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## "One More, One More... You Get Stuck" – The Role of Craving in Smartphone-Related Technostress

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# “ONE MORE, ONE MORE... YOU GET STUCK” – THE ROLE OF CRAVING IN SMARTPHONE-RELATED TECHNOSTRESS

*Research Paper*

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## **Abstract**

*Smartphones have been integrated into nearly every aspect of human life. Because of them, being entertained, communicating with others, and finding information has never been easier. Even though such possibilities are positive on the surface, the versatile nature of smartphones has also created issues, such as people using them compulsively or excessively. By collecting and analyzing data from 30 semi-structured interviews, we explored how users may experience craving (unstoppable/uncontrollable desire to use, despite the negative consequences) that make them use smartphones compulsively or excessively. Such use may eventually lead to technostress, which is stress caused by technology use. We present three levels of craving (stimuli, sensation, and content) and discuss how they affect smartphone use and technostress. We contribute to research by discussing craving in the context of technostress. As a practical implication, different stakeholders could use our results to address the issues relating to stress caused by smartphone use.*

*Keywords: Technostress, Craving, Smartphone, Compulsive use, Excessive use.*

## **1 Introduction**

In the modern world, smartphones are everywhere. It is virtually impossible not to encounter individuals browsing their smartphones in a whole host of everyday situations, such as strolling in the streets, waiting for somebody or something, or even more radically, while driving a car (see, e.g., Maier et al., 2020). Even though there are many positive effects of smartphone use, numerous problems have emerged from it. Individuals may, for example, use technology compulsively, meaning that they are unable to control their use (Caplan, 2002). In addition, it has been demonstrated that smartphone use can be excessive (Zheng and Lee, 2016). Excessive use is usually defined as using too much (e.g., using more than planned, using more than is desirable, or using more than others) (Caplan, 2002; Luqman et al., 2017). Both compulsive and excessive use have been previously linked to a phenomenon known as technostress, which is stress caused by technology use (Tarafdar et al., 2019). In such a context, both compulsive and excessive use have been discussed as stressors (e.g., Cao and Yu, 2019; Cao et al., 2018; Dhir et al., 2018; Hsiao et al., 2017; Lee et al., 2014). Studies have shown that such stressors may lead to a number of negative outcomes, or strains, such as fatigue, anxiety, emotional and physical ill-being, conflicts, cognitive distraction, and discontinuance of use (Dhir et al., 2018; Masood et al., 2020; Panda and Jain, 2018; Zheng and Lee, 2016). Focusing on smartphones, previous studies have shown that problematic use can lead to users' reduced well-being (Horwood and Anglim, 2019; Hughes and Burke, 2018), thus highlighting the importance of studying the subject even further.

Although different technostressors and strains in particular are well-reported in the literature, many issues remain unsolved. While prior research has studied how technostress may contribute to a sufferer

discontinuing their use of a service (Maier et al., 2015b), reasons for behavior leading to continued use despite experiencing technostress have not been extensively studied. In addition, pre-stressor behavior (i.e., what happens before stressors emerge) remains understudied. To explore the issues further, we have employed the concept of craving to technostress research. In this study, craving is defined as “an unstoppable and uncontrollable desire that can lead to use (a drug, a technology), despite its negative and detrimental effects” (De-Sola et al., 2017, p. 2). Even though craving is usually associated with addiction, it has been argued that individuals can experience craving without being addicted (Franken, 2003; Kavanagh et al., 2005). In addition, we discuss compulsive use and excessive use, which support us in understanding the relationship between craving and technostress, since both compulsive (Abrams, 2000; Clements and Boyle, 2018) and excessive behavior (Hormes et al., 2014) have been linked to craving. Two research questions have been set for the study:

**RQ1: How is craving present in personal smartphone use?**

**RQ2: How are craving, compulsive and excessive use, and technostress linked in the context of personal smartphone use?**

We answered our research questions through a qualitative approach by collecting and analyzing interview data from 30 participants. Our research contributions are threefold. First, we contribute to the literature by developing a three-level categorization of smartphone-related craving. Second, we extend technostress research by explaining how craving affects technostress. Third, we discuss how compulsive and excessive use can be antecedents to stressors triggered by craving. Thus, we offer new insights to pre-stressor behavior in relation to technostress. Our results should offer practitioners (e.g., service providers) valuable information about individuals’ smartphone behavior, focusing especially on the issues that emerge from using these devices compulsively and excessively.

In the next section, we present the theoretical background of our study. We then discuss how the empirical part of our research was conducted. Then, we move on to presenting the results of our study. After that is the discussion, in which we present the research contributions, practical implications, limitations and possible future directions of our research.

## 2 Theoretical Background

In this section, we present the theoretical background of our study. First, we discuss the concept of craving. Second, we focus on compulsive and excessive use. Finally, we introduce the background of technostress.

### 2.1 Craving

Previously, in both substance-related (Franken, 2003; Sayette et al., 2000) and behavior-related literature (De-Sola et al., 2017), it has been pointed out that the concept of craving has not been established or defined unanimously. Generally speaking, craving can be seen as a desire to use (Sayette et al., 2000). In this article, we follow the definition of De-Sola et al. (2017, p. 2) that “craving can be defined as an unstoppable and uncontrollable desire that can lead to use (a drug, a technology), despite its negative and detrimental effects”. Previously, some research (e.g., Kozlowski and Wilkinson, 1987) has restricted craving to extreme desire or longing. Others, however, dispute this by saying that individuals do not need to be addicted for them to experience craving (Kavanagh et al., 2005; Franken, 2003). Thus, experiencing craving does not implicitly mean that one is addicted.

Craving can be explained from two perspectives. First, it may be focused on withdrawals and their avoidance, and second, it may be focused on the rewards associated with the target of craving (Tiffany and Conklin, 2000). Much of the previous discussion and research on craving has been in the context of addiction, primarily focusing on substances such as alcohol (e.g., Addolorato et al., 2005) and drugs (e.g., Robinson and Berridge, 1993). Even though the majority of craving research has been centered on substance-related craving, the term has been used in other contexts, such as social networking services (SNSs) (Savci and Griffiths, 2021), the Internet (Niu et al., 2016), and smartphones (De-Sola et al., 2017). Also, Savci and Griffiths (2021) stated after their review of existing research that even though

craving has been studied primarily in terms of substance-related research, it should not be limited to such context.

Some concepts are similar to craving. For example, Wang and Lee (2020) studied compulsive use of smartphones by utilizing the concept of “urge,” which they defined, referencing Beatty and Ferrel (1998), as “a state of a sudden, strong, and irresistible desire to use” (Wang and Lee, 2020, p. 179). Grant et al. (2006) used the words “urge” and “craving” in the same context, highlighting the link between the two. Sayette et al. (2000) discussed the two concepts in their article, reporting that individuals had answered almost identically in many different studies to measurements of cravings and urges. In the end, we found that the concept of craving was suitable for our research topic, which we elaborate next.

Following the literature presented in this chapter, we approach the concept of craving as follows. First, the concept can be used in contexts that are not substance-related. Second, experiencing craving or having a craving does not necessarily refer to extreme feelings or addiction. Third, in terms of the twofold meaning of craving (Tiffany and Conklin, 2000), we discuss craving as being associated with rewards rather than withdrawal avoidance. Also, craving has been linked to compulsive (Abrams, 2000; Clements and Boyle, 2018) and excessive behavior (Hormes et al., 2014). Both types of use are of interest for our study. Thus, next we discuss the background of compulsive and excessive use.

## 2.2 Compulsive and Excessive Use

Both compulsive and excessive use have been associated with technologies such as the Internet (e.g., Van den Eijnden et al., 2008; Weinstein and Lejoyeux, 2010), SNSs (e.g., Cao and Yu, 2019; Dhir et al., 2018), and smartphones (e.g., Wang and Lee, 2020; Wolniewicz et al., 2018). Even though compulsive use and excessive use have similarities and are sometimes used interchangeably, there are differences between them.

Compulsion can be defined as a “response to an uncontrollable drive or desire to obtain, use, or experience a feeling, substance, or activity that leads an individual to repetitively engage in a behavior that will ultimately cause harm to the individual and/or to others” (O’Guinn and Faber, 1989, p. 148). In his research on problematic Internet use, Caplan (2010) discussed compulsive use in terms of uncontrollability, time spent online, and urges related to using. As can be seen from these definitions, compulsive use is characterized by its uncontrollability, similar to craving. In the context of smartphones, compulsive use has been associated with increased stress (Lee et al., 2014), which can lead to negative consequences such as exhaustion and reduced productivity (Lee et al., 2016).

On the other hand, excessive use of technologies is associated with the amount of time that is spent using them. In general, excessive use can be characterized as use that exceeds the amount of normal use (Luqman et al., 2017). The amount of normal use is, however, subjective. Thus, excessive use can be defined by individuals’ own perception of their time spent, meaning that users themselves believe that their use is too much compared to what they believe is normal, to that of others, or the use that was planned (Caplan, 2002; Caplan and High, 2006). In the context of smartphones, excessive use has been associated with negative consequences such as conflicts and worsened academic performance (Cao et al., 2018; Zheng and Lee, 2016). To conclude, compulsive use is associated with uncontrollability, and excessive use is characterized by using too much. Both have been linked to a phenomenon known as technostress, which we discuss next.

## 2.3 Technostress

Stress has been described as a transaction between individuals and their environments (Lazarus, 1966). If individuals appraise their environments as too taxing, and their resources are insufficient for handling the demands, stress may form (Lazarus and Folkman, 1984). By interacting with their environments, individuals may encounter stress-inducing stimuli (stressors), which can affect them physically, psychologically, or behaviorally, causing them to feel strain (Cooper et al., 2001; Lazarus and Folkman,

1984). Stress is a complex and dynamic process whereby individuals, their resources, as well as environmental factors are in constant interaction (Lazarus, 1984, 1990).

The development of technological environments has presented people with new possibilities for encountering stress. The term technostress, defined as the negative result of users not being able to handle the demands of emerging technologies, had already been established in the 1980s (Brod, 1982). Technostress can be seen as forming via technostress-creating stimuli (technostressors) such as techno-overload (Ragu-Nathan et al., 2008; Tarafdar et al., 2007) and technology dependency (Shu et al., 2011). In a similar way to non-technology-related stress, by encountering stressors users may experience strain or other outcomes (Ayyagari et al., 2011) such as decreased job satisfaction (Califf et al., 2020) or even job burnout (Srivastava et al., 2015). As in the examples mentioned earlier, much of the previous technostress research has been conducted on organizations that usually mandate their members to use specific items of information technology, and the technology is used mainly for utilitarian purposes such as increasing productivity (e.g., Tarafdar et al., 2015; Tu et al., 2005).

Organizational technostress research has been extended to personal and voluntary contexts in recent years (e.g., Benlian et al., 2020; Maier et al., 2015a; Salo et al., 2022). With new technologies such as smartphones and SNSs becoming widespread, opportunities for encountering technostress have increased substantially, leading to a number of issues. For example, as mentioned earlier, compulsive and excessive use have been discussed as stressors that may lead to strains (and other outcomes) such as worsened academic performance, reduced productivity, emotional ill-being, invasion, and conflicts (Cao et al., 2018; Hsiao, 2017; Lee et al., 2016; Panda and Jain, 2018; Zheng and Lee, 2016). Focusing especially on personal smartphone use, previous research has shown how users can experience stressors such as overload and fear of missing out along with strains such as fatigue and reduced psychological well-being (Chen et al., 2017; Dhir et al., 2019; Horwood and Anglim, 2019; Malik et al., 2020).

Even though some previous studies have explored compulsive use, excessive use, and even addiction (Brooks et al., 2017; Tarafdar et al., 2020) in the context of technostress, we find that the research is lacking in the area of explaining why individuals engage in such use despite the negative consequences. To address this, we employ the concept of craving to the context. We believe that craving could explain technology use that has compulsive and excessive characteristics and that causes stress. We explore the connections between the concepts empirically as follows.

### 3 Research Method

To answer our research questions, we needed to understand in detail how individuals interact with their smartphones. To do that, we took a qualitative research approach by collecting and analyzing data from 30 participants. We sought to collect rich data representing the participants' experiences in detail, helping us understand their behavior (Schultze and Avital, 2011). Since stress is a subjective phenomenon, we had to explore the nuances of the negative encounters our participants had while using smartphones in depth. For this, qualitative interviews were considered suitable.

#### 3.1 Data Collection

We collected empirical data by conducting 30 semi-structured interviews. To find interviewees, purposeful sampling was utilized by selecting "information-rich cases for in-depth study" (Patton, 2002, p. 230). Thus, we sought out participants who had used smartphones actively and encountered negative experiences while using them. The interviewees had to be over 18 years old and native Finnish speakers. Initially, we looked for participants from an age group traditionally seen to be active smartphone users (young adults). However, in the end, we did not set age criteria for the interviewees, as we found it more important that the interviewees used their smartphones actively and had encountered stress while doing so. After suitable participants were found, we used snowballing to source more interviewees (Patton, 2002). The interviews were done in two separate phases: 10 interviews (one remote via video chat, nine face-to-face) were conducted between June and August 2019, and 20 interviews (all remote using video chat) were conducted between February and April 2021. More information is presented in Table 1.

<b>Interviews</b>
30 semi-structured interviews: 10 interviews in 2019; 20 interviews in 2021
9 face-to-face interviews; 21 interviews conducted remotely using video chat
Interview duration: 34–77 minutes (average 54 minutes)
<b>Interviewees</b>
30 in total (11 men, 19 women); age: 22–41 years (average 27 years)
Diverse professions, e.g., student, entrepreneur, software developer, firefighter, masseuse, HR specialist ...
Average daily personal smartphone use: 1–9 hours (average 5 hours)
Applications/services/sites used (mentioned by at least two participants): <b>SNSs</b> (Instagram, Facebook, Snapchat, YouTube, Twitter, Reddit, TikTok, Pinterest, LinkedIn); <b>IMs</b> (WhatsApp, Discord, Telegram, Messenger); <b>other</b> (e-mail, news sites/applications, browser, Spotify, online marketplaces, Netflix)

Table 1. Information about the interviews and interviewees.

During the interviews, it was essential for the interviewees to explain their experiences and emotions in their own words. The role of the interviewer was to act neutrally and allow the interaction to develop on its own (Myers and Newman, 2007). The first author, who was responsible for interviewing the participants, aimed to act naturally to create a comfortable atmosphere during the interviews. Methods such as mirroring (Myers and Newman, 2007) were used to advance the discussion and encourage the interviewees to talk more deeply about their experiences.

Since we conducted semi-structured interviews, an interview framework formed the basis for them. All interviews had similar overarching themes (e.g., general smartphone use and negative incidents/consequences/thoughts regarding smartphone use) but the precise course of the interviews differed between each other. The interviewees were asked questions such as “Why do you use a smartphone?”, “How did you realize that your smartphone use was causing issues?” and “Do you think you spend too much time using your smartphone?” Finally, it was deemed that sufficient saturation had been reached during the interviews, and the data gathered were rich and able to satisfy our research goals, and we proceeded with our study.

### 3.2 Data Analysis

The analysis part of our research began during the data collection phase. Each interview was transcribed as soon as possible after it was conducted. Initial notes were also made about the data. After all the interviews were conducted and transcribed, the first author read and re-read the collected data and made notes about the observations that could be of interest for the research topic. After sufficient familiarity was reached, the first author systematically coded the data. We wish to highlight that even though the first author was mainly responsible for the analysis process, the process was also discussed with the co-authors. These discussions were necessary for the quality of the analytical process, and they helped us answer our research questions in more detail. We discussed, for example, the different paths of craving and technostress that are presented in more detail in Section 4.2.

Next, open coding was utilized using NVivo analysis software. Through open coding, we were able to systematically establish interesting observations from our data (Lune and Berg, 2017). We partially followed the methods used in grounded theory, which has been common in information systems research (Wiesche et al., 2017). During this phase, all relevant data were labeled (words, sentences, and even whole paragraphs). For example, the sentence “I definitely feel like I use it too much” was coded under “Uses too much.” After open coding, we used our theoretical background for categorizing the codes. We assigned relevant codes to categories representing craving, compulsive and excessive use,

technostressors, and strains. For example, the code “Uses too much” was categorized under “Excessive use” following the definition discussed in the theoretical background.

When we assigned the open codes to the category of craving, we carefully followed the definition used in our article, meaning that codes that had to reflect “uncontrollable or unstoppable desire to use despite the negative effects” to be considered craving. For example, if the codes reflected sentences in which the interviewees had discussed “using despite wanting to do something else” or “having to do something on the phone” (both of which could be seen as uncontrollable or unstoppable), in relation to smartphone use and its negative effects, such codes were categorized as craving. After the formation of the craving category, we took a step backwards and explored possibilities for categorizing craving into subcategories by further evaluating the different types of craving that we could see in our data. Accordingly, we deemed that craving can be present on three levels: craving stimuli (general), craving certain sensations (e.g., relaxation), and craving specific content (e.g., messages), and we assigned codes from the craving category to such subcategories. For example, the sentence “You feel like your hands are itching and you want to open, read and answer [a message], but you have to wait” was originally coded under “Itching to read” which was subsequently categorized under craving. After going through the category of craving again, the original code was eventually categorized under “Craving messages,” which, in the end, became part of the “Content craving” category.

After this, we engaged in synthesizing our data. Our goal was to describe the phenomena we observed in detail (Wiesche et al., 2017). We looked for relationships between craving, compulsive and excessive use, and technostress. We first identified the stressors and strains that users had experienced. We traced back from the strains to cravings and were able to find different paths of how technostress and craving were linked. We confirmed these paths by also following them from craving to technostress. We compared the paths with our data, and we deemed that our thoughts concerning the different paths were consistent and loyal to the data. We also used constant comparison to find similarities and differences between the participants (Glaser and Strauss, 1967). Finally, the entire data set was read through one more time by the first author, and it was deemed that the codes, categories, and their relationships were able to capture the essence of what the interviewees had said.

Next, we move on to the results, where we discuss first the three levels of craving identified in our study. We then explain how craving, compulsive and excessive smartphone use, and technostress can be linked. Direct quotes from the interviews are presented as evidence (translated from Finnish to English).

## 4 Results

In this section, we present the results of our study. We first discuss the three levels of craving (stimuli, sensation, content) that we observed from the interview data. Subsequently, we demonstrate how craving can lead to compulsive and excessive use of smartphones and, eventually, technostress.

### 4.1 Craving

Based on the definition and our data, we saw craving affecting smartphone use in three different ways. First, craving can trigger unpleasant thoughts related to smartphones. Second, craving can make individuals initiate smartphone use even when they know they should not or even when they do not necessarily want to. Third, craving can keep individuals tethered to their smartphones for too long. In Section 4.2, we discuss this in more detail from the perspective of compulsive and excessive use as well as of technostress.

Craving can occur in the personal use of smartphones because, for example, smartphones deliver stimuli that give users (short-term) pleasure. Most interviewees claimed that their smartphone use was “unnecessary” at times. We think that the concept of craving is well suited for explaining such behavior because of the uncontrollable nature of craving. People do not necessarily want to or need to do something, but craving guides their behavior, which might be frustrating, leading to stressful situations. As one of the interviewees described browsing content on smartphones:

*And you are like, one more, one more... You get stuck. (Interviewee 26)*

We found in our data that craving can occur on three different levels. On the bottom level, users crave stimuli. In such cases, craving is not associated with any particular sensations or content. Rather, individuals simply crave the stimuli that smartphones deliver. On the middle level, users crave sensations (e.g., relaxation). In such cases, they crave the specific sensations that smartphones are able to elicit. On the top level, users crave specific content (e.g., videos). The levels are described in Figure 1, and discussed in more detail below.

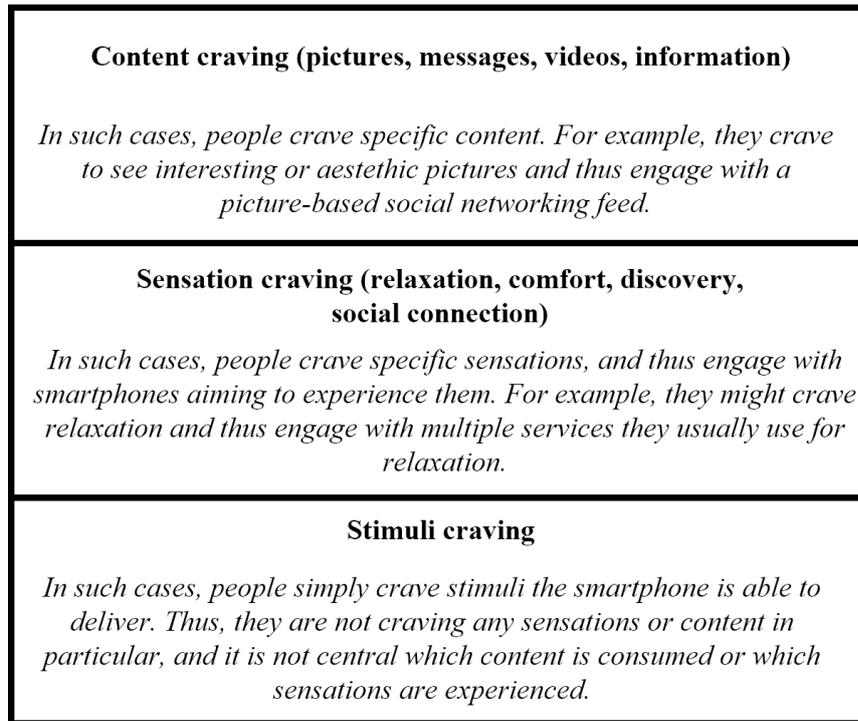


Figure 1. Three levels of craving related to smartphone use.

**Stimuli craving.** Many interviewees pointed out that smartphones deliver stimuli that make it easy to start or difficult to stop using the device. People may not want to engage specifically with the content they are browsing, but they crave some stimuli which cause them to initiate use or keeps them attached. The participants described such behavior as unnecessary. In such cases, it is not important which kind of sensations are experienced or content is browsed but the stimuli, generally speaking, are craved.

*They are just unnecessary feeds, and then you just want the stimuli and the new information, even though they are not even interesting or useful in a way that it would bring real joy, as it is for the short-term. (Interviewee 6)*

Some also thought that they had become accustomed to the stimuli they received via their phones, making them browse, sometimes even automatically. In situations such as this, the users might not have specific goals for their behavior, they just wanted the stimuli.

*The more used to it you get, the more automatic the browsing becomes. You realize that your brain is used to receiving smartphone stimuli all the time. (Interviewee 7)*

Many interviewees craved stimuli especially in situations that they considered boring. They craved the dopamine that smartphone-delivered stimuli were able to provide. Even though use of the devices brought them something positive, in most cases the interviewees were not happy with themselves for alleviating their boredom by browsing the phone.

*Pretty often it is like boredom or something, like you have to get some stimuli to receive dopamine or... something. Yeah, probably the different stimuli; you kind of have to get it when nothing is happening. (Interviewee 22)*

**Sensation craving (relaxation, comfort, discovery, social connection).** Many interviewees craved the different sensations that smartphones are able to deliver. In such cases, it does not central which kind of content is browsed; the craving is for the sensation. For example, people can crave the relaxation effect of smartphones. Such use is quite conflicting, since many interviewees thought that when they used their devices to relax, they were more exhausted afterwards. It was typical that even though this had happened multiple times, people still engaged in such use.

*It is not very recovering, browsing the phone. You always think that it will help you relax, but in the end, it is as tiring as the thing you were doing before you started browsing the phone.*  
(Interviewee 12)

Many craved a wide range of positive sensations from their smartphones, among them comfort. Sometimes this happened in situations during which another task, usually something stressful, was in progress. In moments like this, people felt the need to escape from stressful situations and thus craved positive sensations.

*When you end up in an uncomfortable situation, you have to take out the phone to receive something good.* (Interviewee 27)

Some interviewees also highlighted how one might crave new content that would keep them attached to the devices. Such craving might be so powerful that individuals would engage uncontrollably with their smartphones.

*You say, "Okay, I have seen this, but ... is there more? Where will it lead?" It's probably because of the ease with which you can quickly move from one thing to something new, and you sort of don't know when to stop.* (Interviewee 2)

Craving the social connection that smartphones can offer was also prevalent. People were very used to constantly checking their devices to see if someone had tried to contact them.

*When you have nothing to do, you always take out the phone, and then you end up in constant contact with someone.* (Interviewee 22)

**Content craving (pictures, messages, videos, information).** Many interviewees had craved content that smartphones are able to deliver. In such cases, the kinds of sensations that result from the content are not central, but the craving is for the content itself. For example, many applications such as Instagram were used to look at pictures. A number of the interviewees revealed that they would sometimes spend hours each day browsing pictures on different applications even though they simultaneously thought they should be doing something else.

*Imgur doesn't feel that important, and it really isn't. It just shows nice pictures, and the same is also the case for Twitter and Instagram. All you find are pictures and hashtags, and they actually aren't very interesting or even meaningful.* (Interviewee 6)

All interviewees used their smartphones for communication. There were situations where the participants had been both in a real-life social situation and at the same time they checked their devices for any messages they might have received. Everyone who behaved in such a way told that they knew they should be focusing on the real-life situation, but they nevertheless simultaneously shifted their attention to their device.

*I had the phone in my hand all the time. Especially when I was younger and in a relationship, I constantly had to see if the other person had sent me messages.* (Interviewee 26)

Many interviewees also used different services to look at videos on their devices. In particular, services that rapidly presented the user with short videos (e.g., TikTok) were discussed as negative during the interviews. The participants thought it was easy to become tethered to the content even though this use was not considered beneficial.

*I would just watch TikTok videos, but then I realized that this made no sense, and I started wondering if I got anything from this. I realized I got nothing apart from the wasted time.*  
(Interviewee 30)

Finally, smartphones were used to access a wide range of information. In some situations, such behavior was due to information craving. For example, many interviewees said they “had to” immediately check their smartphones in the morning because they “needed to” know what had happened during the night. Some found this disturbing.

*Especially in the mornings, when you wake up, your immediate thought is that you have to know what’s going on. You feel like your morning hasn’t started if you’re not allowed to look at the phone. I am being honest, it’s horrible to say this out loud [laughs]. (Interviewee 7)*

#### 4.2 Craving, compulsive and excessive use, and technostress

In this section, we discuss the negative effects of craving and smartphone use in more detail by demonstrating how craving may contribute to technostress in three different ways. First, craving can occur, and even though it does not necessarily lead to active use, it can be disturbing and may, for example, harm concentration (**craving contributes to technostress**). Second, craving can trigger use that the individual is unable to control and that can harm other activities such as sleeping (**craving contributes to technostress via compulsive use**). Third, craving can contribute to the individual using the device too much, which can, for example, create conflicts (**craving contributes to technostress via excessive use**). All of these paths can be problematic and lead to different technostressors (e.g., invasion, interruptions, conflicts, overdependence, overload) and strains (e.g., anxiety, frustration, concentration issues, sleep issues, annoyance, exhaustion). The three different paths are depicted in Figure 2, with examples.

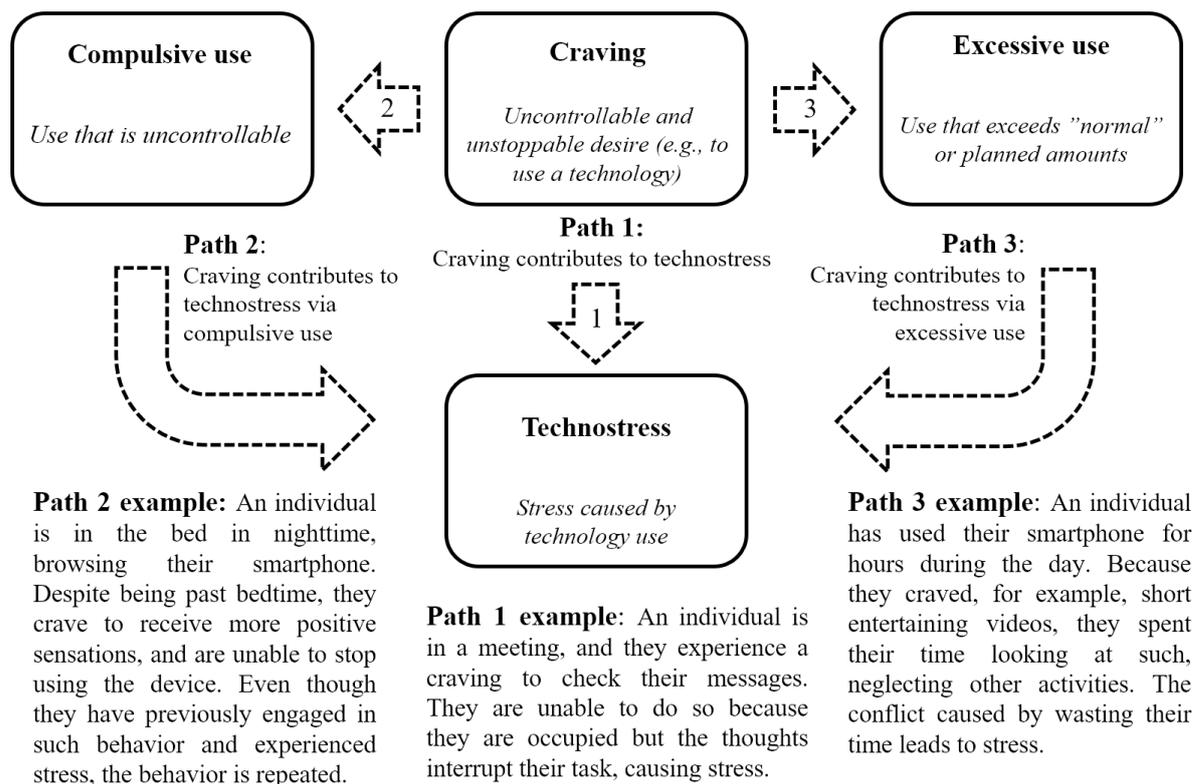


Figure 2. Three paths of craving and technostress.

**Craving contributes to technostress (no active use) – Path 1.** Craving is a desire that *can* lead to use. In some cases, craving does not lead to active use, but it still causes stress. For example, individuals may be craving something that smartphones are able to deliver, and this can interrupt ongoing tasks. This can happen without them even seeing the phone, but it was more typical among our interviewees

that they would see notifications and be in a situation where they could not or should not check their phone. In such situations, individuals experienced craving (e.g., for messages) that created stressors such as interruptions, leading to strains such as anxiety.

*If I find that I am receiving messages all the time [on the smartphone], it is very difficult for me not to take out [the smartphone], look at it, and answer. I feel like I have to, like... I get anxiety because there are messages or notifications. (Interviewee 10)*

Also, because of craving, people may feel conflicted about their smartphone use. Simultaneously, they may feel like they want to use their device but also feel like they do not want to. Many interviewees knew that certain types of use caused negativity and they were conflicted when thinking about such use, causing them to feel frustration. This can happen, for example, when craving social connection through messages or SNSs.

*When I am away from my phone for a longer period, I feel like, "yuck, I don't want it back." But I still end up in the same situation... Yeah, I mean, kind of, I don't know, you can't resist it. You feel like you have to, and then you kind of have a conflicting feeling all the time that you want to look at it—messages and Insta [Instagram]—but you kind of don't want to. I don't know. (Interviewee 27)*

**Craving contributes to technostress via compulsive use – Path 2.** The link between craving and compulsive use is evident from the definitions, since both highlight uncontrollability. Thus, compulsive use can be seen as a response to craving. Even though most participants had identified situations in which they were unable to control their smartphone use despite the negative consequences, many emphasized that they were perplexed why they behaved in such a way repeatedly. This highlights uncontrollability, and can thus be explained through craving and compulsive use. Even though people believe they should do something else, they are unable to, which causes stress.

*All the unnecessary browsing—that's the worst in my opinion. I try to be efficient in everything, and it annoys me. Why am I doing something unnecessary when I could be using the time for something more useful? (Interviewee 20)*

One interviewee even described that his smartphone sometimes made him feel “zombie-like,” which highlights uncontrollability. He knew that using a service was negatively affecting him, but nevertheless, he kept using the device. He was experiencing technostress through conflicts and frustration.

*I don't know what I should call it, something like compulsive browsing... It's annoying that you still go there [SNS] and you feel like a zombie. You don't actually get any content from there. (Interviewee 19)*

Several interviewees pointed out that because there was always something new to see on a smartphone, it was difficult for them to detach from the device. People can simply crave seeing new things. Such behavior can eventually cause, for example, being too dependent on the phone in certain situations, which may lead to concentration issues.

*It is difficult to detach from it because there is always something new, and then you are like, "I'll just watch a couple more." Then you can't concentrate on anything else. All of your concentration is on the phone. (Interviewee 14)*

Similarly, craving-triggered compulsive use can also happen before nighttime, which may harm sleep. Individuals can crave positive sensations such as relaxation and comfort after a hard day, making them engage in compulsive use, which harms their ability to sleep. Many of the interviewees had become too dependent on their bedtime smartphone use even though they knew it was harmful. We found that this happened because they were craving sensations, leading to compulsive use which invaded their sleeping schedules.

*At some point, I was unable to get away from the phone [laughs], even during the night. I would browse Pinterest, I would browse Facebook, I would browse... I just browsed and browsed, and I felt like it [smartphone] had grown attached to my hand. I wasn't able to stop at all. I was always like, "I'll just watch this" and "I'll just watch this" and... (Interviewee 15)*

Sometimes interviewees engaged in compulsive use because they experienced impulses. Impulses can be external (e.g., they receive a notification) or internal (e.g., they get an impulse wanting to see/experience something). In such situations, people encounter craving (e.g., for messages or relaxation) and thus compulsively use the device, which can be stressful because of the interruptions.

*Especially when I need to be doing something else, very often there is a nice post and I must see it, and so I get interrupted. Or someone sends me a message... It's annoying, but I still do it again and again. (Interviewee 6)*

**Craving contributes to technostress via excessive use – Path 3.** As discussed in Section 2.1, excessive use is something that individuals believe surpasses the amount that they consider to be normal. Hence, we asked the interviewees whether they thought they used their smartphones too much. Most (23 out of 30) thought that they did. Interestingly, some who used their devices two hours a day thought it was too much, while others used theirs for eight hours and did not consider that to be too much.

Even though excessive use has similarities with compulsive use, it is central to excessive use that the amount of time is problematic. Many interviewees criticized the amount of time they spent on their devices. They questioned their use but still continued it to the extent they believed was too much. This happened because users craved, for example, the videos delivered by certain services. For some, such behavior invaded other aspects of their life, such as doing school work, causing stress.

*Probably when I had school work due and I wondered where all my time had gone—I realized that I had actually been browsing TikTok for an hour. All my time had been spent doing that. At that moment, I realized, “damn, where did I spend all my time? This is not what I want.” I was, contrary to my values, watching unnecessary videos when I should have been doing many other things. (Interviewee 30)*

Because SNSs host an infinite amount of content, it is easy to use smartphones excessively when viewing them. Many used their smartphones to relax, but in many cases they eventually attained the opposite. Thus, people craved positive sensations even though their use eventually caused stress. Most of the interviewees revealed that they felt like they were wasting their time using smartphones, yet still, every day, they used them for hours, which was conflicting and stressful.

*First of all, the time I spend on it [smartphone] is too much. I should not spend so much time on it. For some reason, at least on Instagram, you get so easily hooked on it. You kind of start believing that some things that are useless are actually important in life. (Interviewee 27)*

Because of their excessive use, many interviewees thought that they felt like they were in a rush all the time. For example, services that delivered an endless number of pictures were considered harmful for such situations. Many browsed smartphones to spend time, craved seeing more pictures, which kept them attached, and they spend more time on the device than they had planned to. Such behavior can contribute to the users feeling like they are constantly in a hurry, which many highlighted as stressful.

*Sometimes I realize that I have checked the time, and I think, “Well, I will stop in five minutes and go eat or something.” Then I realize that oops, thirty minutes have gone by while I was aimlessly browsing. (Interviewee 4)*

In general, many of the interviewees thought they used their devices too much and could not control their use. They experienced an unstoppable craving that can lead to compulsive use, excessive use, and eventually, may contribute to technostress.

*It is pretty shocking if you think about everything that you could do for eight hours every single day; you could gain something much more meaningful. Yeah, it is quite horrible [laughs]. (Interviewee 27)*

## 5 Discussion

In this section, we first discuss the research contributions of our research. We highlight how we have been able to contribute to the existing literature. Second, we discuss the practical implications of the study. Finally, we acknowledge the limitations of our research and offer suggestions for future research.

## 5.1 Research Contributions

Our study has three research contributions. First, we employ the concept of craving to explore smartphone use and technostress. To our knowledge, craving has not been discussed before in the context of technostress. Previous research has shown that technostress can lead to discontinued use (Maier et al., 2015b). However, detailed explorations are scarce on the behavioral mechanisms underlying the continued use of technology despite experiencing technostress. It has previously been shown that certain enabling factors, such as receiving gratification (Chaouali, 2016; Cheikh-Ammar, 2020), may contribute to continued use despite experiencing stress. We extend this by approaching it from a different perspective, harnessing the concept of craving to explain such behavior. We argue that craving contributes to users being unable to stop their use because of the concept's uncontrollable nature (i.e., the desire to use is uncontrollable). Even though we employ such an approach to craving that focuses on rewards (Tiffany and Conklin, 2000), this focus differs from gratification-seeking, since craving is characterized by uncontrollability while gratification-seeking is more controlled and active. Thus, by answering our RQ2, we can link technostress with craving. To do that, we have also discussed compulsive and excessive use, the contributions of which we address next.

Second, we shed light on the complex nature of compulsive and excessive behavior in relation to smartphone use and technostress. In the technostress literature, compulsive and excessive use have both been previously discussed as stressors (e.g., Hsiao et al., 2017; Lee et al., 2016), and we agree with such observations. However, we see them as complex reflections of human behavior that are not necessarily solely stressors, and chose a different approach and explained how they can be types of use triggered by craving that can lead to stressors (e.g., invasion and conflicts), and eventually, strains (e.g., exhaustion and anxiety). The concept of craving is especially evident in compulsive use, since both are characterized by uncontrollability (Caplan, 2010; De Sola et al., 2017). However, when feelings are uncontrollable, they can also contribute to excessive use (Igarashi et al., 2008). We demonstrate that craving is an uncontrollable trigger that can cause compulsive or excessive use that could lead to the draining of users' resources via technostress.

Third, by answering our RQ1, we elicit three levels of craving (stimuli, sensation, content) from our data. Such levels of smartphone-related craving have not been discussed before. By identifying such levels, we showcase how individuals can experience craving for different things in relation to smartphones. We would like to emphasize that even though craving has been mostly associated with substances such as alcohol (e.g., Tiffany and Conklin, 2000), more recent studies have addressed it in behavioral contexts (e.g., De-Sola et al., 2017). Also, craving is traditionally associated with addiction. However, following Franken (2003), we see craving as something that can be present in non-addicted individuals. Even though one can be addicted to smartphones (Salehan and Negahban, 2013), that is not always the case, even when individuals display behavior that has some similarities to that of addicts. For example, Gerlach and Cenfetelli (2020) posited that individuals who constantly check their devices should not be called addicts. We see craving as something that could trigger compulsive and excessive smartphone use that leads to stressful situations without the users being addicted to their devices. Thus, we offer new insights to problematic smartphone behavior that is uncontrollable and stressful without being addiction.

## 5.2 Implications for Practice

We discuss here the implications for practice from two perspectives that we believe are most relevant: the user's perspective and that of the service/application/platform/device provider/manufacturer.

From the individual's perspective, our three-level categorization of smartphone-related craving is helpful for all smartphone users that believe they may be too attached to their devices. Individuals can evaluate whether they think all stimuli, certain types of sensations, or certain types of content are the ones that they are too drawn to. If users could identify the source of their craving, they could modify their behavior and mitigate the negative consequences emerging from their use. Since technostress caused by voluntary technology use can negatively affect important aspects of life, such as sleeping and social relations (e.g., Salo et al., 2019), individuals need to be careful with such issues to tackle the

possible negative well-being consequences of technology use. From our interviews, it could be seen that individuals believe that the negative consequences of smartphone use are partially their own fault, although some responsibility is with the developers of the devices, services, and applications.

Even though more use means more revenue for the providers, we believe that more attention should be given to the fact that some applications, and certain features, are too engaging. It is very easy to receive different stimuli by using different services on smartphones, and service providers should evaluate why individuals develop craving towards their services. Such could be approached, for example, by using the three levels of craving established in this article. It would be beneficial for users to use different services because they want to use them, not because they crave using them. For example, different SNSs could scale back on the amount of endless information they present to users to create a healthier environment in which users' well-being is not endangered. Since technostress can lead to discontinued use (Maier et al., 2015b), different service providers should take more concrete action to limit such issues, which would benefit different stakeholders.

### **5.3 Limitations and Future Research**

There are some limitations to our research that we need to address. First, the concept of craving and its relationship with addiction is a limiting factor. Even though some scholars have addressed how craving can exist without addiction, most previous studies regarding craving have been in the context of addiction. We took the stance that experiencing craving does not inherently mean that one is addicted, but we acknowledge that some could disagree. Second, the research methods that we used have some limitations. Since we used qualitative research methods, our results cannot be generalized. We also collected data that the subjects had to recall and report themselves. Also, since the participants had to recall past experiences and discuss them in an artificial situation, issues such as memory bias could be present. Third, demographic factors such as cultural background and age were relatively homogenous among our participants, meaning that in other contexts the results could be different. Fourth, the second data collection phase took place during the COVID-19 pandemic. Some interviewees thought that the pandemic had affected their smartphone use (they used devices more because they spent more time at home), which could have affected their experiences and answers.

Future research could focus on how, why, and when cravings emerge in the context of our study. We focused more on situations in which craving was already present. It could be fruitful to dive deeper into the process of developing cravings towards smartphone-delivered content. Another interesting future research avenue could be discussing craving associated with different kinds of applications, such as mobile games. Also, it could be interesting to quantitatively approach the interplay of craving, compulsive and excessive use, and technostress in the context of smartphone use. We believe that our research could be extended to a number of different scenarios that could help us to understand the complex nature of stress caused by technology use in even more detail.

## **6 Conclusion**

In this article, we explored the relationship between craving, compulsive and excessive use of smartphones, and technostress. By employing the concept of craving in technostress research, we offer a new perspective for exploring smartphone use and the negative consequences of it. We demonstrate how the uncontrollable desire (i.e., craving) to use smartphones can contribute to technostress directly or via compulsive and excessive use. We also establish three levels of craving related to smartphone use (stimuli, sensation, content). Our results should give new insights into the complex nature of technostress caused by voluntary smartphone use. Our results could offer both researchers and practitioners tools to address the consequences of technostress.

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