultimately damaging that part of us which is "inherently human."

2. Technological addictions and beyond

The obvious changes in society due to the technological revolution led to large-scale research efforts to describe and also treat the problem of Internet addiction (Young, 1998; see also Camardese, Leone, Walstra, Janiri, & Guglielmo, 2015; Dau, Hoffmann, & Banger, 2015) and its close relative, smartphone addiction (e.g. Choi et al., 2012; Kim, 2013). Although the scientific community has not solved the important question of whether Internet addiction requires its own category in the Diagnostic and Statistical Manual of Mental Disorders (DSM; which is—among other reasons—due to strong overlap with tendencies toward ADHD and depression, e.g. Sariyska, Reuter, Lachmann, & Montag, 2015; Yen, Ko, Yen, Wu, & Yang, 2007; Yoo et al., 2004), in the last edition of the DSM, (DSM-5), the term Internet Gaming Disorder has been included as an emerging disorder in section III. By the inclusion of this term in this section of DSM-5, a clear call goes out to the scientific community—namely, to investigate this delicate topic. But a large problem also arises from this call: Internet Gaming Disorder represents a specific form of Internet addiction and is only in part correlated with the more generalized form of Internet addiction (Montag et al., 2015). Following from this, the issue of the inclusion or exclusion of Internet Gaming Disorder in the next edition of the DSM is actually far too narrow a question.

What is generalized Internet addiction? One could describe it by general over usage of diverse aspects of the Internet. Generalized Internet addiction is characterized by procrastinating over important daily tasks by aimlessly surfing or posting in online social networks. Tao et al. (2010) proposed a 2+1 rule derived from empirical data to help in diagnosing (generalized) Internet addiction. This rule states that, among other factors, it is necessary to observe both Internet preoccupation and withdrawal symptoms plus one further symptom out of a longer list such as development of tolerance. The full extent of digital technology overuse is even more complicated by the fact that measures of smartphone addiction and generalized Internet addiction only overlap in part (Kwon, Kim, Cho, & Yang, 2013b; Kwon et al., 2013a). Although much progress has been made in our understanding of problematic use of the Internet (for an overview see Montag, Duke, & Reuter, 2015; Montag & Reuter, 2015; Widyanto & Griffiths, 2006), less is known about smartphone addiction. Given the fact that in 2016 more than 2 billion people will use a smartphone (Statista.com, 2015), studies of the influence of the smartphone on individuals and society will be of particular importance.

With the present short opinion piece, we aim to build an argument (and a theoretical framework) regarding why the study of digital technology (over)use is of significant interest to be followed even without or beyond an official diagnosis. We would like to summarize important literature and include some of our own observations resulting in possible avenues for future research.

We believe that there are two topics of importance to be discussed. Independent of a focus on addictive behaviors in the context of smartphone and Internet usage, we are all suffering more or less from the daily digital human machine interaction at some level. We will demonstrate this by two lines of argument. The first section will deal with productivity issues and the second section will deal with the needs of our ancient emotional brain in the era of digital technologies. Finally, we summarize several ideas to help humans cut down their technology use.

3. Productivity and use of the Internet/smartphone

With the introduction of the Internet and later the advent of mobile devices such as the smartphone, life and work became easier in many domains. Suddenly, communication was cheaper and faster and we were easily able to compare prices when we needed to buy a new laundry machine. Moreover, other areas such as booking a train ticket or planning our next vacation became much more efficient. Nevertheless, there are also deleterious effects to be observed.

Montag (2015) recently outlined in a German publication that the association between smartphone usage and productivity might resemble an inverted U-function. The right amount of technological use indeed makes us more productive, but clearly technology could be overused. When does productive use become overuse? In our opinion, it begins when we are getting distracted on a minute-to-minute basis: messages via WhatsApp or other messenger applications or emails are just overwhelming us (see also Figure 1). The figure outlined poses several questions, which need to be answered by the research community, in order to support or refute the described inverted U-function. Among these questions are: How do we best assess productivity? And is there a certain amount of hours spent on the smartphone or other technological devices where productivity actually goes down? With respect to the last point, we believe that constant interruptions lead to greatest productivity loss, rather than the total time spent on the phone. It is a different matter to spend one hour on the phone without a break or to have one hour of smartphone consumption on a given day which is defined by 60 one-minute sessions.

How much time actually is stolen from everyday life due to technology use becomes clear when looking at some new numbers from a large-scale smartphone investigation (Montag et al., 2015a). In this study, more than 2,400 participants were tracked for four weeks and their smartphone usage was recorded. The average user spent >160 min every day on the smartphone with WhatsApp (about 20% of this time) and Facebook (about 10%) applications as the major driving forces (taking the median into account instead of means, the numbers differ somewhat). Clearly, much of the time spent on smartphone is not actually needed but is wasted. This poses particular problems when you need to concentrate on complicated processes at work. A state of deep concentration characterized by positive emotions accompanying flow (Csikszentmihalyi & LeFevre, 1989) cannot be reached when we are constantly getting distracted. Furthermore, the smartphone is not the only source of distraction. While writing the present manuscript, we forgot to close the mail program in the background of our computer. Why is this problematic? Because every incoming email will be presented in one of the corners of the computer screen. Whether we want it or not, our attention automatically jumps to the note in the corner saying a new message has arrived. As a consequence, we switched the program (from the word processing to the mail program), answered the email and then switched back to the word processing program. Because of this kind of back and forth switching, flow will never occur. In order to make flow happen, we all need some time of fully focused concentration to forget about time and space to get absorbed in a process of creation (Csikszentmihalyi & Csikzentmihaly, 1991). Support for the idea to more often close the mail program and only answer emails at stable time points a day comes from a new study by Kushlev and Dunn (2015). This study demonstrated that answering your mails at a few time points (in contrast to answering them whenever you like) reduces stress and heightens well-being. Clearly, this strategy also leads to longer undisturbed time windows where flow can actually happen. So whenever you need to concentrate, make sure to shut down your mobile devices and close your mail program.[1] A further factor increasing the use of digital technologies is the abandonment of analog zeitgebers to structure everyday

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Figure 1. Depicts the hypothesized association between smartphone/online usage and productivity.
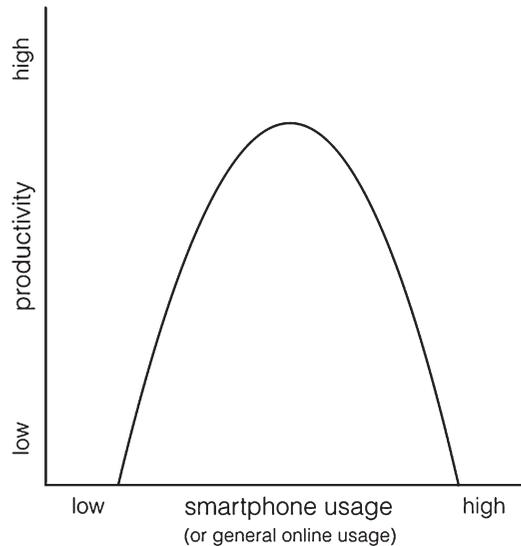
life. By zeitgebers we mean classic (analog) wristwatches and alarm clocks in the sleeping room (we borrowed the term "zeitgeber" from chronobiology; Arendt & Broadway, 1987). Unfortunately, many people have got rid of these classic tools to structure everyday life (e.g. in this study, only 45% reported wearing a wristwatch). The study by Montag et al. (2015b) provided empirical evidence that 11.10% of N = 3,084 participants stated that they "often" or "very often" only want to check on the time, but then get carried away by something else on the smartphone such as use of WhatsApp or Facebook. The empirical data suggest that the "time" app of the smartphone could prolong your smartphone sessions. Moreover, about 36–40% of the owners of the smartphone in the study (81% owned such a device) reported using the smartphone in the last 5 min before going to bed and/or after the 5 first minutes after waking up! This is problematic because our most private room is filled up with work and other digital stuff. Let's not forget that the bedroom is a place to relax and recharge your batteries. In a recent review, Riedl (2012) outlined nicely that technology devices can exert stress on human beings and we must ensure that recreational areas in particular are cleared of such stressors (such as noisy frequently incoming messages from WhatsApp or other channels).

4. Well-being and technological (over) use: An affective neuroscience perspective

According to the Triune Brain Concept by MacLean (e.g. see an overview by Lambert, 2003), the brain is an organ in the human body where the process of evolution remains visible (see also Walla & Panksepp, 2013). The most primitive parts are often referred to as the repitilian brain, including cell clusters involved in the regulation of heart activity and breathing. Built upon the reptilian brain is the old mammalian brain including several primary affective systems driving our behavior—often in an unconsciously bottom-up way. As the newest layer, the neocortex evolved with importance for reasoning, but also our autobiographical self. The life work of Jaak Panksepp is dedicated to study the primary emotional systems anchored in the mammalian brain (Panksepp, 1998a). By means of electrical stimulation of the brain and pharmacological challenges, he carved out four circuits which are associated with positive emotionality (SEEK, LUST, CARE, and PLAY[2]) and three circuits with negative emotionality (FEAR, SADNESS, and RAGE; see also Panksepp, 2011). Imbalances in these brain circuits go along with psychopathologies, e.g. a state of depression is characterized by low activity in the SEEK system and high activity in the SADNESS circuitry. Why is Panksepp's model also of tremendous interest in the context of technology (over)use? By studying our emotional circuitry, we gain insight into those aspects which are necessary to fulfill all criteria of happy lives.

Given our strongly genetically anchored emotional circuits, we have the need to explore the world (SEEK), develop sexual and romantic relationships as well as social interaction in general (LUST/CARE) and of course—in particular in childhood—to play. We fear that although some of these basic

needs can in part be fulfilled using technological devices (surfing the Internet—exploring hence SEEK), chatting with a person via WhatsApp (CARE, belonging), playing a game on a smartphone with another person (PLAY), our brain circuitry will not be nourished sufficiently. It is evident that the best kind of play in order to optimally stimulate the development of the human brain is rough and tumble play. This kind of play is both an ancient and very bodily form of play behavior. It is of tremendous importance to learn social competences and motoric skills. And no, it is not about training the thumb or index finger via the smartphone! A lack of rough and tumble play could indeed be linked to the rise of ADHD (Panksepp, 1998b, 2007). This potentially also explains why over usage of the Internet has been linked several times to ADHD (e.g. Sariyska et al., 2015). Another situation also shows why social interaction via smartphones might not be the real nourishment for our brains. Imagine yourself being very sad. What would you like more: Support via WhatsApp—someone is sending you a supportive emoticon—or a real hug from a person? In recent years, we are increasingly aware of the role of human touch in the secretion of hormones such as the prosocial neuropeptide oxytocin (e.g. Field, 2010; Holt-Lunstad, Birmingham, & Light, 2008; McGlone, Wessberg, & Olausson, 2014). Arguing from the perspective of affective neuroscience, it becomes apparent that interactions with smartphones are clearly not sufficient to nourish the needs of our ancient emotional systems. However, some of our thoughts need to be backed up by further empirical evidence in the future.

There is also a link between the FEAR and RAGE circuitry and technology use. A large body of evidence shows that trait anxiety is linked to the overuse of the Internet, e.g. the broad personality dimension neuroticism has been often associated with Internet addiction (e.g. Hardie & Tee, 2007; see also Montag & Reuter, 2015), although other personality dimensions such as self-directedness might be better predictors (Montag, Jurkiewicz, & Reuter, 2010; Montag et al., 2011 and Sariyska et al., 2014). As most studies are correlational in the field, it is not clear if anxiety is the cause or the result of technology overuse. Ultimately, both directions of effect are imaginable. In particular, humans with tendencies toward social phobia/anxiety might overuse technologies to fulfill their needs for social interaction (Shepherd & Edelmann, 2005). Finally, the RAGE circuit might be activated in the mammalian brain by feelings of frustration when dealing with an overload of incoming messages. If you have the feeling that you cannot handle the massive amounts of incoming messages via different channels anymore, this might lead to an anger reaction via frustration (Berkowitz, 1989). In this context, the concept of "technostress" needs to be mentioned again (Riedl, 2012) because it describes that humans show stress responses when a computer breakdown or similar digital failures can be observed. These digital failures clearly could also elicit activity in the RAGE circuitry (we guess a lot of readers might have experienced a desire to smash a computer device due to malfunctioning).

5. Atrophy of the social mind due to overuse of digital communication devices

In the following, we try to explain why we believe that IT overuse not only might cause addiction, furthers pathologies and wastes time, but even worse, it has the potential to cause damage to social functioning. Use it or lose it! Do not use your muscles for only one week and you'll see the result. If we do not use what evolved over millions of years as biological social interaction, including reading a person's face (see Mavratzakis, Herbert, & Walla, 2015), observing someone's postures and gestures, listening to the tones of speech melody, and processing further non-verbal information, then social capacity might shrink to the size of rather isolated organisms that have forgotten what it means to look into each other's eyes. In a recent study, Riedl, Mohr, Kenning, Davis, and Heekeren (2014) observed that humans can better assess trustworthiness in human faces compared to avatars which are more and more often used as interaction partners on diverse online platforms. This underlines the need for real human interaction compared to virtual social interactions.

About six million years ago, when some of our ancestors' offspring started exploring the wide savannah lands, the evolution toward human species began. Today, about 240.000 generations afterwards (see Walla & Dal-Bianco, 2010), homo sapiens stands upright with significant intellectual capacity. The far sight in the savannah naturally selected individuals with upright locomotion

(Darwin, 1859) and free hands allowed sophisticated tool use. However, besides numerous further anatomical adaptations, it has been to a large extent the social living style that made humans what we are today. Living in a group turned out to be advantageous compared to a lonely isolated life. One can share tasks in a group and also better defend offspring and oneself. As a consequence of a social life style, a number of emotion-related capacities, such as reading expressions in someone's face and listening to varying affective speech melody while being actively engaged in direct communication with a conspecific, evolved. As mentioned above, we gradually might be about to lose those capacities and thus also lose the ability to comprehend and even detect emotions, our own and somebody else's. Genuine emotion recognition depends on all those reads, while smilies and smugglies (or other emoticons) are no better than a "nice try" as alternatives to true emotions. Outlining this a bit further: if we are on WhatsApp or Facebook, we are mainly confronted with text or pictures. As a consequence, we are not training our social abilities such as reading emotions from vivid (and moving) faces or listening to the sound of the giggling of the interacting partner. We are depriving ourselves of several kinds of communication levels by this kind of IT use. Future research is recommended that tries to demonstrate that our deeply subcortical brain structures processing affective information indeed respond more negatively (or less positively) to digital social interactions compared to real face-to-face interactions. Even when people believe that a smiley can be as emotional as a true smiling face, it has often been shown that explicit responses do not always match up with implicit responses that can only be accessed via objective physiological technology (e.g. Grahl, Greiner, & Walla, 2012; Koller & Walla, 2015; Walla, Koller, & Meier, 2014). Without any reservations, we thus recommend a careful approach to digital device use with a particular focus on controlling the use of digital communication devices in teenagers, who are about to lose various aspects of a natural social lifestyle.

6. Conclusions

Both the section regarding productivity and that focused on well-being provided evidence that digital technology is overused, which causes serious and most often underestimated or even neglected problems. Although Internet and/or smartphone addiction cannot yet be diagnosed, this overuse is very prevalent in today's society. Deriving from the literature and our present thoughts, we would like to provide the reader with some ideas on how to cut down smartphone overuse:

- Wear an analog wristwatch and use an analog alarm clock in the bedroom. Otherwise, you become distracted by your phone, even when you only want to check the time (Montag et al., 2015b).

- Ban your smartphone from your bedroom, otherwise your first and last interaction of the day will likely be related to the online world (and potentially also work; Montag et al., 2015b). We need to find some rest. Overuse of smartphones is also associated with poor sleep and less work engagement the next day at work (Lanaj et al., 2014). The latter effect is further influenced by your control over work.

- Close your mail program when you need to write something. Please also shut down your smartphone. Otherwise, you will be constantly distracted by incoming messages and never enter a state of flow.

- Answer your emails at stable and only a few time points. Do not answer all your mails immediately. Otherwise, your work flow will be fragmented. Moreover, less checking on mails (or at stable times) is associated with less stress and more well-being (Kushlev & Dunn, 2015). The implementation of this advice clearly depends on the organizational structure a person works in. More research is needed to better adjust this advice to different environments.

- Humans have an intrinsic need for social interaction. That is also one of the reasons why people spend lots of time in bars or other places to meet and communicate. Make sure for yourself that this is quality time and shut down your phones when meeting friends or family.

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• When commuting by train from work, find some happiness and calm by looking out of the window. We all need some spare time, where our minds can wander because this is where we can get creative (Baird et al., 2012).

Crucially, one has to understand and be fully aware of the negative consequences of overusing digital communication devices to get the best results with respect to all above-mentioned suggestions.

Competing Interests
The authors declare no competing interest.

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Notes
1. An interesting finding shows that humans also can get into a flow when playing computer games or dealing with other technological devices (e.g. Mauri, Cipresso, Balgera, Villamira, & Riva, 2011; Weibel, Wissmath, Habegger, Steiner, & Groner, 2008). Results such as these do not weaken our argument because in this short opinion piece, we outline loss of productivity because persons are getting interrupted at work or other important jobs due to technology overuse. Moreover, persons trying to concentrate on a computer game will also suffer from a loss of flow experience, when being constantly interrupted while playing the game.
2. Primary emotional systems are written in large letters to not confound them with same sounding terms in psychological literature.

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